Transportation Engineering I
ENCE 304

Year/Part: III/I

Teaching Schedule				Examination Scheme						Total
				Theory			Practical			
L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		
					Duration (Hrs)	Marks		Duration (Hrs)	Marks	
3	2	1	6	40	3	60	25	0	0	125

Depth Codes

E-Explanation	S-State	D-Definition	DM-Demonstration
DV-Derivation	NUM-Numerical	P-Proof	I-Illustration
MP- Mini Project	EXP-Experiment	REV-Review / Recap	PS- Problem Solving
QA- Question Answer	Q- Quiz	ST- Surprise Test	MT-Mid Term Test

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
1	Transportation System, Planning and Engineering			**10**	**4**		
	1.1. Transportation system	D, E E E E QA,E	Definition, scope and role of transportation Components and characteristics of transportation system Transportation system classification Modes of transportation Comparison of different modes of transportation	2			1
	1.2. Transportation planning	E E E D, E	Need of transportation planning Classification and system approach in transportation planning Multimodal transportation planning Transportation planning and land use transportation model	2			2
	1.3. Transportation engineering	D, E D, E D, E D, E	Scope of transportation engineering Highway engineering Airport engineering (Advantages and disadvantages, airport classification (based on runway length, use), Airport site selection, definition of airport component – runway, taxiway, apron, terminal) Railway engineering (Importance, advantage and disadvantage, definition of components – railway track)	2			2
	1.4. Traffic Engineering	D, E E D, E, NUM D, E, DV, NUM	Definition and scope of traffic engineering Road user (physical, mental, psychological, environmental) and vehicular characteristics (static, dynamic, kinematic) Perception reaction process, skid resistance and brake efficiency Stopping sight distance and overtaking sight distance	4	4		3
	Evaluation	QA, Q					

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
2	Highway Engineering			**4**	**2**		
	2.1 Highway engineering and scope	D, E	Definition of Highway Engineering, Scope of highway engineering	0.5			4
	2.2 Advantages of road transportation	E	Advantages and disadvantages of Road Transportation	0.5			
	2.3 History of road development	E	Roman, Telford, Macadam Roads, Modern Roads, Road development in Nepal	0.5			
	2.4 Classification of roads in Nepal (NRS, NRRS, NURS)	E	Classification criteria, Road class based on NRS 2070 (old & new classification), NRRS 2071, NURS 2076	0.5			
	2.5 Highway alignment	D QA, E QA, E QA, E E	Definition of Highway alignment Requirements of ideal alignment Factors controlling highway alignment Engineering survey for highway alignment Special consideration in hill road alignment	2	2		5
	Evaluation	QA, Q, ST					

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
3	Geometric Design of Highway			**16**	**18**		
	3.1 Factors controlling geometric design of highway	D, E	Definition of Geometric Design, Importance, design control factors and relevant linkage to NRS 2070, NRRS 2071, NURS 2076	2			5
	3.2 Design of cross-sectional elements of highway	E, I, D, E, DV, NUM, I	Factors controlling cross section, cross sectional elements (Traffic lane, carriageway, shoulder, median, side slope, Right of way, laybys, footpath, cross walks, kerbs, cycle lane, guard rails etc.) Camber (definition, purpose, types and design)	2	2		6
	3.3 Design of horizontal alignment: Tangents; Curves including transition curves; Hair pin bends; Setback requirement considering sight distance	D, E, I, DV, NUM D, E, I, DV, NUM D, E, I, DV, NUM	Tangents, Definition and types of horizontal curves, Design of horizontal curve, Design of super elevation, method of providing super elevation. Radius of curve from night visibility requirement, Extra widening and method of providing extra widening, Design of Transition Curve Setback requirements, Hair pin bend (design parameter and length of hair pin bend)	6	10		7-8
	3.4 Design of vertical alignment: Gradient; Grade compensation; Vertical curve	D, E, I, NUM D, E, I, NUM	Gradients: Definition, Type, selection, Curve resistance and grade compensation Vertical curve: Definition, Types, design of summit and valley curves	4	4		9
	3.5 Combination of horizontal and vertical alignment, safety in road design	E, I	3 dimensional perspective of road alignment	2			10
	Evaluation	MT Presentation			2		

