

## Highway Materials

**Course objectives:** This course will enable students to: -

- Understand the basic construction materials and their suitability as road materials and analyze the aggregates and design aggregate gradation for construction of pavement layers.
- Characterize the binder material for bituminous roads and provide an optimum bituminous mix design  
     Understand mix design using different materials for various components of a CC pavement

### Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Highway Materials	MET-2211	3	-	-

#### Unit – I

**Basic Road Construction Material:** types, source, functions, requirements, properties, tests and specifications for use in various components of road. Soil compaction for use in fill and subgrade of roads, compaction studies in laboratory and field, properties of compacted soils.

#### Unit – II

##### **Aggregate: -**

Aggregates, Blending of aggregates by Rothfutch, Triangular Chart, Trial and error and mathematical proportioning methods. Classification, nomenclature, quality and manufacture of aggregates with respect to W.B.M., bituminous and concrete roads.

#### Unit – III

**Bituminous Materials:** Classification and various terms used related to tar and bitumen, uses and application of different bituminous materials in highway construction. Origin and preparation of different grades of bitumen and tar used for road construction. The Rheology of bituminous binders, Adhesion of binders to road aggregates and mechanism of stripping and adhesion failures, Weathering of bituminous road materials, Admixtures, rubber, tar bitumen and foam asphalt.

#### Unit – IV

**Bituminous Mixes:** Requirements of bituminous mixes. Methods of bituminous mix design and their suitability, advantages and disadvantages. Design of bituminous mixes by Marshall, Hubbard Field, Hveem and Triaxial test methods.

## Unit – V

**Materials for Low Cost Roads and Cement Concrete Mixes :** Stabilized soils, Lime Fly Ash, Soil-cement and soil-bitumen stabilization. Soft aggregates, low Cement Concrete: Proportioning of concrete mixes by absolute volume method, Road Note No. 4 method, Kennedy's method, Talbot Richart method and design method for vibrated concrete.

### Course Outcomes: -

After studying this course, students will be able to:

**CO1:** Identify and select based on their characteristics the basic construction materials for road construction.

**CO2:** Design aggregate gradation for construction of pavement layers keeping in mind the density and strength parameters.

**CO3:** Characterize the binder material for bituminous roads and provide an optimum bituminous mix design and Provide mix design procedure and the base layer for a CC pavement.

### Reference Books: -

- 1) Khanna, S.K., and Justo, C.E.G., 'Highway Engineering', Nem Chand and Bros. Roorkee.
- 2) RRL, DSIR, 'Bituminous Materials in Road Construction', HMSO Publication.
- 3) L.R Kadiyali, "Traffic Engineering"- Khanna Publishers New Delhi
- 4) "Soil Mechanics for Road Engineers"- HMSO Publication 11.
- 5) "Bituminous materials in Road Construction"- HMSO Publication.

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## Transportation Planning

### Course Objectives

- To make the students understand different aspects of planning and operation of public transportations.
- To impart the knowledge of different modes of transportations and their services
- To learn the fundamentals of transportation planning

### Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Transportation Planning	MET-2212	3	-	-

#### Unit – I

**Transportation planning:** - Methodology, hierarchical levels of planning-statewide, regional, urban, passenger and goods transportation, General concept and process of transport planning.

#### Unit – II

**Urban transportation planning, urban travel characteristics:** - basics of urban transportation network, basics of tour-based or activity-based travel demand model, private and public, travel behaviour analysis.

Travel demand estimation and forecasting. Trip classification and socio-economic variables in trip making, trip generation: multiple regression analysis, category analysis, comparative study.

#### Unit –III

**Modal split analysis:** - Basics of activity-based model, traditional analysis, behavioural approach to mode choice, two-stage modal split models. Trip distribution: Growth factor method, gravity model, intervening opportunity and competing opportunity models, comparative study. Entropy maximizing method and linear programming method in trip distribution.

#### Unit – IV

**Traffic assignment** - network assignment, capacity restrained and simultaneous, distribution-assignment methods. Direct demand models of transport planning, traffic management techniques for improving vehicular flow

#### Unit – V

**Land-use transport planning:** land-use transport interactions, transport related land-use models, their use in transportation planning. Corridor type travel planning, statewide and regional transportation planning.

