

**DR. A.P.J ABDUL KALAM TECHNICAL UNIVERSITY,  
LUCKNOW**



**EVALUATION SCHEME & SYLLABUS**

**FOR**

**B. TECH. THIRD YEAR**

**(CIVIL ENGINEERING)**

**On**

**Choice Based Credit System  
[Effective from session 2018-19]**

## FIFTH SEMESTER

Sl No.	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
						ESE	CT TA.		
1	RAS501	MANEGIRIAL ECONOMICS	Applied Science	3—0---0	70	20	10	100	3
2	RAS-502/ RUC501	SOCIOLOGY /CYBER SECURITY	Applied Science	3—0---0	70	20	10	100	3
3	RCE501	GEOTECHNICAL ENGINEERING	Core Deptt.	3—0---0	70	20	10	100	3
4	RCE502	DESIGN OF STRUCTURE-I	Core Deptt.	3—1---0	70	20	10	100	4
5	RCE503	QUANTITY ESTIMATION AND MANAGEMENT	Core Deptt.	3—0---0	70	20	10	100	3
6	RCE051 RCE052 RCE053	<b>ELECTIVE -1</b> MODERN CONSTRUCTION MATERIALS CONCRETE TECHNOLOGY GEOENVIRONMENTAL	Core Deptt.	3—1--0	70	20	10	100	4

## CIVIL ENGINEERING

		ENGINEERING							
7	RCE551	GEOTECHNICAL ENGINEERING LAB	Core Deptt.	0—0---2	50		50	100	1
8	RCE552	CAD LAB-1	Core Deptt.	0—0---2	50		50	100	1
9	RCE553	CONSTRUCTION MANAGEMENT LAB	Core Deptt.	0—0---2	50		50	100	1
10	RCE554	CONCRETE LAB	Core Deptt.	0—0---2	50		50	100	1
	<b>TOTAL</b>				620	120	260	<b>1000</b>	<b>24</b>

**SESSION 2018-19**

## **RCE 501 GEOTECHNICAL ENGINEERING**

**(L-T-P 3-0-0) Credit - 3**

### **Unit 1**

Origin and classification: Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition, Basic definitions, Weight volume relationships, Clay minerals, Soil structure, Index properties, sensitivity and thixotropy, Particle size analysis, Unified and Indian standard soil classification system. **[8]**

### **Unit 2**

Soil Hydraulics: Stress conditions in soil- total, effective and neutral stresses and relationships. Permeability - Darcy's Law, hydraulic conductivity, equivalent hydraulic conductivity in stratified soil. Seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition, uplift pressure, piping; **[8]**

### **Unit 3**

Soil compaction, water content – dry unit weight relationships. Factors controlling compaction. Field compaction equipment; field compaction control; Proctor needle method. Consolidation: Primary and secondary consolidation, Terzaghi's one dimensional theory of consolidation, Consolidation test, Normal and Over Consolidated soils, Over Consolidation Ratio, determination of coefficient of consolidation, Contact pressure **[8]**

### **Unit 4**

Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination; direct and tri-axial shear test; unconfined compression test; pore pressure, Skempton's pore pressure coefficients. Earth pressure: Classical theories, Coulomb and Rankine's approaches for frictional and  $c-\phi$  soils, inclined backfill, Graphical methods of earth pressure determination, Stability of slopes, Culman method & Method of slices, Stability number & chart. **[8]**

### **Unit 5**

Sub surface structure: Bearing capacity of shallow foundations, SPT, Plate load test; Effect of water table. Deep foundations: Types of piles, Static and dynamic formulae, Pile group, Settlement of Pile Group, Negative skin friction. **[8]**

### **Text & References Books**

1. V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)
2. K.R. Arora – Soil Mechanics and Foundation Engineering
3. Narasinga Rao, B.N.D, "Soil Mechanics & Foundation Engineering", John Wiley & Sons, Wiley India Pvt. Ltd., Daryaganj, New Delhi – 110 002.

