CIVIL ENGINEERING
M.E. (TRANSPORTATION ENGINEERING) – SCHEME OF INSTRUCTION AND EXAMINATION

I-SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut/drw.	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
TRR-1.1	Urban Transportation Planning	4	—	3	70	30	100	4
TRR-1.2	Traffic Engineering & Management	4	—	3	70	30	100	4
TRR-1.3	Geometric design of Highways	4	—	3	70	30	100	4
TRR-1.4	Advanced Foundation Engineering	4	—	3	70	30	100	4
TRR-1.5	Operations Research	4	—	3	70	30	100	4
TRR-1.6	Computational Transportational Engineering Laboratory	—	3	—	50	50	100	2
TRR-1.7	Traffic Engineering Laboratory	—	3	—	50	50	100	3
	Total	20 + 6 = 26			450	250	700	25

II-SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut./drw	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
TRR-2.1	Traffic flow theory	4	—	3	70	30	100	4
TRR-2.2	Transportation Economics	4	—	3	70	30	100	4
TRR-2.3	Analysis and Design of Pavements	4	—	3	70	30	100	4
TRR-2.4	Probability and Statistics	4	—	3	70	30	100	4
TRR-2.5	Ground Improvement Techniques	4	—	3	70	30	100	4
TRR-2.6	Pavement Material and Evaluation Laboratories	—	3	—	50	50	100	3
TRR-2.7	Design Project & Seminar	—	3	—	—	100	100	2
	Total	20 + 6 = 26			400	300	700	25

III-SEMESTER

Code No.	Course title	Scheme of Instruction		Scheme of Examination			Total	Credits
		Lec.	Tut./drw	Duration of Exam. (hrs)	Theory/ Lab./Viva	Sess.		
TRR-3.1	Analysis of Transportation Systems	4	—	3	70	30	100	4
TRR-3.2	Airport Planning and Design	4	—	3	70	30	100	4
TRR-3.3	Traffic Design and Studio	—	4	—	50	50	100	2
TRR-3.4	Thesis	—	—	—	—	—	—	—
	Total	8+4=12			190	110	300	10

IV-SEMESTER

Code No.	Course title		Credits
TRR-4.1	Thesis/Dissertation	100 marks	Credits: 20
	GRAND TOTAL	1800	80

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TE – Four Semester Course

TRR 101 - Urban Transportation Planning
- Urban transportation planning concepts – systems approach to the planning process.
- Trip generation modeling – variables influencing trip generation, regression analysis and category analysis.
- Trip distribution modeling – factors governing trip distribution, growth-factor methods and gravity models, calibration of gravity models.
- Modal split modeling – factors influencing mode choice, discrete choice models, route assignment – traffic assignment techniques.
- Transportation surveys.
- Transport related land use models, urban structure, urban goods transport.

References: Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, New York, 1974. Ortuzar, J. and Willumsen, L.G., Modelling Transport, Wiley, Chinchestor, 1994.

TRR 102 - Traffic Engineering and Management
Traffic Engineering:
- Introduction and scope.
- Traffic stream components and characteristics.
- Traffic studies.
- Highway capacity and performance characteristics.
- Planning and design of facilities.
- Probability and statistics for traffic engineering.
- Theoretical techniques for describing traffic flow.
- Traffic forecasting principles and techniques.
- Simulation in traffic engineering.

Traffic Management:
- Transportation system management – Travel demand management, Traffic management.

References: Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2000. Traffic Engineering and Transport Planning by L.R.Kadiyali, Khanna Publishers. Fundamentals of Transportation and Traffic Operations, Pergamon, Elsevier Science Inc., New York, 1997.

TRR 103 - Geometric Design of Highways
- Geometric design provisions for various transportation facilities as per AASHTO, IRC and other guidelines.
- Discussion of controls governing geometric design
- Route layout and selection.
- Elements of design – sight distances, horizontal alignment, transition curves, super elevation and side friction.
- Vertical alignment – grades, crest and sag curves.
- Highway cross-sectional elements and their design for rural highways, urban street and hill roads.
- At–grade intersections, sight distance considerations and principles of design, channelisation, mini round-abouts, layout of round-abouts.
- Interchanges – Major and minor interchanges, entrance and exit ramps, acceleration and deceleration lanes, bicycle and pedestrian facility design.
- Parking layout and design.
- Terminal layout and design.

