

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Kartik

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering I (CE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Describe the different modes of transportation. Justify the ongoing discussion on promoting railway transportation in Nepal. [4+4]
2. What are the differences among the data collected at different stages of engineering survey for highway alignment? [8]
3. Explain in detail how the design speed, design vehicle and topography affect the geometric design of road. [8]
4. A two lane rural highway passing through a forested area has sight obstruction located at 1.5 m from the edge of the carriageway on inner side of circular curve of radius 116 m and deflection angle 40° . The super elevation provided was 7% and lateral friction was 0.15. A vehicle traveling in horizontal curve of the highway with posted speed of 50 kmph had a crash. Check the designed super elevation and setback distance. Suggest mitigation measures to reduce such crashes in future. [8]
5. What is momentum grade? Explain the methods of providing superelevation. [2+6]
6. A parabolic curve connecting an ascending gradient of 1 in 40 to another ascending gradient of 1 in 20 has been designed for comfort condition with a total length of 40 m. Determine the elevation of the lowest point and at point 5 m left from PVI if the elevation of PVI is 310.12 m. Calculate the comfortable speed on the curve using the rate of change of centrifugal acceleration of 0.54 m/s^3 and compare this curve with the one required to provide minimum sight distance for the speed under headlight sight distance condition. Use of height of headlight beam as 0.75 m and head light beam dispersion angle in vertical plane of 1° . [8]
7. What are the methods for draining out subsurface water in highway? [8]
8. Discuss the different types of special structures used in hill road with neat sketch. [8]
9. Discuss about the desirable properties of road aggregate. Describe the test procedure to determine impact value with its significance. [4+4]
10. Differentiate between bitumen and tar. Explain lab test procedure of Marshall Stability along with its significance. [2+6]

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2082 Chaitra

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Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering I (CE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. Elaborate the importance of transportation in the context of Nepal with a suitable example. Define system approach of transportation planning. [4+4]
2. How do the various stages of surveys assist in finalizing a road alignment, and what essential information is gathered at each stage? [8]
3. Describe the types of gradients used in highway. Why and when grade compensation is provided in highway alignment? [5+3]
4. Discuss PIEV theory with suitable example. Define stopping sight distance and list out the various factors affecting the stopping sight distance. [4+4]
5. A transition curve is provided to connect the circular curve with a straight section of a two-lane road in a rolling terrain with heavy rainfall. If the design speed of the road is 100 kmph and radius of the circular section is 250 m, determine the length of the transition curve for comfort and for introducing super-elevation at 1 in 100. The length of the wheel base of the design vehicle is 6 m. [8]
6. Two approaching vehicles were involved in a head-on collision at a vertical summit curve connecting a 4% ascending gradient and a 3.5% descending gradient. The posted speed limit on the road is 80 km/h. Upon checking the roadway geometry, the highway engineer found that the highest point of the vertical curve is located 120 m from the beginning of the curve. Examine whether the crash could be attributed to an incorrect posted speed limit. If a deficiency exists in the posted speed sign, determine the appropriate speed limit that should be displayed. [8]
7. What are the causes of moisture variation in a subgrade soil? Briefly explain the types of cross drainage structures. [3+5]
8. Discuss the different types of special structures used in hill roads. [8]
9. List out the desirable properties of subgrade soil. Discuss the test method for hardness of road aggregate. [4+4]
10. Describe the procedure of sample preparation and stability flow test for bituminous mix in laboratory. [8]

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2080 Ashwin

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Subject: - Transportation Engineering I (CE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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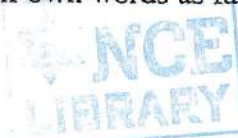
1. What is transport planning? How does this differ from road planning? Discuss the importance of multi-modal transportation planning. [2+2+4]
2. What are the various objectives of preliminary survey? Explain the details to be collected and various steps in third stage of engineering survey for highway alignment. [2+6]
3. A two lane two way highway was designed with super elevation of 6% and coefficient of lateral friction of 0.15. The radius of curve is 210 m. Design overtaking sight distance required if the acceleration of the overtaking vehicle is 4 kmph per sec. If the overtaking operation cannot be allowed throughout the road section, provide the overtaking zone with suitable sketches and position of signage. The reaction time = 2 sec. [8]
4. Describe briefly the various methods of providing super elevation with sketches. Describe the disadvantages of heavy camber. [6+2]
5. Describe the significance of momentum grade. Discuss the reason and method of providing grade compensation. [4+4]
6. Compute the minimum length of a vertical curve with an entrance grade of 4.2% and an exit grade of -3.2% that will provide 1.5 m of cover for a 21 cm diameter concrete pipe that has a 1.1 cm wall thickness. The invert elevation of the concrete pipe is 266 m and is located at a station 70+12.43. The PVC is located at station 65+29.94 at an elevation of 265.77 m. [8]
7. What are the requirements of Highway Drainage System? Explain the method of controlling subsoil water with neat sketch. [3+5]
8. How temperature, rainfall, atmospheric pressure and geological condition affect road alignment in hills? Write down the characteristics of river route and ridge route. [4+4]
9. Discuss the desirable properties of road aggregate. Write down the laboratory procedure for determining toughness of aggregate. [4+4]
10. Explain the advantages and disadvantages of cut-backs and emulsion for bituminous road construction. Explain the penetration test carried out for bituminous material. [8]