4. Alam Singh – Modern Geotechnical Engineering
5. Brij Mohan Das – Geotechnical Engineering , CENGAGE Learning
6. I.H. Khan – Text Book of Geotechnical Engineering
7. C. Venkataramaiah – Geotechnical Engineering
8. Gopal Ranjan and A.S.R. Rao – Basic and Applied Soil Mechanics
9. G.V. Rao & G.V.S.S. Raju – Engineering with Geosynthetics
10. P. Purushottam Raj- Soil Mechanics and Foundation Engineering, Pearson Education in South Asia, New Delhi.
11. Shenbaga R Kaniraj- Design Aids in Soil Mechanics and Foundation Engineering
12. Gulati, S.K., “Geotechnical Engineering” McGraw Hill Education (India), Pvt. Ltd., Noida.

## **RCE 502 DESIGN OF STRUCTURE 1**

**(L-T-P 3-1-0) Credit- 4**

### **Unit – 1**

Analysis of fixed beams, Continuous beams and simple frames with and without translation of joint by Slope-Deflection method, Moment Distribution method and Strain Energy method. **[8]**

### **Unit – 2**

Muller-Breslau’s Principle and its applications for drawing influence lines for indeterminate beams, Analysis of two hinged and fixed arches, Influence line diagrams for maximum bending moment, Shear force and thrust in two hinge arches. Analysis of two and three hinged stiffening girders. **[8]**

### **Unit – 3**

Introduction to Suspension Bridges, Analysis of two and three hinged stiffening girders, Influence line diagrams for maximum bending moment and shear force for stiffening girders. **[8]**

### **Unit – 4**

Basic Force and Displacement Matrix method for analysis of beams, frames and trusses. **[8]**

### **Unit – 5**

Basics of Plastic Analysis. Applications of Static and Kinematic theorem for Plastic Analysis of Beams and Single Storied Frames. **[8]**

## **References:**

1. Jain, A. K., “Advanced Structural Analysis “, Nem Chand & Bros., Roorkee.
2. Hibbeler, R.C., “Structural Analysis”, Pearson Prentice Hall, Sector - 62, Noida-201309
3. C. S. Reddy “Structural Analysis”, Tata Mc Graw Hill Publishing Company Limited, New Delhi.

4. Timoshenko, S. P. and D. Young, "Theory of Structures", Tata Mc-Graw Hill Book Publishing Company Ltd., New Delhi.
5. Dayaratnam, P. "Analysis of Statically Indeterminate Structures", Affiliated East-West Press.
6. Wang, C. K. "Intermediate Structural Analysis", Mc Graw-Hill Book Publishing Company Ltd.
7. Thandavamoorthy, T.S., "Structural Analysis" Oxford University Press, New Delhi.
8. Martin, H. C. "Introduction to Matrix Methods of Structural Analysis", Mc-Graw Hill Book Publishing Company Ltd, New Delhi.
9. Mau, "Introduction to Structural Analysis" CRC Press Taylor & Francis Group.
10. Ghali, "Structural Analysis: A Unified Classical and Matrix Approach" 5/e, CRC Press Taylor & Francis Group.
11. Wilbur and Norris, "Elementary Structural Analysis", Tata McGraw Hill.
12. Vazirani & Ratwani et al, "Analysis of Structures", Khanna Publishers
13. Coates, RC, Coutie, M.G. & Kong, F.K., "Structural Analysis", English Language Book Society & Nelson, 1980.
14. SP Gupta & Gupta "Theory of Structure Vol.1 & 2" TMH
15. DS Prakash Rao "Structural Analysis: A Unified Approach" Universities Press.
16. S Ramamurtham "Theory of Structure" Dhanpat Rai.
17. Devdas Menon "Advanced Structural Analysis" Narosa
18. Hsieh, "Elementary Theory of Structures" 4/e, Pearson Education, Noida.
19. Mckenzie, "Examples in Structural Analysis" 2/e, CRC Press Taylor & Francis Group.
20. R Agor, Structural Analysis, " Khanna Book Publishing.
21. Jacques Heyman, "Structural Analysis" Cambridge University Press.

