# AKTU B.E./B.Tech CIVIL Sem 6 syllabus

## Transportation Engineering

### KCE 062 TRANSPORTATION ENGINEERING

### Credit – 4

### Unit 1
Introduction: Role of Transportation, Modes of Transportation History of road development, Road types and pattern, Nagpur road plan, Bombay road plan & 3rd 20 Year Road Plan, Highway Alignment & Location Survey: Horizontal Profile, Vertical Profile, Factors Controlling the alignment, Survey for route location,

### Unit 2
Geometric Design(IRC:73-Latest revision): Cross sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vertical curves, summit and valley curves.

### Unit 3
Traffic Engineering: Traffic Characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, accident study , traffic capacity, density, traffic control devices: signs, Island, signal design by Webster’s and IRC method . Intersection at grade and grade separated intersections, design of roundabouts as per IRC:65-2017.Highway capacity and level of service of rural highways and urban roads as per latest IRC recommendation

### Unit 4
Highway Materials: Properties of Subgrade, Aggregates & Binding materials, Various tests and specifications, Design of Highway Pavement : Types of Pavements, Design factors,Design of bituminous paving mixes; Design of Flexible Pavement by CBR method (IRC : 37-Latest revision), Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement

design (IRC:58-2015)

**Unit 5**

Highway Construction: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction,

Note: All designs and procedure are to be done with reference to latest revision of IRC as given below in reference section

**Text Book:**

1. Khanna S. K., Justo C.E.G, & Veeraragavan, A. “Highway Engineering”, Nem Chand and Bros., Roorkee- 247 667.
2. Khanna S. K., Justo C.E.G, & Veeraragavan A., “Highway Materials and Pavement Testing”, Nem Chand and Bros., Roorkee- 247 667.

**References:**

1. Kadiyali L. R., & Lal, N.B. “Principles and Practices of Highway Engineering (including Expressways and Airport Engineering)”, Khanna Publications, Delhi – 110 006
2. Saxena, Subhash C, A Textbook of Highway and Traffic Engineering, CBS Publishers & Distributers, New Delhi
3. Kumar, R Srinivasa, “A Text book of Highway Engineering”, Universities Press, Hyderabad.
4. Kumar, R Srinivasa, “Pavement Design”, Universities Press, Hyderabad.
5. Chakraborty Partha & Das Animesh., “Principles of Transportation Engineering”, Prentice Hall (India), New Delhi,
6. IRC : 37- Latest revision, “Tentative Guidelines for the design of Flexible Pavements” Indian Roads Congress, New Delhi
7. IRC:58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision) (with CD)
8. IRC:65-2017 Guidelines for Planning and Design of Roundabouts (First Revision)
9. IRC:73-1980 Geometric Design Standards for Rural (Non-Urban) Highways
10.IRC:106-1990 Guidelines for Capacity of Urban Roads in Plain Areas
11.IRC:93-1985 Guidelines on Design and Installation of Road Traffic Signals.
12.IRC:92-2017 Guidelines for Design of Interchanges in Urban Areas (First Revision)

13.IRC: SP: 68-2005, “Guidelines for Construction of Roller Compacted Concrete Pavements”, Indian Roads Congress, New Delhi.
14.IRC: 15-2002, “Standard Specifications and Code of Practice for construction of Concrete Roads” Indian Roads Congress, New Delhi.
15.MORTH, “Specifications for Road and Bridge Works”, Ministry of Shipping, Road Transport & Highways, Published by Indian Roads Congress, New Delhi.

# Environmental Engineering

### KCE 603 ENVIRONMENTAL ENGINEERING

### Credit – 4

### Unit 1
Fresh water, water demands, variation in demands, population forecasting by various methods, basic needs and factors affecting consumption, design period.
Transmission of water: Various types of conduits, capacity and sizes including economical sizes of rising main, structural requirements; laying and testing of water supply pipelines; pipe materials, joints, appurtenances and valves; leakages and control.

### Unit 2
Storage and distribution of water: Methods of distribution, pressure and gravity distribution systems, Concept of service and balancing reservoirs.
Capacity of distribution reservoirs: general design guidelines for distribution system.