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Subject: - Transportation Engineering I (CE 653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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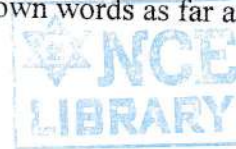
1. Discuss the component of transportation system. Explain the different types of urban road patterns. [4+4]
2. Define highway alignment. Explain the factors controlling highway alignment. [2+6]
3. Define overtaking sight distance. Derive an expression for overtaking sight distance with neat sketch. [2+6]
4. Explain momentum grade. Discuss method of providing superelevation. [4+4]
5. A transition curve is to be provided to connect a straight and circular curve of radius 325 m of a two lane road in a hilly terrain with heavy rainfall. Design the length of transition curve assuming suitable data. The design speed of the highway is 60 kmph and rate of introduction of super elevation is to be 1 in 60. Determine the elevations of outer edges at two typical straight and circular curved sections of the road with centre line at elevations of 312.23 m and 312.9 m respectively considering a parabolic camber of 2.5% to be provided. [8]
6. A -3% gradients meets a 1.5% gradient at a chainage of 2000 m and at the reduced level of 500 m if the design speed of the road is 100 km/hr, determine RL and chainage of the tangent points, lowest point on the curve. Assume height of head light is 0.75 m and take frictional coefficient $f = 0.35$ and $\alpha = 1^\circ$. [8]
7. What are the requirements of highway drainage? Explain the surface drainage system. [3+5]
8. Explain why hill road construction is challenging. Sketch different types of hill road cross-sections. [4+4]
9. Define highway material. Discuss the desirable properties of subgrade soil. Explain the laboratory procedure for determining hardness of aggregate. [1+3+4]
10. Enumerate the various types of tests on bituminous binders. Explain the procedure and significance of softening point test. [3+5]

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Subject: - Transportation Engineering I (CE 653)

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1. Explain about the role of transportation in our society. Explain the major road patterns developed in major urban areas. [4+4]
2. Discuss the structure of highway route location. Explain briefly the final location and detail survey of highway alignment. [3+5]
3. Explain the factors controlling geometric design of highway. [8]
4. State the reason of introducing extra widening. Derive the condition of lateral skidding and overturning of vehicle moving at a horizontal curve section. [3+5]
5. A Two-lane highway was designed with super elevation of 6% and coefficient of lateral friction of 0.15. The design speed of curve is 75 kmph. The stopping sight distance required is 115 m. Determine set back distance required for this curve for providing reasonable opportunities of overtaking as there not enough space to provide full overtaking opportunities, provided that the deflection angle is 70° . [8]
6. An intermediate lane road is to be designed with intermediate sight distance of 255m. The road is the two-way road having 5% gradients meets a 1.5% gradient at a chainage of (1 + 000) and at the reduced level of 500m. If the design speed of the road is 80km/hr, determine RL and chainage of the beginning of the curve, highest point and 50 m right of point of vertical intersection on the curve. Take frictional coefficient $f = 0.35$. [8]
7. Define sub-surface drainage system and discuss its importance. Describe the measures that can be applied for the control of sub-surface water with suitable sketches. [3+5]
8. Discuss typical types of cross-section of hill road with neat sketches and their application. [8]
9. What are the desirable properties of soil? Describe the laboratory procedure of determining soundness of aggregate and mention its significance. [3+5]
10. What are the bulk specific gravity and maximum specific gravity of bituminous mix? Describe the ductility test on bituminous binders with neat sketch and its significance. [2+6]

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Subject: - Transportation Engineering I (CE 653)

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1. Discuss the components of transportation system. Explain the relevance of road classification based on NRS 2070 in present context. [4+4]
2. What are the factors controlling the highway alignment? Explain why reconnaissance survey is conducted? [5+3]
3. What are the advantages of providing camber? Discuss the effect of centrifugal force in horizontal curve. [3+5]
4. What are curve resistance and grade compensation? Derive an expression for determining the mechanical widening. [4+4]
5. A 4 lane major highway passing through rolling terrain in heavy rain fall area with a 2% grade intersects a 2 lane minor highway with 3% grade at an uncontrolled right angled intersection. Determine the minimum intersection sight distance required given the design speeds of major and minor approaches are 80 kmph and 60 kmph respectively. A section of major highway passing has a horizontal curve of radius 230 m. Design the length of transition curve. Use coefficient of longitudinal and lateral friction value as 0.35 and 0.15 respectively. [3+5]
6. An ascending gradient of 1.2% meets a descending gradient of 1.08% on a two lane two-way road. Determine the length of vertical curve to provide overtaking sight distance for a design speed of 60 kmph. Assume overtaking acceleration as 2.5 kmphs. Locate the highest point and end of curve, calculate their elevations if the elevation of BVC is 334.792 m. [8]
7. Why catch water drains are necessary in hill roads? Discuss the different types of energy dissipating structures with their use. [8]
8. What are the design and construction problems associated with hill roads? List the merits and demerits of river route and ridge route. [4+4]
9. Explain the desirable properties of subgrade soil. How are FI and EI values determined in the laboratory? [4+4]
10. Discuss about the Marshall method of Bituminous mix design. [8]