## **RCE 503 QUANTITY ESTIMATION & MANAGEMENT (L-T-P 3-0-0) Credit - 3**

### **UNIT I: Quantity Estimation for Buildings**

Measurement units for various building materials, Centreline method, Long and short wall method of estimates, PWD schedule of rate, Delhi schedule of rate. **[8]**

### **UNIT II: Rate Analysis, Specification and Tenders**

Analysis of rates knowing cost of material, labour, equipment, overheads, profit, taxes etc, Specifications – Preparation of detailed and general specifications, Legal aspects of contracts, laws related to contracts, land acquisition, labour safety and welfare. Different types of contracts, their relative advantages and disadvantages. Elements of tender preparation, process of tendering, pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract extra items. **[8]**

### **UNIT III: Elements of Management & Network Techniques**

Project cycle, Organization, planning, scheduling, monitoring, updating and management system

in construction, Bar charts, milestone charts, work break down structure and preparation of networks. Network Techniques like PERT & CPM in construction management. Project monitoring and resource allocation through network techniques. [8]

#### **UNIT IV: Equipment Management**

Productivity, operational cost, owning and hiring cost and the work motion study. Simulation techniques for resource scheduling. Construction Equipment for earth moving, earth compaction, Hauling Equipment, Hoisting Equipment, Conveying Equipment, Concrete Production Equipment, Tunnelling Equipment [8]

#### **UNIT V: Project Cost Management**

Budgeting, Cost planning, Direct Cost, Indirect cost, Total Cost Curve, Cost Slope. Time value of money, Present economy studies, Equivalence concept, financing of projects, economic comparison, present worth method Equivalent annual cost method, discounted cash flow method, Depreciation and break even cost analysis. [8]

#### **References:**

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003
2. Srinath, L.S., "PERT and CPM Principles and applications" Affiliated East-West Press Pvt. Ltd., New Delhi.
3. Patil, B.S., "Civil Engineering Contracts and Estimates" University Press India, Pvt. Ltd. Hyderabad –500 004
4. Construction Management by Ojha
5. Srivastava, U.K., "Construction Planning and Management", Galgotia Publications Pvt. Ltd., New Delhi.
6. Construction Technology by Sarkar, Oxford
7. Delhi Schedule of Rates (latest version)
8. S V Deodhar and SC Sharma, "Costruction Engineering and Management, Khanna Publishing house.

### **RCE 051      MODERN CONSTRUCTION MATERIALS      (L-T-P 3-0-0)      Credit - 3**

#### **Unit – 1**

Introduction, properties and uses of modern building materials: fly ash bricks, soil - cement blocks, calcium silicate bricks, red mud jute fibre polymer composite (RFPC) , glass reinforced gypsum. [8]

#### **Unit – 2**

Introduction , properties and use of: geosynthetics, bituminous material, fire resistant materials (chemicals ,paints ,tiles ,bricks, glass),metals, light - weight concrete, mass concrete, waste material based concrete. [8]

### **Unit – 3**

Introduction , properties and use of: Ferro cement & fibre reinforced concrete, different types of fibres, high density concrete, Nuclear concrete, heat resisting & refractory concretes, pre fabricated systems. [8]

### **Unit – 4**

Introduction , properties and use of: Polymers, fibre reinforced polymers, polymer concrete composites (PCCs), sulphur concrete and sulphur - infiltrated concrete. [8]

### **Unit – 5**

Introduction , properties and use of: Conventional and modern water proofing materials, Conventional and modern insulating materials( thermal, sound and electrical insulating materials).Concept of polymer floor finishes. [8]