Unit	Topic/ Sub topic	Depth	Description of Depth	Actual plan	Week

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
		Code		L	T	P	
4	Highway Drainage			**4**	**2**		
	4.1 Highway drainage and its importance	D, E, I	Definition, drainage in rural, urban roads,	1			11
	4.2 Requirements of highway drainage	E	Requirements	0.5			
	4.3 Causes of moisture variation in subgrade soil	E, I	Causes	0.5			
	4.4 Classification of highway drainage: Surface drainage; Subsurface drainage; Cross drainage	E, I	Classification and application	1			
	4.5 Erosion control and energy dissipation measures in highway drainage structures along with special drainage structures in hill roads	E, I	Erosion control measures, energy dissipating measures, special drainage structures in hill roads (Gully control measures)	1			12
	Evaluation	QA	Visual presentation		2		

Unit	Topic/ Sub topic	Depth Code	Description of Depth	Actual plan			Week
				L	T	P	
5	Highway Materials			**11**	**4**		
	5.1 Introduction and classification of highway materials	D, E	Introduction, classification (mineral materials, binding materials, other materials)	1			
	5.2 Subgrade soil: Desirable properties; CBR test	E, I	Subgrade soil, Desirable properties, CBR test	1		2	12
	5.3 Road aggregates: Desirable properties; Lab tests; Gradation analysis	D, E, I D, E, NUM	Definition, classification, desirable properties, tests (shape, gradation, specific gravity, crushing, impact, abrasion) Gradation analysis (blending of aggregate by mathematical method)	2 2	 2	6	13
	5.4 Bituminous binders: Introduction, types and lab tests	D, E, I	Bituminous binder definition and types, tests (penetration, viscosity, softening point, ductility, specific gravity, flash and fire point)	2		2	14
	5.5 Bituminous mixes: Definition and types; Bituminous concrete mix design	D, E, I, NUM	Definition, desirable properties, types, mix design, Marshall method mix design, density void analysis	3	2	2	15
	Evaluation	Final assessment				3	

References

1. Sharma, S. K. (2014). Principles, Practice and Design of Highway Engineering (4th Edition). S. Chand & Company Ltd.
2. Khanna, S. K., Justo, C. E. G. (2021). Highway Engineering (Revised 10th ed.). Nem Chand & Bros.
3. Flaherty, C. A. (2002). Highway Engineering. Edward Arnold Publishers Ltd.
4. Department of Roads, Ministry of Physical Infrastructure and Transport. (2013). Nepal Road Standard 2070. Government of Nepal.
5. Ministry of Urban Development. (2019). Nepal Urban Road Standard 2076. Government of Nepal.
6. Ministry of Federal Affairs and Local Development. (2014). Nepal Rural Road Standards (2055, 2nd rev. 2071). Government of Nepal.

7. Shrestha, D. K., Marsani, A. (2020). Transportation Engineering, I (4th Edition). Heritage Publisher and Distributors.
8. Khanna, S. K., Justo, C. E. G., Veeraragavan, A. (2013). Highway Materials and Pavement Testing. Nem Chand & Bros.

Model Question

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QN	Question	Marks	Unit
1	Explain critical role of road transportation in the context of multimodal transportation network.	6	1
2	The speeds of overtaking and overtaken vehicles are 80kmph and 65 kmph respectively on two way traffic road. If the acceleration of overtaking vehicle is 3.6 kmph/sec. Calculate a) Safe overtaking sight distance b) Minimum length of overtaking zone and desirable length of overtaking zone	6	1
3	Why NRS 2070 and NRRS 2071 is not so relevant in classifying roads at present context of Nepal? Describe the requirements of ideal highway alignment	6	2
4	What are the limitations of NRS 2070 in the current context of expanding highways to four/six lane in major national highway of Nepal?	6	3
5	A four lane carriageway has a curve of 220m long and 400m radius. The safe stopping sight distance and overtaking sight distance are 152m and 300m respectively. Calculate the minimum set back distance from the inner edge of the carriageway to the edge of the obstruction to ensure safe visibility for both the cases of sight distance.	6	3
6	An upward gradient of 1 in 100 meets a downward gradient of 1 in 100 on a National Highway. Calculate length of summit curve if (i) the stopping sight distance is 180 m, (ii) the overtaking sight distance is 640 m. What will be the RL of the highest point on the summit curve if RL of the tangent point at the start on the curve is 100.000 m?	6	3
7	What are the requirements of highway drainage? When and where causes ways are used as cross drainage structure?	6	4
8	Describe the desirable properties of soil. Why corrected load is to be used in CBR calculation?	6	5
9	How the materials properties affect the bituminous mix performance in terms of its desirable properties	6	5
10	Define/explain the followings: Grade compensation, moisture variation in subgrade soil, gradation analysis of aggregates	6	3,4,5

Note: *Number of questions and distribution of marks are indicative only*