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Subject: - Transportation Engineering (CE 653)

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1. Discuss land use transportation cycle. Briefly explain the components of transportation system. [4+4]
2. What are the requirements of ideal highway alignment? Discuss the method of carrying out preliminary survey for a proposed highway alignment. [3+5]
3. Explain the cross-sectional elements of a typical highway section with a neat sketch. [8]
4. A national highway of two lane with a curve of 310 m radius is to be set out to connect two straight roads in plain terrain. The maximum speed of moving vehicles on this curve is restricted to 90 Kmph. Transition curve are to be introduced at each end curve. Design the transition curve and determine chainage of the beginning of transition curve, and end of circular curve. [8]

Given that angle of intersection-136°

Chainage at the point of intersection: (1+ 000)

Rate of introduction of super elevation = 1 in 120

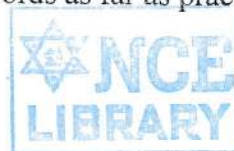
Rate of change of centrifugal acceleration (c)= 0.5m/s³
5. Define superelevation and equilibrium superelevation. State the assumptions and discuss the method of calculation of overtaking sight distance. [2+6]
6. A vertical curve of length 35m is designed to connect a mild ascending gradient of 3% to a steep ascending gradient of 9.5% based on headlight sight distance condition (neglecting effect of gradient). i) Calculate the design speed of the highway section. ii) Determine the maximum allowable length of the steeper gradient to design it as a momentum grade with an exit speed of 15 Kmph. Assume the head light beam angle and height of the headlight from the road surface are 1 degree and 0.75 m respectively and take coefficients of longitudinal friction and inertia as 0.35 and 0.85, respectively. [8]
7. Discuss the necessity of highway drainage. List and briefly explain the application of various types of highway cross drainage with sketches. [3+5]
8. Discuss design and construction problems associated with hill road. Differentiate river route and ridge route in hill roads. [5+3]
9. Discuss descriptive tests of aggregate. Describe the laboratory procedure of determining hardness of aggregate with a neat sketch and mention its significance. [2+6]
10. The weight of a compacted specimen of bituminous mix in air, water and SSD condition is 1231gm, 715gm, and 1232gm, respectively. The maximum theoretical specific gravity of mix is 2.56. Determine the percentage air void in the mix. Describe the viscosity test on bituminous binders with neat sketch. [2+6]

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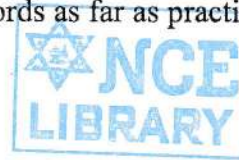
1. Write down the merits and demerits of Railway with respect to Air Transportation? Explain the land use transport cycle. [4+4]
2. Explain the factors affecting selection of highway alignment. [8]
3. A horizontal curve of radius 250 m in a two-lane highway passing through rolling terrain in heavy rainfall area is designed with an equilibrium superelevation of 0.065. Design the length of a transition curve and the shift required to connect this curve to the straight section of the highway. Assume rate of introduction of superelevation of 1 in 150. [8]
4. What are the advantages of providing shoulder and extra widening in road? What is the significance of locating highest and lowest points on vertical curves? [6+2]
5. With a typical drawing of urban road cross section, explain in brief the various elements of urban road cross section. [8]
6. A vertical curve connects an ascending gradient of +2% grade with another ascending gradient of +5.5% grade on a highway of design speed 60 kmph at an elevation of 1411.6m. Design the length of the vertical curve and determine the elevations at the beginning and end point of the curve. Use coefficient of longitudinal friction of 0.35. [8]
7. Define highway drainage. Explain the causes of moisture variation in subgrade soil. [2+6]
8. Explain shortly various special considerations to be given in design and construction of Hill roads in highway design. [8]
9. Write down desirable properties of subgrade soil. Explain preparation of dynamically compacted soil specimen for CBR test and explain method of conducting CBR test of subgrade soil. [2+2+4]
10. Explain the concept of ductility test with test procedure. Describe using graphical sketches how one obtains optimum binder content. [4+4]

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Subject: - Transportation Engineering I (CE 653)

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1. Explain briefly, the classification of road as per NRs (2070). Discuss Macadam road construction method with neat sketch. [4+4]
2. What are the requirements of highway alignment? Explain how the information collected in the preceding stages of survey are utilized in the succeeding stages of survey for highway alignment. [2+6]
3. Write the necessity for extra widening of road pavement at horizontal curves. Derive an expression for finding the extra widening required on horizontal curve. [3+5]
4. Explain the factors affecting geometric design of road. [8]
5. A two-lane highway with a ruling gradient of 6% has a compensated gradient of 4.5% at a horizontal curve section of length 60m. The curve section has a sight obstruction at 2m from the edge of the carriageway. Determine the possible speed on the curve section based on stopping criterion. Assume coefficient of longitudinal friction of 0.35. [8]
6. Two approaching cars were caught on head-on-collision at a vertical summit curve connecting 4% ascending gradient with 3.5% descending gradient. The posted speed on this road is 70 Km/hr. The highway engineer checked the geometrics of the road and found that the highest point of the vertical curve lies at the distance of 120m from the beginning of the vertical curve. Check if the crash is due to fault in posted speed sign. Height of car driver's eye = 1.08m, reaction time = 2.5 sec, coefficient of longitudinal friction = 0.35. What should be the posted speed if there is fault in posted speed limit sign? [8]
7. Discuss the importance of Highway Drainage. Explain control mechanism of subsoil water with neat sketch. [3+5]
8. Discuss the design and construction problems that are associated with hill road. What are the merits and demerits of river route and ridge route? [3+5]
9. List out the desirable properties of the road aggregates. Describe the test procedure for the determination of Los Angeles abrasion value of the road aggregates. [3+5]
10. What are the tests conducted on bituminous binders? Explain the Marshall method of bituminous mix design procedure in detail. [2+6]