### **Reference Book:**

- 1) Ghambhir M.L."Concrete Technology" Tata McGraw Hill education private Limited.
- 2) A.R. Santhakumar, Concrete Technology, Oxford University Press.
- 3) Building Materials, P.C. Varghese, Prentice-Hall India.
- 4) Shetty, M. S., "Concrete Technology" S. Chand Publication.
- 5) Krishnaraju .N., Advanced Concrete Technology, CBS Published.
- 6) Materials Science and Engineering: An introduction, W.D. Callister, John Wiley.
- 7) Neville. A.M., Concrete Technology, Prentice Hall, Newyork.
- 8) Dr. U. K. Shrivastava, Building Materials Technology, Galgotia Publication pvt.ltd.
- 9) Materials Science and Engineering, V. Raghavan, Prentice Hall.
- 10) Properties of Engineering Materials, R.A. Higgins, Industrial Press.
- 11) Construction materials: Their nature and behaviour, Eds. J.M. Illston and P.L.J. Domone, 3rd ed., Spon Press.
- 12) The Science and Technology of Civil Engineering Materials, J.F. Young, S. Mindess, R.J. Gray & A. Bentur, Prentice Hall.
- 13) Engineering Materials 1: An introduction to their properties & applications, M.F. Ashby and D.R.H. Jones, Butterworth Heinemann.
- 14) The Science and Design of Engineering Materials, J.P. Schaffer, A. Saxena, S.D. Antolovich, T.H. Sanders and S.B. Warner, Irwin.
- 15) Concrete: Microstructure, properties and materials, P.K. Mehta and P.J.M. Monteiro, McGraw Hill.
- 16) S K Sharma, "Civil Engineering and construction material," Khanna Publuishing House.
- 17) Properties of concrete, A.M. Neville, Pearson.

**Unit I**

Cement: production, composition properties, types and cement chemistry. Introduction to supplementary cementitious materials. Aggregates: mineralogy, properties, test and standards. Quality of water for use in concrete. **[8]**

**Unit II**

Introduction & study of accelerators, retarders, water reducers, air entrainers, water proofers, super plasticizers. Study of supplementary cementing materials like fly ash, silica fume, ground granulated blast furnace slag, metakaoline and pozzolana; their production, properties and effect on concrete properties. **[8]**

**Unit III**

Principle of mix proportioning, properties related to mix design, Mix design method (IS method and ACI method). Mix design of concrete: packing density, Rheology, mix design examples. **[8]**

**Unit IV**

Concrete production, batching, mixing and transportation of concrete. Workability: test for workability of concrete (slump test, compacting factor test and Vee Bee test). Segregation and bleeding in concrete, curing of concrete and its methods. Determination of compressive and flexural strength as per BIS. Mechanical properties of concrete: elastic modulus, Poisson's ratio, creep, shrinkage and durability of concrete. **[8]**

**Unit V**

Study and uses of high strength concrete, self compacting concrete, fiber reinforced concrete, ferro cement, ready Mix Concrete, recycled aggregate concrete and status in India. **[8]**

**References**

1. Neville, A.M. and Brooks, J.J., "CONCRETE TECHNOLOGY", ELBS.
2. Shetty, M.S, "Concrete Technology, Theory and Practice", S. Chand and Company Ltd, New Delhi, 2008.
3. Gambhir, M.L, "Concrete Technology", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2004.
4. Santha kumar, A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007.
5. Gupta B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
6. Newman, K., "CONCRETE SYSTEMS in COMPOSITE MATERIALS".EDT BY L.Holliday. Elsevier Publishing Company. 1966.
7. Popovics. S., "FUNDAMENTALS OF PORTLAND CEMENT CONCRETE: A Quantitative Approach VOL 1 FRESH CONCRETE" JOHN WILEY & SONS.1982.



## **Text**

1. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
2. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
3. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
4. Mitchell, J. K., "Fundamentals of Soil Behaviour" Wiley, 2005.
5. Hillel D., "Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
6. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
7. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.