**COURSE OUTCOME: -**

After completion of this course, the students will be able to

**CO1:** Fix the schedule and the operational frequency for public transportation

**CO2:** Model the travel demand of different modes of public transportation

**CO3:** Understand Urban Activity System And Travel Patterns

**References Books -**

1. L.R. Kadiyali, *Traffic Engineering and Transport Planning*.
2. Williamsen and Ortuzar, *Modelling Transport*.
3. Kanafani, *Transp. Demand Analysis*.
4. C. J. Khisty and B. K. Lall, *Transportation Engineering: An Introduction*, Prentice-Hall India, 2003. Hutchinson, B.G., *Principles of Urban Transport Systems Planning*, Scripta, McGraw-Hill, NewYork, 1974.
5. Khisty C.J., *Transportation Engineering - An Introduction*, Prentice Hall, NJ, 2007.
6. Papacostas C.S. and Prevedouros, P.D., *Transportation Engineering & Planning*, PHI, New Delhi, 2002.

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## Highway Geometric Design

### Course Objectives

- Student will learn principles, concept, elements, facilities, codal provisions, necessity and scope of highways and their planning.
- Student will learn analysis computation, forecasting as per codal provisions, formation level, gradient. speed, sight distances and curve and intersection elements.
- Student will learn to design space requirements, for upgrading existing highway, traffic flow channels, rotaries and parkings.

### • Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportations Engg)	Highway Geometric Design	MET-2213	3	-	-

### Unit – I

**Design controls and Criteria:** Topography and physical features, traffic, impact of vehicular characteristics on road geometrics, speed and safety.

**Roadway Capacity Analysis and Design of Lane Requirements:** 2 lane, 4 lane divided and undivided, multilane, freeway, expressways.

### Unit – II

**Cross-section Elements:** Pavement surface characteristics, cross slope, lane width, Curbs, shoulders, drainage channels and side slopes, medians, frontage roads and outer separations. Single lane, 2-lane, 3-lane and multilane highways, freeway and expressways.

**Sight Distance:** Analysis of stopping and passing sight distance, discussions of factors involved, discussion on I.R.C. specifications for measurements of sight distances.

### Unit – III

**Horizontal Alignment:** Principles of horizontal curve design, maximum curvature, superelevation rates, transition curves, super-elevation runoff, attainment of superelevation for undivided and divided highways, distribution of e and f, IRC specifications.

Pavement widening on curves, sight distance on horizontal curves.



#### Unit – IV

**Vertical Alignment :** Gradients, compensation of grade at curves, design of climbing lanes, shape of vertical curves, procedure for design of summit and valley curves, design of humps. Combination of horizontal and vertical alignment.

#### Unit – V

**Geometrics of At-grade intersection:** Geometric elements, alignment and profile at intersections, median openings, median lanes. Rotary intersection. Geometrics of grade separation and interchanges.

Geometric Design for Parking-Parking space design for on street and off-street parking, layout of parking garages.

#### Course Outcomes

CO1: Student will be able to illustrate, compare, list principles, concept, elements, methodology, codal provisions, necessity and scope in Geometric Design of highways/

CO2: Student will be able to analyse Geometric Design of a given highway and will check for codal provisions.

CO3: Student will be able to design alignment profile, curves, widening of pavement parking, and Intersections space.

#### Reference Books

- 1) Highway Engineering by Justo Khanna & Justo
- 2) Traffic Engineering by Kadiyali
- 3) NPTEL lectures





## Highway Equipment's & Machinery

**Course objectives:** This course will enable students to: -

- Understand major equipment used for road construction works along with their working principle.
- Distinguish the advantages and limitations of the equipment used for earth excavation and grading.
- Understand the knowledge of pavers and form works used to lay flexible and rigid pavements.

### Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Highway Equipment's & Machinery	MET-2214	3	-	-

#### Unit – I

Selection of highway equipments; Operating cost; depreciation cost, calculation by different methods; economic life of Highway equipment; manual and mechanical method of Highway construction; Tractors, uses and types, grad ability; bulldozers, types, operation; Ripping of rock, types of rippers, economy of ripping rock.

#### Unit – II

Soil compaction, types of compacting equipments & their output; scrapers, types, operation, cycle time, output, load growth curve; Power shovels, size of power shovel, basic parts and operation, factors affecting output of power shovel; draglines basic parts and operation, factors affecting its output.

#### Unit – III

Trucks and Wagons, general features, types, matching of size of truck and power shovel; Belt Conveyor, its economy, idlers, power required to drive, driving equipment, hold backs, feeders, trippers; Crushers, Jaw crusher, roll crusher Road and Ball Mill, selection of crushing equipment, screening aggregate, handling crushed stone aggregate.

#### Unit – IV

Cement concrete mixers, proportioning of concrete mixtures, fresh concrete, batching of concrete materials. Tilting concrete mixer, concrete batching plant, Transit mixer, ready mixed concrete, placing of concrete; vibrators, types, cold water & hot water curing of concrete, slip form pavers.