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2077 Chaitra

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1. What are the advantage of road transport over other modes of transportation. Discuss urban network planning in brief. [4+4]
2. What are the requirements of an ideal highway alignment? Describe the procedure of the conventional method of preliminary survey. [4+4]
3. Differentiate between camber and superelevation. Describe methods of providing superelevation. [3+5]
4. Calculate the length of transition curve and shift, if the design speed is 60kmph. The radius of circular curve is 220m. An allowable rate of change of centrifugal acceleration is 60cm/sec^3 . Allowable rate of change of superelevation is 1 in 120. The width of the pavement is 7.00m. Assume rotation of Pavement about the inner edge. [8]
5. Discuss the different types of gradients used in highway? What are the causes of proving grade compensation in highway? [5+3]
6. A section of highway has vertical and horizontal curves with the same design speed. A horizontal curve on this highway with a ruling radius and a deviation angle of 45° is 180m long. Design the length of a vertical curve on this highway connecting a +3% grade with -1.5% grade so as to fulfill the stopping sight distance criteria. Assume coefficient of longitudinal friction as 0.35. [8]
7. Define highway drainage system. List out its requirements. Explain with neat sketches a proper subsurface drainage system to lower the underground water table. [1+3+4]
8. Define hill road. Describe the factors to be considered in hill road design. [8]
9. What are the desirable properties of sub-grade soil? Describe the crushing strength test of road aggregate. [4+4]
10. Write down the laboratory procedure of Marshall Stability test of bitumen mixes. [8]

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2076 Baisakh

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- Why transportation planning is important? Explain the road classification system based on Nepal Road Standard.
- State the basic principle for locating highways and describe the complexities associated with route location process.
- Derive an expression for finding the super-elevation required if the design coefficient of friction is 'f'. List the design steps of super-elevation.
- The speed of overtaking vehicle is 60 kmph on a two way traffic road. If the acceleration of overtaking vehicle is 0.79 m/sec^2 ,
 - Calculate safe overtaking sight distance
 - Mention the minimum length of overtaking zone
 - Draw a neat sketch of the overtaking zone and show the position of sign posts.
- A national highway curve of 400m radius is to be set out to connect two straights. The maximum speed of moving vehicles on this curve is restricted to 85 Kmph. Transition curve are to be introduced at each end of curve. Calculate
 - A suitable length of transition curve.
 - The necessary shift of circular curve.
 - The chainage at the beginning and end of curve.

Given that angle of intersection = $125^\circ 25'$
 Rate of change of centrifugal acceleration = 0.52 m/sec^3
 Chainage at the point of intersection = 1075.50m
- Design a total length of valley curve at the junction of the descending gradient of 1 in 40 and an ascending gradient of 1 in 30 if the design speed is 80kmph. Locate the lowest point and end points and calculate their elevations if the elevation of beginning of the curve is 2.12.86 m above sea level. Take co-efficient of friction as 0.35.
- What are the causes of moisture variation in sub-grade soil? Explain design procedure of surface drainage system.
- Sketch typical cross sections of hill roads. Discuss hill road drainage structure.
- What are the laboratory tests performed on road aggregates? Explain the test procedure of determining the crushing value of road aggregate.
- What are the desirable properties of bituminous mixes? Briefly explain the ductility test of bitumen and its engineering application.

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1. Explain the components and characteristics of Transportation System.
2. What are the various requirements of an ideal highway alignment? Explain various factors controlling the highway alignment with sketch.
3. Discuss the basic control criteria of geometric design of highway. Explain the cross section element of road with neat sketch.
4. A two lane highway has a curve 300m long, 650m radius. The setback distance from centre of the carriageway is specified to be 25m with reference to the intermediate sight distance of the curve. Find the design speed for the curve. Assume coefficient of longitudinal friction as 0.35.
5. Derive the expression for super elevation. Explain the method of providing extra-widening.
6. Design the total length of the valley curve at the junction of the descending gradient of 1 in 40 and an ascending gradient of 1 in 30 if the design speed is 100 kmph so as to fulfill both comfort condition and head light sight distance for night driving. Locate the lowest point and the end of curve point too. Calculate their elevations if the elevation of BVC is 312.56m above sea level. Assume other necessary data reasonably.
7. What are the causes of moisture variation in subgrade and how can it be controlled?
8. Discuss about the retaining and slope protection structures that are frequently used in the hill road.
9. Enumerate the desirable properties of the subgrade soil. Describe the laboratory test to determine the crushing value of aggregate. What are the significance of crushing value?
10. What are the desirable properties of bituminous mixes? Write down the procedure for determining the ductility value of bitumen and its significance.