## **References**

1. Hillel D., "Introduction to Soil Physics" Academic Press, New York, 1982.
2. Sparks, D.L., "Environmental Soil Chemistry" Academic Press, New York, 2002.
3. Bagchi, A., "Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.
4. O.P. Gupta, Elements of Environmental Chemistry, Khanna Publishing House
5. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water-Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
6. Berkowitz, B. Dror, I. and Yaron, B., "Contaminant Geochemistry" Springer, Germany, 2008.
7. Mohamed, A. M. O., "Principles and Applications of Time Domain Electrometry in Geoenvironmental Engineering" Taylor and Francis, New York, 2006.
8. O P Gupta, Elements of land and soil pollution, Khanna Publishing House

## **RCE-551 GEOTECHNICAL ENGINEERING LAB (L-T-P 0-0-2) Credit- 1**

1. Determination of water content of a given moist soil sample by (i) oven drying method, (ii) pycnometer method.
2. Determination of specific gravity of a given soil sample by (i) density bottle, (ii) pycnometer method.
3. Determination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand replacement method.
4. Determination of relative density of a given soil sample.
5. Determination of complete grain size distribution of a given soil sample by sieve analysis and sedimentation (hydrometer) analysis.
6. Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample used in experiment no. 5 (grain-size analysis).
7. Determination of shear strength of soil by Direct shear test.

8. Determination of compaction characteristics (OMC & MDD) of a given soil sample.
9. Determination of permeability of a remoulded soil sample by constant head &/or falling head method.
10. Determination of consolidation characteristics of a remoulded soil sample by an odometer test.
11. Determination of shear strength characteristics of a given soil sample by U/U test from Tri-axial Compression Machine.
12. Retrieving soil samples and conducting SPT tests by advancing boreholes through hand-held auger.

**Note: Any 8 experiments are to be performed from the list of experiments.**

**References:**

1. Bowles, Joseph E., "Engineering Properties of Soil and Their Measurement" Fourth Edition, Indian Edition, McGraw Hill Education (India) Pvt. Ltd, New Delhi-110032.

**RCE 552 CAD LAB 1**

**(L-T-P0-0-2) Credit- 1**

1. Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS , ADINA , NISA, MATLAB
2. Working on Latest Version of DESIGN SOFTWARE LIKE STAAD PRO / STRUDS / SAP / ETAB / STRAP
3. Working on Latest Version of GEOTECHNICAL SOFTWARES like GEO-5 / PLAXIS

**RCE 553 CONSTRUCTION MANAGEMENT LAB**

**(L-T-P 0-0-2) Credit-1**

1. Estimation of quantities for any one of the following: Building/ Septic tank/Water supply pipe line/road/bridge.
2. Preparation of Bill of Quantities (BOQ) for above project.
3. Practice of MS Project/Primavera software for same problem.
4. Study of any full set of tender documents (Institute shall provide the set from ongoing/completed tenders).

These exercises will be done through use of software and spread in 8-10 classes.

**References:**

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003
2. Srinath, L.S., "PERT and CPM Principals and applications" Affiliated East-West Press Pvt. Ltd., New Delhi.

3. Patil, B.S., "Civil Engineering Contracts and Estimates" University Press India, Pvt. Ltd. Hyderabad –500 004
4. Construction Management by Ojha
5. Srivastava, U.K., "Construction Planning and Management", Galgotia Publications Pvt. Ltd., New Delhi.
6. Construction Technology by Sarkar, Oxford
7. S V Deodhar and SC Sharma, " Construction engineering and Management", Khanna Publishing House.
7. Delhi Schedule of Rates (latest version)

### **RCE 554 CONCRETE LAB**

**(L-T-P 0-0-2) Credit- 1**

1. Study of IS codes for (i) Aggregates (ii) Cements (iii) Admixtures (iv) Fly ash
2. Concrete Mix design computation by ACI 211.1-91 method, IS code method as per 10262-2007 & 456-2000, DOE method for given sample.
3. Preparation and testing of samples as per any one of the above mentioned computations (Minimum grade of concrete is M30)
4. Tests on Concrete- (a) Workability tests - Slump cone test, compaction factor test, Vee-bee consistometer test, flow table test. (b) Strength tests- compressive strength, flexural strength, split tensile strength.
5. Effects of Admixture - Accelerator, Retarder, Super Plasticizer.
6. Non destructive Testing - Rebound Hammer test, Ultrasonic Pulse Velocity test.