### Unit 3
Physical, chemical and bacteriological examination of water and wastewater: Temperature, pH, colour and odour, solids, nitrogen and phosphorus, chlorides, toxic metals and compounds, BOD, COD etc. quality requirements, standards of water and waste water, disposal of wastewater on land and water bodies.

### Unit 4
Objectives of water treatment: unit operations, processes, and flow sheets.
Water treatment: screening, sedimentation, determination of settling velocity, efficiency of idealsedimentation tank, design of settling tanks, grit chamber.
Primary sedimentation and coagulation, filtration: theory of filtration;

hydraulics of filtration; slow sand, rapid sand and pressure filters, backwashing; design of slow and rapid sand filters.
Disinfection: requirements of an ideal disinfectant; various disinfectants, chlorination and practices of chlorination, water softening and ion-exchange process

**Unit 5**
Objectives of waste water treatment: unit operations, processes, and flow sheets.

Secondary and tertiary treatment: secondary sedimentation and theory of organic matter removal.
Working of activated sludge process, trickling filters; aerated lagoons, waste stabilization ponds, oxidation ditches, rotating biological contactors (RBC).
Anaerobic digestion of sludge: design of low and high rate anaerobic digesters and septic tank.
Working of up flow anaerobic sludge blanket (UASB) reactor and other emerging technologies for wastewater treatment

**Text Books:**
1. Peavy, Howard S., Rowe, Donald R and Tchobanoglous, George, “Environmental Engineering” McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Metcalf & Eddy “Wastewater Engineering: Treatment & Reuse”, Tata Mc-Graw Hill.
3. Garg, S.K.: Water Supply Engineering (Environmental Engineering Vol. – I)
4. Garg, S.K.: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol.–II).
4. Garg: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol. – II).
5. Davis, M.L. & Cornwell, D.A.: Introduction to Environmental Engineering, Mc-Graw Hill.

**References:**
1. Manual on Water Supply and Treatment, C. P. H. E. E. O.,Ministry of Urban Development, Government of India, New Delhi
2. Manual on Sewerage and Sewage Treatment, C. P. H. E. E. O.,Ministry of Urban Development, Government of India, New Delhi
3. Steel and McGhee: Water Supply and Sewerage
4. Fair and Geyer: Water Supply and Wastewater Disposal
5. Hammer and Hammer Jr.: Water and Wastewater Technology
6. Raju: Water Supply and Wastewater Engineering

7. Rao: Textbook of Environmental Engineering
8. Davis and Cornwell: Introduction to Environmental Engineering
9. Kshirsagar: Water Supply and Treatment and Sewage Treatment Vol. I and II
10. Punmia: Water Supply and Wastewater Engineering Vol. I and II
11. Birdie: Water Supply and Sanitary Engineering
12. Ramalho: Introduction to Wastewater Treatment Processes
13. Davis Mackenzie L., Cornwell, David A., “Introduction to Environmental Engineering” McGraw Hill Education (India) Pvt. Ltd., New Delhi.
14. Birdie: Water Supply and Sanitary Engineering
15. Ramalho: Introduction to Wastewater Treatment Processes
16. Parker: Wastewater Systems Engineering

# Foundation Design

### KCE 064 FOUNDATION DESIGN

**Credit – 3**

**Unit 1**

Introduction to soil exploration, methods of boring and drilling, soil sampling and sampler, in- situ tests, SPT, CPT, DCPT, geophysical methods; soil resistivity methods seismic refraction methods.

**Unit 2**
Bearing capacity of shallow foundation, design criteria, factors affecting bearing capacity, factors influencing selection of depth of foundation, modes of shear failures, types of shallow foundations, contact pressure under rigid and flexible footings, Terzaghi’s, Meyerhof, Hansen’s bearing capacity theories, IS code method Settlement of shallow foundations: components of settlement & its estimation, immediate, consolidation, & differential settlements.