Exam.	Regular		
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Subject: - Transportation Engineering I (CE653)

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 - ✓ Attempt All questions.
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-
1. Differentiate between public and private transportation. Why macadam is considered as a pioneer of modern roads?
 2. What are the requirements of good Highway alignment? Explain different stages of surveying for highway alignment.
 3. Discuss the effects of a horizontal curve on which vehicle stability depends and derive the condition for overtaking and skidding.
 4. National highway curve of 400 m radius to be set out to connect two straights. The maximum speed of moving vehicles on this curve is restricted to 85 Kmph. Transition curve are to be introduced at each end curve. Calculate:
 - i) A suitable length of transition curve
 - ii) The necessary shift of circular curve
 - iii) The chainage at the beginning and end of curveGiven that angle of intersection- $125^{\circ}25'$
Rate of change of centrifugal acceleration = 0.52 m/sec^3
Chainage at the point of intersection = 1075.5 m
 5. Explain the factors that govern the stopping sight distance. Derive the expression for analysis of stopping sight distance.
 6. A vertical curve is to be designed when an ascending grade of line 60 meets a descending grade of 1 in 45 on a highway. The stopping sight distance and overtaking sight distance required are 210 m and 600 m respectively. But due to site condition, the length of curve has to be restricted to a maximum value of 750 m if possible. Calculate the length of curve needed to fulfill the requirements of:
 - i) Stopping sight distance
 - ii) Overtaking sight distance
 - iii) At least intermediate sight distance and discuss the results
 7. What are the components of highway drainage system? Write down the design steps for surface drainage system.
 8. What are design and construction problems in hill roads? Describe the different methods that hill road alignment can be located.
 9. Enumerate the desirable properties of road aggregate. Briefly describe the laboratory test to determine impact value of aggregate.
 10. Define bitumen premixes. Explain the Marshall method of Bitumen mix design

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1. Write down the scope of highway engineering. What are the characteristics of road transport in comparison with other modes of transportation?
2. Enlist the requirements of highway alignment. Write the process of detailed engineering survey of highway alignment.
3. Define stopping sight distance. Explain the factors affecting stopping sight distance. Derive the expression for stopping sight distance.
4. A horizontal curve of 625 m radius is to be set out to connect two straight of a national highway. The speed of the vehicle is restricted to 90 Kmph. Calculate
 - a) length of transition curve
 - b) the chainage of beginning and end of the curve given that,
angle of intersection = $130^{\circ}24'$
rate of change of centrifugal acceleration = 0.25 m/s^3
 - c) chainage of point of intersection = 1092.500m
5. Design the total length of the valley curve at the junction of the descending gradient of 1 in 40 and an ascending gradient of 1 in 30 if the design speed is 100 kmph. So as to fulfill both comfort condition and head light sight distance for night driving. Locate the lowest point and the end of curve point too. Calculate their elevations if the elevation of the beginning of the curve is 312.56m above sea level. Assume other necessary data reasonably.
6. Explain the different types of gradient and factors to be considered in its selection.
7. Explain how the surface water is collected and disposed-off in rural and urban roads. What are the special problems in drainage of surface water in hill roads?
8. Explain the special considerations and challenges of hill road construction?
9. Explain the desirable properties of sub-grade soil? Also explain the impact test of aggregate.
10. Define bitumen premixes. Explain the laboratory test procedure of Marshall stability along with its significance.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Explain the relevancy of road transportation in the context of Nepal.
2. Explain the engineering surveys to be carried out for a highway alignment.
3. What are the importance of highway geometric design? Critically discuss various factors that affect geometric design of road.
4. Define super elevation. Explain the methods of introducing super elevation with neat sketches.
5. Calculate the minimum sight distance required to avoid a head-on collision of vehicles approaching from the opposite directions speed at 60 kmph. Use the total perception reaction time of 2.5 seconds, coefficient of friction 0.40 and brake efficiency of 50%. The section of the road under consideration has a grade of 10%.
6. A vertical curve connects a - 3.0% grade with + 4.5% grade on a rural highway at station 6+525 and elevation 411.6m. The curve should be designed at least to provide the visibility of the road surface to a distance of 250 m at night time. Locate the starting, lowest, and end point of vertical curve. Calculate the elevation of road at all these points along the curve and at a distance of 50m left and right from the point of vertical intersection. Assume the head light beam angle and heights of the head light from the road surface for the design vehicle are 2° and 0.6m respectively.
7. Define cross-drainage structure. Explain its types with neat sketches.
8. What are various problems in hill road construction? List out different characteristics for ridge route and river route location.
9. Explain the desirable properties of aggregate to be used in different types of pavement construction.
10. What are the different types of bitumen? Write down the laboratory procedure of ductility test of bitumen.