#### **References:**

1. Concrete Technology – A.M. Neville & J. J. Brooks , Pearson
2. Concrete Technology Theory & Practice-M.S. Shetty, S. Chand Publishers
3. Concrete Technology Theory & Practice-M.L. Gambhir, TMH Publishers
4. IS:10262-2009-Concrete Mix Proportioning Guidelines

**SIXTH SEMESTER**

**CIVIL ENGINEERING**

**SESSION 2018-19**

Sl No	Subject Code	Subject Name	Teaching Deptt.	L-T-P	Th/Lab Marks	Sessional		Total	Credit
					ESE	CT	TA.		
1	RAS601	INDUSTRIAL MANAGEMENT	Applied Science	3—0---0	70	20	10	100	3
2	RUC601/ RAS602	CYBER SECURITY/SOCIOLOGY	Applied Science	3—0---0	70	20	10	100	3
3	RCE601	DESIGN OF STRUCTURE-II	Core Deptt.	3—0---0	70	20	10	100	3
4	RCE602	ENVIRONMENTAL ENGINEERING	Core Deptt.	3—1---0	70	20	10	100	4
5	RCE603	TRANSPORTATION ENGINEERING	Core Deptt.	3—0---0	70	20	10	100	3
6	RCE061 REC062  RCE063	<b>ELECTIVE -2</b> FOUNDATION DESIGN INTEGRATED WASTE MANAGEMENT FOR A SMART CITY GEOSYNTHESIS AND REINFORCED SOIL STRUCTURES	Core Deptt.	3—1---0	70	20	10	100	4
7	RCE651	CAD LAB-2	Core Deptt.	0—0---2	50		50	100	1
8	RCE652	ENVIRONMENTAL ENGINEERING LAB	Core Deptt.	0—0---2	50		50	100	1
9	RCE653	TRANSPORTATION ENGINEERING LAB	Core Deptt.	0—0---2	50		50	100	1
10	RCE 654	STRUCTURAL DETAILING LAB	Core Deptt.	0—0---2	50		50	100	1
	<b>TOTAL</b>				620	120	260	<b>1000</b>	<b>24</b>

**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. **[8]**

**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. **[8]**

**Unit – 3**

Design of one way, One way continuous and cantilever solid slabs by Limit State Design Method, Design of RCC staircases.

Design of lintels and chajjas. Design of two way slabs by limit state method, Serviceability Limit States, Control of deflection, cracking and vibrations. **[8]**

**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. **[8]**

**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. **[8]**

**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.

## **RCE 602 ENVIRONMENTAL ENGINEERING**

**(L-T-P 3-1-0) Credit - 4**

### **Unit-I**

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. **[8]**

### **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. **[8]**

### **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. **[8]**

### **Unit-4**

Objectives of water treatment: unit operations, processes, and flow sheets.

Water treatment: screening, sedimentation, determination of settling velocity, efficiency of ideal sedimentation 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 **[8]**

### **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 **[8]**

**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. M. P. Poonia and SC Sharma: Environmental Engineering, kahanna publishing house
4. Keshav Kant, "Air Pollution Control Engineering", Khanna Publishing House
5. OP Gupta, Elements of Environmental Polluton Control, Khanna Publication
6. 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
17. A.K. Jain, Environmental Engineering, Khanna Publishing House

**RCE 603 TRANSPORTATION ENGINEERING****(L-T-P 3-0-0) Credit- 3****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, [8]

**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. [8]

### **UNIT-3**

Traffic Engineering: Traffic Characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, 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 **[8]**

### **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) **[8]**

### **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, Roller Compacted Concrete Roads. **[8]**

**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.
3. LR Kadiyali, Transportation Engineering, Khanna Publication.

#### **References:**

1. L.R. Kadiyali, Transportation Engineering, Khanna Publishing House
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.

**RCE 061      FOUNDATION DESIGN      ( L-T-P 3-0-0)      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. **[8]**

**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. **[8]**

**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. **[8]**

#### **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. [8]

#### **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. [8]

#### **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, Bangalore
- 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.

