

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE  
**(VJTI)**  
MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)



**Curriculum**  
**(Scheme of Instruction & Evaluation and Course contents)**  
(Revision 2018)

For  
Third Year  
of  
Four Year Undergraduate Programmes Leading to  
Bachelor of Technology (B. Tech) Degree in Civil Engineering

**Implemented from the batch admitted in First year, 2018-2019**

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE (VJTI)

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Third Year

of

Four Year Undergraduate Programme Leading to  
Bachelor of Technology (B.Tech)

In

101 Civil Engineering

### **Programme Educational Objectives (PEO)**

1. Develop a professional to pursue career as a Civil Engineer with adequate technical knowledge and skills while using modern tools for problem solving and exhibiting qualities of communication, team membership, and leadership.
2. Develop ability to practice ethically focusing on social relevance, environmental sustainability, optimal solutions and safety of stakeholders.
3. Develop abilities of lifelong learning to continuously strive to enhance decision making abilities to investigate, design and develop complex facilities.

### **Programme Specific Outcomes (PSO)**

1. Able to analyze various Civil Engineering structures and systems by using basic and advanced technologies.
2. Able to design civil engineering facilities and their elements and also use of modern software tools for the same.
3. Able to plan, monitor and supervise construction activities to complete civil engineering facilities satisfactorily.
4. Able to practice as construction professional through ethical practice while focusing on sustainability and economy.

## Programme Outcomes (PO)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Veermata Jijabai Technological Institute (VJTI)**  
**B Tech. Civil Engineering**  
**Scheme of Instruction and Evaluation**

**SEMESTER V**

Scheme of Instruction						Scheme of Evaluation				
Sr. No	Course Code	Course Title	L	T	P	Credits	TA	MST	ESE	ESE hours
1	R4SE3001S	Structural Analysis – II	3	1	0	4	20	20	60	3
2	R4SE3002S	Geotechnical Engineering	3	0	0	3	20	20	60	3
3	R4CE3001S	Hydrology and Water Resource Engineering	3	1	0	4	20	20	60	3
4	R4SE3004T	Concrete Technology	3	0	0	3	20	20	60	3
5	R4CE3002T	Building Drawing and Services	2	0	0	2	20	20	60	3
6	R4HM3001L	Professional Communication Skill	1	0	2	2	60		40	
7	R4CE2010M A	Professional Ethics and Engineering Economics	2	0	0	P/NP				
8	R4SE3004P	Concrete and Soil Laboratory	0	0	2	1	60		40	
9	R4CE3002P	Building Drawing and Services Laboratory	0	0	2	1	60		40	
	Total		17	2	6	20				
	Total Contact Hours		25							

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: Mid Semester Test (One Mid Semester Test), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

**Veermata Jijabai Technological Institute (VJTI)**  
**B Tech. Civil Engineering**  
**Scheme of Instruction and Evaluation**

**SEMESTER VI**

Scheme of Instruction						Scheme of Evaluation				
Sr. No	Course Code	Course Title	L	T	P	Credits	TA	MS T	ESE	ESE hours
1	R4SE3005T	Design of RCC & PSC Structures	3	0	0	3	20	20	60	3
2	R4CE3004S	Environmental Engineering	3	0	0	3	20	20	60	3
3	R4CE3006T	Quantity Survey and Estimation	2	1	0	3	20	20	60	3
4	R4CE3007T	Pavement Engineering	3	0	0	3	20	20	60	3
5	PE1	Professional Elective - I	3	0	0	3	20	20	60	3
6	OE1	Open Elective - I	3	0	0	3	20	20	60	3
7	R4SE3005P	Design of RCC Laboratory	0	0	2	1	60		40	
8	R4CE3006P	Quantity Survey and Estimation Laboratory	0	0	2	1	60		40	
9	R4CE3007P	Transportation Engineering Laboratory	0	0	2	1	60		40	
10	R4CE3008L	Site Visit	0	0	2	1	60		40	
	Total		17	1	8	22				
	Total Contact Hours		26							

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: Mid Semester Test (One Mid Semester Test), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

**Minimum six weeks mandatory internship in industry/research Institute after 6<sup>th</sup> Semester**

**Semester VI List of Professional Elective-I:**

<b>Sr. No</b>	<b>Course code</b>	<b>Course Title</b>
1	R4CE3101S-1	Geographic Information System
2	R4CE3101S-2	Advanced Hydrology
3	R4SE3101S-1	Advanced Structural Analysis
4	R4SE3003S-1	Numerical Methods in Civil Engineering
5	R4SE3101S-2	Advanced Foundation Engineering
6	R4SE3101S-3	Soil Dynamics and Machine Foundation

**Semester VI List of Open Elective-I:**

<b>Sr. No</b>	<b>Course code</b>	<b>Course Title</b>
1	R4SE3003S-1	Numerical Methods in Civil Engineering
2	R4CE3003S-1	Project Appraisal
3	R4CE3101S-1	Geographic Information System

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4SE3001S</b>	
<b>Course Title</b>	<b>Structural Analysis II</b>	
<b>Prerequisites</b>	<b>Mechanics of Solids, Structural Analysis I</b>	

### Course Outcomes

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

1. Identify the stable and unstable structures and evaluate the degree of static and kinematic indeterminacy.
2. Determine the deflection of statically determinate and indeterminate structures under different loads and support conditions.
3. Analyze indeterminate structures by using force method.
4. Analyze indeterminate structures by using displacement method.