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Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Discuss the classification of roads as per Nepal road standard (NRS 2070). Why road transportation is considered the most feasible in Nepal? [8]
2. Describe the requirements and factors affecting the highway alignment. [8]
3. Discuss about PIEV theory with example. Define Stopping Sight distance and enumerate the various factors affecting the stopping sight distance. [3+5]
4. The angle of intersection between two straights is 145.37° . The spiral angle for each transition curve is 10.32° . Calculate the length of transition curve, combined length of curve and the length of tangent if the radius of the curve is 350 m. [8]
5. Define superelevation. Derive an expression for superelevation. [8]
6. An ascending gradient of 2.75% meets with descending gradient of 2.25%. The radius of curve is 5000 m. If the reduced level of the curve at a distance of 60 m from BVC is 312.12 m, find the reduced level of BVC, EVC and highest point of the curve. [8]
7. Describe the causes of moisture variation in subsurface soil. Explain with neat sketches how the sub surface drainage is provided to lower the water table and control of seepage flow. [1+3+4]
8. Explain briefly the special consideration to be taken in hill road design. Draw neat sketches of different types of cross section of hill road. [8]
9. What are the desirable properties of road aggregates? Explain the crushing value test of aggregate? [4+4]
10. Describe the procedure of Marshall Stability test in laboratory. [8]

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Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Describe the different modes of transportation. Which mode of transportation is suitable for Nepal? Give reasons.
2. What is highway alignment? Describe how the information collected in preceding stages is updated in successive stages in road alignment survey.
3. Define extrawidening. What are the reasons of providing extrawidening on horizontal curve? Derive the expression for determining extrawidening.
4. There is a horizontal curve with radius of 450m and length 220m on the six lane Koteshwor-Suryabinayak highway. Compute the setback distance required from the edge of the inner lane of the highway so as to provide (i) stopping sight distance of 100 m and (ii) safe overtaking sight distance of 310 m.
5. What are the objectives of providing transition curve? Derive an expression for the length of transition curve in horizontal alignment.
6. A vertical curve connects -3.25% grade with +3.75% grade. The curve should be designed at least to provide the visibility of the road surface to a distance of 225 m at night time. Calculate elevation of BVC, lowest point and EVC if the RL of the curve at 18m distance from EVC is 125.32 m.
7. Clarify the necessity of the following elements of highway drainage:
 - i) Catch drain
 - ii) Causeway
 - iii) Energy dissipating structure
 - iv) Sub-surface drainage
8. What are the design and construction problems that are associated with hill roads? Enumerate the merits and demerits of River Route and Ridge Route.
9. What are the desirable properties of sub grade soil? Explain briefly the test procedure of LOS Angeles Abrasion test on aggregates.
10. Enumerate the various types of consistency tests on bituminous binders. Explain the procedure and significance of Penetration test.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Explain the components of transportation system. What are the objectives of road planning?
2. Mention engineering surveys to be carried out for highway location. Explain Preliminary Survey for Highway location in brief.
3. Derive an expression for finding the superelevation required if the design coefficient of friction is 'f'. List the design steps of superelevation.
4. A vertical summit curve is to be designed when two grades +1/60 and -1/45 meet on a highway. The stopping sight distance and overtaking sight distance required are 210 m and 600 m respectively. But due to site condition, the length of vertical curve has to be restricted to a maximum value of 750m if possible. Calculate the length of summit curve needed to fulfill the requirements of:
 - i) Stopping sight distance
 - ii) Overtaking sight distance or at least intermediate sight distance. Discuss the result
5. Define transition curve and its necessity in horizontal alignment. Describe the different methods of designing the length of transition curve.
6. A six lane highway has a curve 350 m long and 550 m radius. The stopping sight distance and overtaking sight distance are 200 m and 400 m respectively. Find out the setback distance from the inner edge of the road to the obstruction for both cases.
7. Define highway drainage system. Describe the causes of moisture variation in subsurface soil. Explain with neat sketches how the subsurface drainage is provided to lower the water table and control of seepage flow.
8. What are the design and construction problems that are associated with hill roads? Enumerate the merits and demerits of River Route and Ridge Route.
9. What are the different types of bituminous materials used in road construction? Explain briefly the test procedure of Los Angeles abrasion value of aggregate.
10. What are the desirable properties of bituminous mixes? Briefly explain the ductility test of bitumen and its engineering application.

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Examination Control Division
2072 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Discuss in detail the classification of Roads as per Nepal Road Standard (NRS).
2. What are the requirements of highway alignment? Explain the factors controlling highway alignment.
3. Define stopping sight distance. Describe briefly the various factors affecting stopping sight distance. Derive the expression for stopping sight distance.
4. Define camber. How is camber value decided? What are the disadvantages of heavy camber?
5. The curve consists of circular arc combined with transition curve at both ends. Calculate the radius of the circular curve, the length of transition curve and total length of composite curve with the following data:
 - a) Design speed = 60 kmph
 - b) Maximum centrifugal ratio = $1/6$
 - c) Maximum rate of change of centrifugal acceleration = 0.45 m/s^3
 - d) Deflection angle = 48°
6. A ascending gradient 3% meets the 2.5% descending gradient. Calculate the elevation of the road at a distance of every 185 m on either side of the point of vertical intersection (PVI) if the elevation of PVI is 500.00 m. Assume the radius of vertical curve as 8500 m.
7. What are the requirements of highway drainage? Describe the methods of lowering the sub-soil water.
8. Explain why design, construction and maintenance of hill roads need special consideration. What is gully control and land stabilization.
9. What are the laboratory tests performed on road aggregates? Explain the test procedure of determining the crushing value of road aggregate.
10. Enumerate the various types of consistency tests on bituminous binders. How is the ductility test carried out? What is the significance of this test?