**Unit 3**
Design of shallow foundation; principles of design of footing, design of isolated footings and strip footing.
Deep foundation; introduction, necessity of deep foundations, pile installation, pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, single and double under reamed piles.

**Unit 4**

Introduction, shapes and characteristics of wells, components of well foundation, forces acting on well foundation, sinking of wells, causes and remedies of tilts and shifts.
Retaining walls: introduction, types of retaining structures, support systems for flexible retaining walls (struts, anchoring), construction methods, introduction and uses of sheet piles.

**Unit 5**

Geotechnical properties of reinforced soil, use of soil reinforcement, shallow foundation on soil with reinforcement, design considerations, idealized soil, foundation and interface behaviour, elastic models of soil behaviour.

**Reference Books:**
1) Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi
2) Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
3) Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
4) Joseph E. Bowles: Foundation analysis and design.McGraw-Hill Higher Education
5) Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
6) Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi
7) B.C. Punamia; Soil Mechanics & Foundation Engineering; Laxmi Pub. Pvt. Ltd., Delhi.
8) V. N. S. Murthy; Soil Mechanics & Foundation Engineering; Sai Kripa Technical Consultants, Banglore
9) P. Purushothama Raj; Soil Mechanics and Foundation Engineering; Pearson Education.
10) I.H. Khan – Text Book of Geotechnical Engineering
11) C. Venkataramaiah – Geotechnical Engineering
12) Shenbaga R Kaniraj- Design Aids in Soil Mechanics and Foundation Engineering
13) Gulati, S.K., “Geotechnical Engineering” McGraw Hill Education (India), Pvt. Ltd., Noida.

# DESIGN OF CONCRETE STRUCTURE

### KCE 601 DESIGN OF CONCRETE STRUCTURE

**Credit – 4**

**Unit 1**
Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress Method. Assumptions in Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams by Limit State Design Method.

**Unit 2**
Behaviour of RC beam in Shear, Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, design of beam in shear.
Introduction to development length, Anchorage bond, flexural bond. (Detailed Examples by Limit State Design Method), Failure of beam under shear, Concept of Equivalent Shear and Moments.

**Unit 3**
Design of one way, One way continuous and cantilever solid slabs by Limit State Design Method, Design of Dog-legged staircases.
Design of two way slabs by limit state method, Serviceability Limit States, Control of deflection, cracking and vibrations.

**Unit 4**
Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uni-axial bending, Design of columns under bi-axial loading by Design Charts.

**Unit 5**
Structural behaviour of footings, Design of isolated footings, combined rectangular and trapezoidal footings by Limit State Method, Design of strap footings.
Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of cantilever retaining wall by Limit State Method.

**References**
1. IS: 456 – 2000.
2. Reinforced Concrete Design by S. U. Pillai& D. Menon, Tata Mc.-Graw, New Delhi
3. Reinforced Concrete – Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee.

4. Reinforced Concrete Vol. - II by H.J. Shah, Charotar Publisher, Gujarat.
5. RCC Designs (Reinforced Concrete Structures) by B.C. Punmia, Ashoka Kumar Jain and Arun Kumar Jain, Laxmi Publishers, New Delhi.
6. Reinforced Concrete Structures by R. Park and Pauley.
7. Reinforced Concrete Design by P. Dayaratnam.
8. Reinforced Concrete Design by M.L. Gambhir
9. Reinforced Concrete Design by S.N. Sinha , TMH
10. Plain and Reinforced Concrete Vol. I & II by O.P. Jain & Jai Krishna, Nem Chand & Bros.
11. SP-16: Design Aid to IS- 456.

# COMPUTER BASED NUMERICAL TECHNIQUES

## KOE 065: COMPUTER BASED NUMERICAL TECHNIQUES

**Unit 1 Error and roots of Algrabraic and Transcendental Equations:** Introduction of Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation. Solution of Algebraic and Transcendental Equation: Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding real and complex roots, Muller's method, Rate of convergence of Iterative methods, Polynomial Equations.

**Unit 2 Interpolation:** Introduction Finite Differences, Difference tables Polynomial Interpolation: Newton's forward and backward formula Central Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula. Interpolation with unequal intervals: Lagrange's Interpolation, Newton Divided difference formula, Hermite's Interpolation.