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## Unit - V

Drilling rock and earth, types of drilling machines, selection of drilling method and machine, selecting drilling pattern, rate of drilling rock; Blasting of rock, dynamite, ammonium nitrate explosives, slurries, stemming, firing charges, safety fuse, electric blasting cap, delay blasting caps, handling misfire, presplitting rock, spacing of blast holes.

**Course outcomes:** After studying this course, students will be able to:

**CO1:** Get the knowledge of major equipment used for road construction works along with their working principle.

**CO2:** Distinguish the earth excavation and grading equipment based on their advantages and limitations for use in road construction.

**CO3:** Work out the production capacity of the mixing plants for flexible and rigid pavements producing different sizes of aggregates.

### Reference Books: -

1. Khanna, S.K., and Justo, C.E.G., 'Highway Engineering', Nem Chand and Bros. Roorkee.
2. Peurifoy/ Schexnayder "Construction Planning, Equipment and Methods"- McGraw-Hill Higher Education
3. Sharma S.C. "Construction Equipment and its Management"- Khanna Publishers, Delhi
4. K.K. Chitkara, "Construction Project Management, -Planning, Scheduling and Controlling"- Tata McGraw -Hill Publications
5. "Operation Manuals of various equipment manufacturers".

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## ELECTIVE- I (A) Cost Effective Roads

### Course Objectives:

- To learn the concept of planning and design of Low-Cost roads.
- To Know about materials used for construction in Low-Cost roads.
- To learn about construction operation of Low-Cost roads.

### Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Cost Effective Roads	MET-2215(A)	3	-	-

#### Unit – I

**Introduction:** Concept, objective, scope and coverage of low cost and rural roads. Significance of low-cost roads for developing countries, with special reference to India.

**Rural Road Planning and Investment:** State of art, review of existing practices and their deficiencies in rural road planning. Socio-economic aspects in planning. Preparation of rural road master plans and their evaluation. Stage constructions and planning, and utilization of successive investments.

#### Unit – II

**Geometrics for Low-Cost Rural Roads:** Traffic and design speed, horizontal alignment, vertical alignment, and cross section elements.

#### Unit – III

**Pavement Design Aspects for Low-Cost Rural Roads:** Existing pavement design practices for rural roads. Minimum level of serviceability concept for rural roads. Use of strength index as a substitute to CBR (IRC). Thickness design charts (I.R.C.)

#### Unit – IV

**Materials for Low-Cost roads:** Stabilized soils. Design of soil-lime, soil-cement, soil-bitumen and soil-lime-fly ash mixes. Use of soft aggregates in low-cost roads.

**Construction, Operation and Plants:** Surveying and setting, Excavation, hauling, shaping and compaction, stabilized soils-spreading, mixing, and compaction. Appropriate technologies, tools, plants and equipments for construction of low cost rural roads I.R.C. practices.

## Unit – V

**Road Drainage:** Drainage of road surface, pavement layers and cross drainage works. Various low-cost drainage alternatives.

**Maintenance:** Short term routine maintenance, long term maintenance. Organization and finance for maintenance works.

### Course Outcomes:

At the end of the course, the student will be able to:

**CO1:** Understand the basic concept of planning and design of Low-cost roads.

**CO2:** To characterize the materials used for construction in low-cost roads.

**CO3:** To gain knowledge about construction operation of low-cost roads.

### Reference books:

1. IRC manual for rural roads. Special publication – 20(2015)
2. HMSO, Soil Mechanics for rural Engineers in, London
3. IRC related code books
4. NRRDA – guidelines and code books M-Tech (Transportation Engg.)

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## ELECTIVE- I (B) Road Safety Engineering

### Course Objectives:

- The objective of this course is understood fundamental of Road Safety Engineering.
- To analyze and investigate Traffic characteristic and road way features
- The role of road safety in planning and designing of transport infrastructure
- The various traffic management systems for safety & safety improvement programs.

### • Course Content

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Road Safety Engineering	MET-2215(B)	3	-	-

**Unit – I: Fundamentals of Traffic Engineering** – Basic vehicular and road user Characteristics, Highway Capacity, Applications of Traffic Control Devices, Traffic Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution methods, Statistical Comparisons.

**Unit – II: Accident Investigations and safety Management**, Collection Accident Data collection and analysis, Condition and Collision Diagram, Causes and Remedial safety measures, Assessment of Road Safety, Methods to Identify and Prioritize safety Hazardous Locations, Determine Possible Causes of accident, Effectiveness of Safety Design Features, Accident Reconstruction studies.

**Unit – III: Road Safety in Planning and Geometric Design:** Road Design and Road Equipments, Redesigning of Junctions, Improvements in Cross Section element, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care

**Unit – IV: Role of Urban infrastructure design in safety:** Geometric Design of Roads; Design of Horizontal and Vertical Elements, Junctions, At Grade and Grade Separated Intersections, Road Safety in Urban Transport, Sustainable Modes and their Safety.