### **RCE 062 INTEGRATED WASTE MANAGEMENT FOR A SMART CITY**

**(L-T-P 3-0-0) Credit - 3**

#### **Unit-1**

**Introduction:** Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements of a waste management system, Current Issues in Solid Waste Management, Integrated Waste Management Hierarchy: Source reduction, Recycling, Waste-to-Energy and Land filling. Review of waste management under Swachh Bharat Mission and Smart Cities Program. [8]

#### **Unit-2**

**Municipal Solid Waste:** Waste Composition and Quantities, Collection, Transportation, Segregation, and Processing. [8]

### **Unit-3**

Disposal of Municipal Solid Waste: Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste. Municipal Solid Waste (MSW) Rules 2016. [8]

### **Unit-4**

**Construction and Demolition (C&D) Waste Management:** Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials. [8]

### **Unit-5**

**Electronic Waste (E-Waste) Management** – Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.

**Hazardous Wastes:** Definition, Classification, Risk assessment, Transportation of hazardous waste, Current Management Practices: Environmental audit, Containment, Remedial alternatives. [8]

### **Books:**

1. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill
2. Ramachandra T.V., *Management of Municipal Solid Waste*, 2009; by The Energy and Resource Institute, TERI
3. Sasikumar, K, Gopi Krishna, Sanoop, *Solid Waste Management*; 2009, PHI.

### **References:**

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization(CPHEEO), India
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.
5. O P Gupta, " Element of Solid waste hazardous management, Khanna Publishing house.
6. Freeman, M. H.1988. Standard Handbook of Hazardous Waste Treatment and Disposal, McGraw-Hill Book Company, New York
7. <http://swachhbharatmission.gov.in/sbmcms/index.htm>
8. <http://swachhbharaturban.gov.in/>

## **RCE 063 GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES**

**(L-T-P 3-0-0) Credit - 3**

### **UNIT 1**

Introduction to Geosynthetics, types of geosynthetics, artificial and natural geosynthetics and their applications, manufacture of geosynthetics, strength of reinforced soils, testing of Geosynthetics. [8]

### **UNIT-2**

Drainage application of geosynthetics , filtration applications of geosynthetics, erosion control using geosynthetics geosynthetic in flexible pavement, introduction to geosynthetics in landfills, geosynthetics for construction of landfills **[8]**

### **UNIT-3**

Sustainable infrastructure development, different types of soil retaining structures, design codes for reinforced soil retaining walls, construction aspects of geosynthetic reinforced soil retaining wall, testing requirements for reinforced soil retaining walls, geosynthetic reinforced soil embankments. **[8]**

### **UNIT-4**

Design of reinforced soil retaining walls – simple geometry, design of reinforced soil retaining walls – sloped backfill soil, soil embankments supported on geocell mattresses, geosynthetic reinforced pile systems for high embankments **[8]**

### **UNIT-5**

Reinforced soil for supporting shallow foundations, response of footings resting on reinforced foundation soils, bearing capacity analysis of footings resting on reinforced foundation soils, carbon footprint analysis **[8]**

## **REFERENCES**

1. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 4th edition, 1999.
2. Jewell, R.A., "Soil Reinforcement with Geotextiles", Special Publication No. 123, CIRIA, Thomas Telford. London, UK, 1996.
3. Geosynthetics - New Horizons, Eds. G.V. Rao, PK Banerjee, J.T. Shahu, G.V. Ramana, Asian Books Private Ltd., New Delhi, 2004.
4. Hoe I. Ling, Guido Gottardi , Daniele Cazzuffi , Jie Han , Fumio Tatsuoka “Design and Practice of Geosynthetic-Reinforced Soil Structures”
5. Sanjay Kumar Shukla, Erol Guler “Advances in Reinforced Soil Structures”

## **RCE 651 CAD LAB- 2**

**(L-T-P 0-0-2) Credit - 1**

1. Working on Latest Version of Environmental Engineering software for Analysis and Design of water & wastewater treatment and distribution systems (WATER CAD / SEWER CAD / WATER GEM / SEWER GEM / LOOP)
2. Working on Latest Version of Transportation Engineering software like MAX ROAD/ Surveying Software.