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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What are the objectives of road planning? Explain the major road patterns developed in modern urban areas.
2. Explain the factors that affect the selection of highway alignment.
3. Derive an expression for finding the superelevation required if the design coefficient of friction is 'f'. Describe briefly the various methods of providing superelevation with sketches.
4. What are the curve resistance and grade compensation? Describe the disadvantages of heavy camber.
5. A vehicle moving in a horizontal curve at a design speed of 65 kmph, develops a centrifugal ratio of 1/5. The deflection angle at curve is 48° . Calculate:
 - a) radius of circular curve
 - b) length of transition curve by rate of change of centrifugal acceleration criteria
 - c) total length of composite curve
6. The driver of a vehicle travelling at 65 kmph down a grade required 12m more stopping sight distance to stop than the driver travelling at same speed up the same grade. If the coefficient of friction between tire and pavement is 0.38. Determine the percent grade and stopping sight distance up the grade.
7. Classify highway drainage. What are the requirements of highway drainage?
8. Describe different types of retaining walls used in road construction. List out the basis of its selection.
9. Explain the materials used in different layers of the road pavement. Describe the desirable properties of road aggregates for pavement works.
10. What are the tests to be conducted on road binders for its suitability on road construction? Describe the test procedure to determine the softening point of bitumen.

05
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INSTITUTE OF ENGINEERING
Examination Control Division
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Explain the modes of transportation and the role of transportation in the development of a country.
2. Explain in brief the different stages of survey for highway alignment.
3. Define stopping sight distance. List out the factors affecting stopping sight distance. Derive an expression for stopping sight distance at level road.
4. Calculate the setback required from the edge of inner lane of pavement to an obstruction on a two lane rural highway designed at the speed of 80 kmph. Assume the length of circular curve as 150 m having ruling minimum radius and required sight distance as 200 m.
5. What is transition curve? List the types of transition curve. Explain different methods of calculating transition curve length.
6. A vertical summit curve is to be designed when two grades +4% and -4% meet on a highway. The stopping sight distance and overtaking sight distance required are 150 m and 500 m respectively. But due to site conditions, the length of curve has to be restricted to a maximum value of 800 m if possible. Calculate the length of curve needed to fulfill the requirements of (a) stopping sight distance (b) overtaking sight distance or at least intermediate sight distance. Discuss the results.
7. List the causes of moisture variation in subgrade soil? Describe the methods of lowering water table.
8. Describe the design and construction problems associated with hill roads.
9. Explain briefly liquid bitumen. Describe step by step procedure of determining penetration value of bitumen.
10. Describe Marshall method of bituminous mix design procedure.

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain briefly, the classification of transportation system. [8]
2. What are the requirements of highway alignment? Explain the importance of map study in highway survey. [8]
3. What are the functions of transition curve? Derive an expression for the length of transition curve to be introduced between the straight and circular path on a horizontal curve from two criteria. [8]
4. Describe the factors which control the geometric elements of road and discuss the reasons for providing an additional width of carriageway on horizontal curve. [8]
5. A four lane carriageway has a curve of 220 m length and 400 m radius. The safe stopping sight distance and overtaking sight distance are 152 m and 300 m respectively. Calculate the minimum set-back distance from the inner edge of the road to the edge of the obstruction to ensure safe visibility for the both cases of sight distances if the width of the pavement per lane is 3.75 m. [8]
6. Design the length of valley curve with a descending grade of 1/35 and ascending grade of 1/45. The design speed is 80 kmph. Determine the RL of beginning, lowest and end point of curve if the RL of PVI is 212.36 m so as to fulfill both comfort condition and head light sight distance for night visibility. Also determine the apex distance and mid ordinate of the curve. Assume coefficient of friction = 0.35, Rate of change of centrifugal acceleration = 60 cm/sec^3 . [8]
7. Why drainage is an important part of highway design? What are the causes of moisture variation in sub-grade soil? [8]
8. Sketch different types of hill road cross-sections. Discuss hill road drainage structures. [8]
9. Define bitumen premixes. Explain the Marshall design method for the Asphalt concrete. [8]
10. Explain briefly the desirable properties of sub-grade soil. Explain the test procedure of the penetration value of bitumen. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Explain different roles of transportation in society? Write down the scope of highway engineering.
2. What is highway alignment? Explain how different factors affect the selection of highway alignment.
3. Define overtaking sight distance. List the factors that affect the overtaking sight distance. Derive the expression for overtaking sight distance for two lane two way traffic roads.
4. Explain the types of highway curves. Describe the different effects on vehicle while it negotiates a horizontal curve without super elevation.
5. A horizontal curve of 200 m radius is to be set out connecting two straights. The maximum speed of the vehicle on the curve is restricted to 60 kmph. Transition curves are to be introduced at each end of the circular curve. If the angle of intersection is $125^{\circ}30'$ and chainage at the point of intersection is 1063 m calculate: (a) Length of transition curve for comfort condition (b) Length of combined curve (c) Chainage of beginning and end of curve.
6. An ascending 4% gradient meets with descending 3% gradient. Design the length of vertical curve to meet the visibility requirement. Calculate the RL of beginning end and highest points on the curve if the curve should pass through the point having elevation 120.10 m located at 60 m right from PVI. Assume design speed as 80 kmph, brake efficiency as 90% and coefficient of friction as 0.35.
7. Describe the main differences between surface drainage and sub surface drainage.
8. What is a hair pin bend? Derive the expression for the elements of symmetrical hair pin bends.
9. Explain the tests required to be conducted to judge the quality of bitumen before using in road construction.
10. List out the test to be conducted on road aggregates to check its suitability in road construction? Describe the test procedure to determine the LOS Angeles Abrasion value.