**Unit – V: Traffic Management Systems** for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

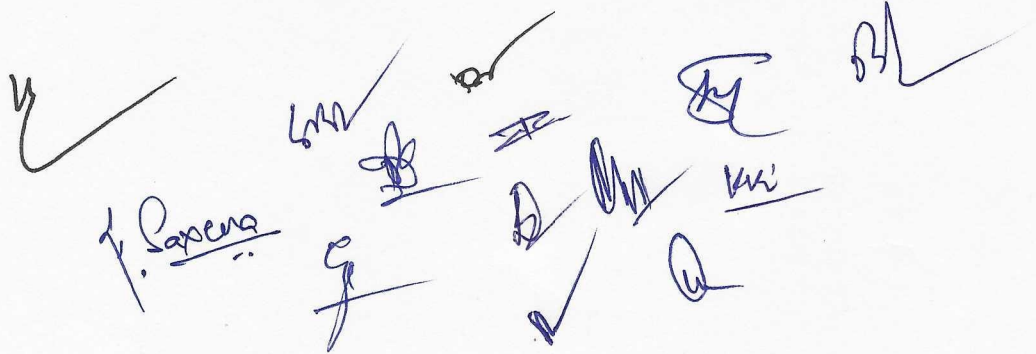
**Course Outcomes:**

At the end of the course, the student will be able to:

- Understand fundamental of Road Safety Engineering and analyse Traffic characteristic of road way
- To investigate and evaluate the collective causes and remedial safety measures of accident involved.
- Design & planning various road geometrics and infer traffic regulation and apply traffic management system.

**References:**

- Khanna.S.K., Justo C.E.J., Verraraghvan A., Highway Engineering, Nem Chand and Brothers.
- Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
- Fundamentals of Transportation Engineering – C.S. Papacostas, Prentice Hall India.
- Transportation Engineering – An Introduction, C.Jotin khisty, B. Kent Lall
- Fundamentals of Traffic Engineering, Richardo G Sigua
- Handbook of Road Safety measures, second Edition, Rune Elvik, Alena Hoye, Truls Vaa, Michael Sorenson
- Road Safety Audit Mannual, IRC-SP-88.



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**ELECTIVE- I (C)**  
**Airport Planning and Design**  
**Course Content & Grade**

**Course Objectives:**

- The objective of this course is understood the Airport Planning History and development of aviation.
- To know the basic concepts of aircraft and elements of geometrics of airport
- To understand the air traffic control and importance of drainage at airport.

• **Course Content**

Branch	Subject Title	Subject Code	Credit allotted subject wise		
			L	T	P
M.E. (Transportation Engg)	Road Safety Engineering	MET-2215(C)			
			3	-	-

**Unit – I**

History and development of aviation. Air traffic trend in India, aviation organizations and their functions.

Airport Planning. Aircraft characteristics related to airport planning and design, airport master plan, Site selection, air traffic demand analysis and planning surveys, obstruction clearance requirements, airport zoning, airport configuration, hierarchic planning levels.

**Unit – II**

Geometric design of landing area. Airport classification, runway and taxiway geometric standards, exit taxiways, separation and clearances.

Capacity and delays, Runway capacity, factors affecting capacity, capacity related and not related with delay, gate capacity.

**Unit – III**

Terminal area, Facilities to be provided at terminal, space requirements, number and size of gate positions, aircraft parking systems.

Visual aids. Airport day time markings, airport lighting, related visual aids, visibility.

**Unit – IV**

Air traffic control. Definition and its importance, flight rules navigational aids, landing aids, VASI, enroute air traffic controls. Heliports and STOL Ports. Heliport site selection, STOL and VTOL aircrafts, STOL ports, obstruction and clearance requirements.

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## Unit – V

Airport Drainage. Design run-off, Inlet size and location design, surface and sub-surface drainage.

### Course Outcomes:

At the end of the course, the student will be able to:

CO1: Introduced the region planning for an airport.

CO2: Design the runway length after considering the correction required for basis runway length.

CO3: Understand the visual aids required for safe landing and takeoff operating of airport.

CO4: Analysis and Design the drainage.

### REFERENCES:

- Airport Planning and Designing by S.K. Khanna, M.G. Arora.
- Highway Engineering including Expressways and Airport Engineering by Dr. L. R. Kadyali, Dr. N. B. Lal.
- Highway Engineering including Airport Pavements by Dr. S. K. Sharma.
- Transportation Engineering by S. P. Chandola.