3. Working on Latest Version of GIS software (ARC GIS / ENVI / GEPSY)

**RCE 652 ENVIRONMENTAL ENGINEERING LAB (L-T-P 0-0-2) Credit -1**

1. Determination of turbidity and conductivity.
2. Determination of pH, alkalinity and acidity.
3. Determination of hardness and chlorides.
4. Determination of residual chlorine.
5. Determination of MPN (most probable number) of coliforms.
6. Measurement of SPM and PM10 with high volume sampler.
7. Measurement of sound level with sound level meter.
8. Determination of total , suspended and dissolved solids.
9. Determination of BOD.
10. Determination of COD.
11. Determination of kjeldahl nitrogen.
12. Determination of fluoride.
13. Determination of optimum dose of coagulants by Jar Test Apparatus.
14. Field Visit of Water/ Sewage Treatment Plant of a nearby area.

**Note: 1. Experiment at S.NO. 14 is mandatory.**

**2. Any 8 Experiments out of the S.NO 1 to 13 are to be performed.**

**References:**

1. A.P.H.A. "Standard Methods for the Examination of Water and Wastewater", American Public Health Association.
2. Sawyer, C.N., McCarty, P.L. & Parkin, G.F. "Chemistry for Environmental Engineering", McGraw Hill.
3. Mathur, R.P. "Water & Wastewater Testing", Lab Manual, Roorkee.
4. O P Gupta, Environmental Chemistry, " Khanna Publishing house.

**RCE 653 TRANSPORTATION ENGINEERING LAB (L-T-P 0-0-2) Credit - 1**

1. To Determine the Crushing Value of Coarse Aggregates.
2. To Determine the Impact Value of Coarse Aggregates.
3. To determine the Flakiness Index and Elongation Index of Coarse Aggregates.
4. To determine the Los Angeles Abrasion Value of Coarse Aggregates.
5. To determine the Stripping Value of Coarse Aggregates.
6. To determine the penetration Value of Bitumen.
7. To determine the Softening Point of Bituminous material.
8. To determine the Ductility Value of Bituminous material.
9. To determine the Flash and Fire Point of Bituminous material.

10. To determine the Stripping Value of Bituminous material.
11. Classified both directional Traffic Volume Study.
12. Traffic Speed Study. (Using Radar Speedometer or Enoscope).
13. Determination of CBR Value of soil sample in the Lab or in Field.

**Note: A minimum of 8 experiments are to be performed from the list of Experiments.**

**References:**

1. Khanna S. K., Justo C.E.G, & Veeraragavan A., “Highway Materials and Pavement Testing”, Nem Chand and Bros., Roorkee- 247 667.
2. Gambhir, M.L., Jamwal, Neha,” Lab Manual: Building and Construction Materials, Testing and Quality Control” McGraw Hill Education (India), Pvt.Ltd., Noida.
3. Duggal, Ajay K., Puri, Vijay P.,” Laboratory Manual in Highway Engineering” New Age International (P) Limited, Publishers, New Delhi.
4. Sood Hemant, Mittal, L.N., Kulkarni,P.D., “ Laboratory Manual on Concrete Technology” CBS Publishers & Distribiters Pvt. Ltd. New Delhi.

**RCE 654 STRUCTURAL DETAILING LAB**

**(L-T-P 0-0-2) Credit - 1**

1. Study of SP34/IS13920/IS456:2000 for detailing of structural elements.
2. Preparation of working hand sketches and Auto CAD drawings for the following-
  - RC Beams- Simply supported, Continuous, Cantilever
  - T – beam / L-beam floor
  - Slabs – Simply supported, Continuous, One way and two way slabs.
  - Columns – Tied Columns and Spirally reinforced columns.
  - Isolated footings for RC Columns.
  - Combined rectangular and trapezoidal footings.
3. Preparation of bar bending schedule
4. Detailing of Buildings with respect to Earthquake Resistant Design
5. Study of full set of structural drawing of a building as made available by Institute.

**References:** Krishna Raju N., “Structural Design and Drawing” University Press (India), Pvt.Ltd., Hyderabad.