Exam.	Regular (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering- I (CE653)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

- 1 Explain the road classification system based on Nepal Road Standard. Why road transportation is considered the most feasible in our country?
- 2 What are the requirements of an ideal highway alignment? Describe the information needed to be collected during reconnaissance survey.
- 3 Discuss the design controls for the geometrics of road and governing factors which affect the stopping sight distance.
- 4 Define super elevation, and derive the expression for super elevation. List the design steps of super elevation.
- 5 The angle of intersection between two straights is 137.23° . The spiral angle for each transition curve is 8.35° . Calculate the length of transition curve, combined length of curves and length of tangent if the radius of the curve is 325 m.
- 6 An ascending gradient of 3.75% meets with descending gradient of 3.25%. Calculate the chainage and elevation of beginning of the curve, end of the curve, highest point of the curve and 90 m left from the point of vertical intersection if the chainage and elevation of PVI are 1+ 225.00 and 875.62 m respectively. The radius of curve provided is 8000 m.
- 7 What are the causes of moisture variation in sub-grade soil? What are the factors to be considered in designing sub-surface drainage system to check seepage flow?
- 8 Discuss the road side structures to be provided for the road way stability. Explain how you will stabilize landslides along the road.
- 9 Define bitumen premixes. Explain the Marshall design procedure for the bituminous premixes.
- 10 What are the desirable properties of sub-grade soil? Explain the method of Los Angeles abrasion test on aggregate.

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What is transportation planning? Why the development of public transportation should be given preference over the development of private transportation? [8]
b) What are the different stages of surveying for highway alignment? List out the various components of economical appraisal. [8]
2. a) Classify the highway curves. What type of effects will take place when the vehicle negotiates a horizontal curve without super elevation? Also give reasons. [8]
b) Calculate the length of transition curve using the following data: [8]
 - i) Design speed = 65 kmph
 - ii) Radius of circular curve = 220m
 - iii) Allowable rate of introduction of super elevation (Pavement rotated about centre line) = 1 in 150
 - iv) Pavement width including extra widening = 7.5m
3. a) Explain PIEV theory. Derive an expression for determining the stopping sight distance at level ground. [8]
b) A summit curve is to be provided at the intersection of two gradients +1.5% and -2%. What is length required (i) For stopping sight distance of 200m (ii) For overtaking sight distance of 600m? What is the vertical distance between the point of vertical intersection and curve in either case? [8]
4. a) Describe the different types of retaining walls used in road construction. Mention the basis of its selection. [8]
b) What do you mean by penetration value of bitumen? Describe step by step procedure for the determination of penetration value of bitumen in the laboratory. [8]
5. a) Explain the different types of erosion control and energy dissipating measures used in highway drainage system. [8]
b) Explain different measures that are taken to stabilize the formation and cross slopes in hill road construction. [8]
6. Write short notes on: [8]
 - a) Requirements of highway alignment
 - b) Extra widening
 - c) Road classification system
 - d) River route

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	III / II	Time	3 hrs.

Subject: - Transportation Engineering I

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Differentiate between public and private transportation. Why Macadam is considered as a pioneer of modern roads? [8]
- b) List out the highway route location process. Describe in brief how the information collected in preceding stages is updated in successive stages in road survey. [8]
2. a) Draw a typical cross section of a partially cut and filled road. Describe its all elements. [8]
- b) There is a horizontal curve with radius of 400m and length of 200m on the highway. Compute the set-back distance required from the centre line on the inner side of the curve so as to provide for (i) stopping sight distance of 90m (ii) safe overtaking sight distance of 300m. The distance between the centre line of the road and inner lane is 1.95m. [8]
3. a) Define superelevation. Discuss the different methods of introducing superelevation with sketches. List the factors on which superelevation depends. [8]
- b) A vertical curve connects a -3% grade with +4.5% grade on a highway at an elevation of 320.8m above the mean sea level. The curve should be designed at least to provide the visibility of the road surface to a distance of 250m at night time. Calculate the elevation of beginning, lowest and end points of vertical curve and at a distance of 60m left and right from the point of vertical intersection. The head light beam angle and height of the head light from the road surface is 1.5° and 0.60m respectively. [8]
4. a) What are the surface and subsurface drainage structures to be provided at hill road? Describe them briefly. [8]
- b) Describe in detail the test procedure of determining the impact value of aggregates. [8]
5. a) What are the causes of moisture variation in subgrade soil? Explain briefly the method of control of seepage flow. [8]
- b) What is a hill road? Describe the factors to be considered in hill road design. [8]
6. Write short notes on: [4×4]
 - a) Culverts
 - b) Functional classification of roads (NRS)
 - c) Road planning
 - d) Hair pin bends