TRR 104 - Advanced Foundation Engineering

- Bearing capacity of shallow foundation, applications of bearing capacity theories, methods – Terzaghi, Mayerhoff, Brinch Hanson, Skempton, Balla.
- Field methods – standard penetration test, factors effecting N value, Plate load test, Coefficient of Sub grade reaction and its determination.
- Settlement analysis – Elastic and consolidation settlement, settlement estimates from penetration test, plate load test, construction period correction, permissible total and differential settlement, causes of settlement, control of settlement, remedial measures, proportion of footing, contact pressure and active zone from pressure bulb concept.
- Factors effecting failures of foundation, case studies, remedial measures.
- Pile foundations – selection of pile foundation, load carrying capacity – dynamic formula, static formula, pile load test - pull out test, lateral load test, initial load test, routine load test, cyclic load test, settlement of pile and pile groups, negative skin friction, laterally loaded piles – **B**room's analysis, IS code method. Under reamed piles, method and design.
- Caissons and well foundations – design aspects of caissons, open caissons, pneumatic caissons, floating caissons, well foundations, monoliths, design and construction aspects of well foundations.

References: Foundation analysis and Design by Bowles, Mc.Graw Hill Inc., second edition. Geotechnical Engineering by C.Venkatramayya, New age international publishers. Soil Mechanics and Foundation Engineering, Vol.II, V.N.S.Murthy.

TRR .1.5 - Operations Research
- Linear programming – problem formulation.
- Graphical solutions – SIMPLEX method
- Duality in Linear programming.
- Transportation problem
- Assignment and routing problem.
- Queuing theory.

References:
- Operation research by Kanti Swarup, Gupta and Manmohan.
- Operation research and statistical analysis by S.D.Sharma.

TRR 1.6 - Computational Transportation Engineering Laboratory
- Programming in C language – functions, arrays, strings, structures, file operations
- Data structures.
- Applications in Transportation Engineering.

TRR 1.7 - Traffic Engineering Laboratory
- Traffic surveys like traffic volume count, speed study, parking study, intersection turning movements, speed & delay study.
- Moving observer survey.
- Origin–destination surveys.
- Road side and house hold interviews.
- Road lighting.
- Traffic noise measurement.
- Measurement of road user characteristics.
- Use of automatic traffic recording equipment.

TRR 2.1 - Traffic Flow Theory
- Microscopic and macroscopic flow characteristics.
- Car following theories.
- Traffic stream models.
- Shock Wave analysis.
- Queuing analysis.
- Introduction to computer simulation models.

References: Traffic System Analysis For Engineers and Planners by Martin Wohl and Brian V. Martin, Mc.Graw Hill Publishers.

TRR 2.2 - Transportation Economics
- Economic analysis of transportation projects ownership and financing of transport.
- Economic function of transportation.
- Road user and transportation costs.
- Highway finance and taxation.
- Case studies of analysis and evaluation of transportation projects.

References: Fair and Williams, Economics of Transportation, Harperand Brothers, Publishers, New York, 1959. Winfrey, Robley, Economic Analysis for Highway International Textbook Co., Pennsylvania, USA, 1969. Harral Clell G., A Manual for the Economic Appraisal of Transport Projects, World Bank Report, Washington D.C., 1980.

TRR 2.3 - Analysis and Design of Pavements
- Pavement types, stress distribution pavements – theoretical and actual
- Sub grade conditions and traffic loading.
- Design principle and methods for flexible and rigid pavements.
- Design of heavy duty pavements.
- Concrete block pavements.

Evaluation of pavement condition, pavement instrumentation:
- Types of pavement distresses, their origins and remedy.
- Roughness and skid resistance.
- Environmental effects and influences.
- Pavement maintenance, overlays.
- Pavement management systems.

References: Pavement Analysis and Design, second edition, by Yang H. Huang, Prentice Hall publishers. Shell Pavement Design Manual – asphalt pavements and overlays for road traffic, by Nilanjan Sarkar, Ooms Avenhorn Holding India Pvt.Ltd.