**Unit 3 Numerical Integration and Differentiation:** Introduction: Numerical differentiation of Newton's forward and backward formula, Stirling's, Bessel's, Everett's formula, Lagrange's Interpolation and Newton Divided difference formula. Numerical Integration: Newton cotes formula, Trapezoidal rule, Simpson's 1/3 and 3/8 rules, Boole's rule, Waddle's rule.

**Unit 4 Solution of differential Equations:** Introduction, Picard's Method, Euler's Method, Taylor's Method, Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring and Stability of solution.

**Unit 5 Boundary Value problems:** Introduction, Finite difference method, solving Eigen value problems, polynomial method and power methods. Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs. Distillation in a Plate Column, Unsteady-state Operation, Starting a Stirred-tank Reactor, Rate at which a Plate Absorber Approaches Steady State.

**Text Books:**

1. Jain, Iyengar and Jain, “Numerical Methods for Scientific and Engineering Computations”, New Age International.
2. Grewal B S, “Numerical methods in Engineering and Science”, Khanna Publishers, Delhi.

**Reference Books**

1. Rajaraman V, Computer Oriented Numerical Methods, Pearson Education
2. T Veerarajan, T Ramachandran, “Theory and Problems in Numerical Methods, McGraw Hill
3. Pradip Niyogi, Numerical Analysis and Algorithms, McGraw Hill.
4. Francis Scheld, Numerical Analysis, McGraw Hill.
5. Sastry S. S, Introductory Methods of Numerical Analysis, Pearson Education.
6. Kiusalaas, J.: Numerical methods in engineering with MATLAB, Cambridge University Press
7. Woodford, C and Phillips, C: Numerical methods with worked examples: MATLAB Edition, Springer

# CONSTITUTION OF INDIA, LAW AND ENGINEERING

## KNC501 CONSTITUTION OF INDIA, LAW AND ENGINEERING

**Module 1-Introduction and Basic Information about Indian Constitution:**

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local

Self Government – Constitutional Scheme in India.

**Module 2-Union Executive and State Executive:**
Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

**Module 3- Introduction and Basic Information about Legal System:**
The Legal System: Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration. Contract law, Tort, Law at workplace.

**Module 4-Intellectual Property Laws and Regulation to Information:**
Intellectual Property Laws- Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information- Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act.

**Module 5 -Business Organizations and E-Governance:**
Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up. E-Governance and role of engineers in E-Governance, Need for reformed engineering

serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

**Suggested Readings:**


• Brij Kishore Sharma: Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
• Granville Austin: The Indian Constitution: Cornerstone of a Nation. 1966, Oxford Clarendon Press.
• Subhash C. Kashyap: Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT, 2018.
• PM Bakshi: The Constitution of India, Latest Edition, Universal Law Publishing.
• V.K. Ahuja: Law Relating to Intellectual Property Rights (2007)
• Suresh T. Viswanathan: The Indian Cyber Laws, Bharat Law House, New Delhi-88
• P. Narayan: Intellectual Property Law, Eastern Law House, New Delhi
• Prabudh Ganguli: Gearing up for Patents: The Indian Scenario, Orient Longman.
• BL Wadehra: Patents, Trademarks, Designs and Geological Indications.Universal Law Publishing - LexisNexis.
• Intellectual Property Rights: Law and Practice, Module III by ICSI (only relevant sections)
• Executive programme study material Company Law, Module II, by ICSI (The Institute of Companies Secretaries of India) (Only relevant sections i.e., Study 1, 4 and 36).https://www.icsi.edu/media/webmodules/publications/Company%20
• Handbook on e-Governance Project Lifecycle, Department of Electronics & Information Technology, Government of India, https://www.meity.gov.in/writereaddata/files/e-Governance_Project_Lifecycle_Participant_Handbook-5Day_CourseV1_20412.pdf

• Companies Act, 2013 Key highlights and analysis by PWC.https://www.pwc.in/assets/pdfs/publications/2013/companies-act-2013-key-highlights-and-analysis.pdf