TRR 2.4 - Probability and Statistics
- Fundamental concepts and role of probability and statistics in civil engineering, collection and presentation of data – design of experiment.
- Elementary probability theory: random variables, conditional probability, theorem of total probability and Baye's theorem.
- Probability distributions: Gaussian and log normal, Binomial geometric, Poisson exponential, Gamma uniform, triangular, Hyper geometric, Beta, Student's 'T' , ψ square, Fischer's 'F'.
- Extreme – value: Gamble distributions, Central limit theorem, Moments and Expectations, Covariance matrix and Covariance propagation, weights.
- Estimation of parameters: Method of least squares – observation equations, normal equations, linear and nonlinear models.
- Confidence interval estimation and statistical testing: Tests of hypothesis and significance for mean, variance and ratio of variances, statistical inference, multi variety analysis, error analysis, error elapses derived probability distributions, goodness–of–fit tests.
- Regression: Linear, Non-linear and Multiple–linear Correlation analysis, Applications in Civil engineering.

References: Ang, H.S. and Tang, W.H., Probability Concepts in Engineering Planning and Design, Wiley, New York, 1975. Benjamin, J.R. and Cornell, C.A., Probability Statistics and Decision for Civil Engineers, McGraw Hill, New York, 1975.

TRR 2.5 - Ground Improvement, Soil Reinforcement and
    Geosynthetics
Ground Improvement:
- Principles of ground improvements, mechanical modification – principles of densification, properties of compacted soil, compaction control tests, specification for compaction.
- Hydraulic modification – Dewatering and filtration, drainage and seepage control with geosynthetics, preloading and vertical drains, electro kinetic dewatering.
- Chemical modification, modification by admixtures, modification by inclusions and confinement, insitu ground reinforcement, ground anchorage, rock bolting, nailing.

References: Monfred R. Hausman, 1990, Mc.Graw Hill publishing Corporation. IS code 13094-1992, Selection of Ground Improvement Techniques for Foundation in Week Soils – Guidelines.

Soil Reinforcement and Geosynthetics:
- History and development of earth reinforcement, geosynthetic materials, functions, properties, characterization. Testing methods for geotextiles and geomembranes, application areas. Principles of earth reinforcement. Mechanical and analytical considerations. Factors affecting the performance and behavior of reinforced soil, construction, durability.
- Designing with geotextiles, geogrids, geomembranes, geocomposites for functions such as separation, reinforcement, filtration, drainage and moisture barrier.

References: Keorner, R.M. Designing with geosynthetics, Prentice Hall. Jones "Earth reinforcement and soil structure" Butter Worths 1996.

TRR 2.6 - Pavement Materials and Evaluation Laboratory
- Tests on aggregates, tests on bitumen, tests on subgrade soil, mix design of bitumen and aggregates for different construction techniques.

TRR 2.7 - Design Project and Seminar
- The student has to do a mini project in the area of Transportation and present the work in the form of a report and deliver a seminar under the direction of the teacher.

TRR 3.1 - Analysis of Transportation Systems
- Introduction to transportation systems, transportation innovations, social and economic impacts of transportation
- Decision makers and their options, demand modeling and predictions.
- Modeling transportation technologies.
- Analysis of network flows
- Transportation network
- Network theory, Wardrop's external principle of traffic assignments, evaluation of impacts, Basic physics of transportation
- Concepts in transportation models and location models.
- Analysis of utility maximizing systems such as transportation systems by entropy concepts
- Major transportation technologies.
- Urban and megalopolitan transportation and economic policy, mathematical programming and other models for selecting network investments and operation planning
- Case studies.

References: Manheim, Analysis of Transportation Systems, MIT, USA, 1980. R.G.Weilson, Entropy in Urban and Regional Transportation, McGraw-Hill, 1980. Miller and Mayor, Decision Analysis and Decision Making Oriented Urban Transportation, McGraw-Hill, 1984.

TRR 3.2 - Airport Planning & Design
- Aircraft characteristics.
- Obstruction criteria.
- Air traffic control.
- Runways: Orientation, length, geometric standards, capacity, configuration.
- Taxiway, geometric standards, fillets, high speed exit taxiway.
- Apron-gate area and circulation.
- Terminal building – functional areas and facilities.
- The planning and site selection.
- Pavement design and evaluation.
- Visual aids.
- Drainage.
- Heliports.

References: Airport Planning and Design by Khanna and Arora.

TRR 3.3 - Traffic Design & Studio:
- Geometric design of traffic facilities, plan and layout of major at – grade and grade – separated intersections
- Parking lot and multi – storied parking garages
- Road network inventory – Design and coding of transportation planning survey.