### Course Contents

#### 1. General

Classification of structural forms, Stability of structures, Static and kinematic indeterminacy of structures, behavior of symmetric structures, symmetric and anti-symmetric loads, distinction between linear and nonlinear material and geometric behavior of structures.

#### 2. Deflection of statically determinate structure

Review of general theorems based on virtual work and energy methods, introduction to the concept of complimentary energy, absolute and relative deflections caused by loads, temperature changes and other causes, application to determinate beams, pin jointed frames and rigid jointed frames. Deflection of truss by Williot–Mohr diagrams.

#### 3. Analysis of indeterminate structures by flexibility method

Flexibility coefficients and their use in the formulation of compatibility equations. Application of Castigliano's theorem of least work to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of fit of members, simple rigid jointed frames and two hinged arches.

#### 4. Analysis of indeterminate structures by stiffness method

Stiffness coefficients and their use for formulation of equilibrium equation, direct stiffness method, slope deflection method, moment distribution method, applications of these methods to indeterminate beams, simple rigid jointed frames and rigid jointed frames with inclined members, including the effect of settlement/rotation of supports.



### **Text Books**

1. S.B. Junnarkar, Structural Mechanics Vol. II, Charotar Publishers, 2015. (ISBN-9385039024/978-9385039027)
2. C.S. Reddy, Basic Structural Analysis, Tata McGraw Hill, 2004. (ISBN-0070702764/978-0070702769)
3. C.K. Wang, Intermediate Structural Analysis, Tata McGraw Hill, 2010. (ISBN-0070702497/978-0070702493).

### **Recommended Reading**

1. B.N. Thadani and J.P. Desai, Modern Methods in structural Analysis, Weinall Book Corporation, 1998. (ISBN-021026957X/978-0210269572)
2. Pandit and Gupta, Matrix Method in Structural Analysis, Tata McGraw Hill, 2008. (ISBN-0070667357/978-0070667358)
3. L.S. Negi and R.S. Jangid, Structural Analysis, Tata McGraw Hill, 2008.
4. Gupta and Pandit, Structural Analysis Vol. I & II, Tata McGraw Hill, 2008. (ISBN-0070667357/978-0070667358)
5. Gare and Weaver, Analysis of Framed Structure, CBS Publication, 2nd Edition, 2004. (ISBN:978- 8123911519/8123911513).

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4SE3002S</b>	
<b>Course Title</b>	<b>Geotechnical Engineering</b>	
<b>Prerequisites</b>	<b>Soil Mechanics</b>	

## Course Outcomes

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

1. Evaluate earth pressures and apply to check external stability of retaining structures.
2. Analyze and design shallow foundations by shear and settlement criteria under different loading and soil conditions.
3. Evaluate the load carrying capacity and settlement of deep foundation by shear and settlement criteria for different soil conditions under axial load.
4. Apply principles of Three-Dimensional Consolidation and soil reinforcement for soft soil improvement.
5. Interpret and use results of soil investigation for design of Geotechnical systems.

## Course Contents

### 1. Lateral earth pressures theories

Earth pressure theories, earth pressure at rest. Rankine's Earth Pressure: active and passive earth pressure for horizontal and inclined backfill including non-homogenous deposit, Coloumb's Wedge Theory: mathematical approach, condition for failure plane, graphical methods. passive pressure by friction circle method.

### 2. Earth retaining structures

Stability analysis of cantilever retaining wall or sheet piles in sand and clay.

### 3. Bearing capacity of shallow foundation

Definitions of ultimate bearing capacity, gross, net and safe pressures, allowable bearing pressure, types of shallow foundations modes of failures. Bearing capacity theories: Terzaghi's approach, Vesic's approach and IS 6403 (1981) method. Bearing capacity based on Standard Penetration Test. Settlement estimation, plate load test (IS1888) and SPT for estimation of settlements. Bearing capacity of foundation on compact and weathered rock.

### 4. Axially loaded pile foundations

Introduction, necessity and classification of pile foundation, classification of piles. Pile capacity and settlement based on static analysis, single and group piles in sand and clay, critical depth method, dynamic methods and their limitations, in- situ penetration tests and pile load test as per IS 2911 specifications, negative skin friction.

### 5. Ground improvement techniques

Ground improvement techniques: Stone columns and sand/band drains. Basic principle of Geogrid design for Reinforced Earth wall

## **6. Planning of subsurface investigation**

Planning of investigation programmes, Geophysical methods. Methods of site investigations: Direct methods, semi-direct methods and indirect methods, Drilling methods. Boring in soils and rocks.

7. Various patented methods (Reinforced Earth walls, geocells, Base, Seal, Geogrid)

## **Text Books**

1. G. Ranjan and A.S.R. Rao, Basic and Applied Soil Mechanics, New Age International Pvt. Ltd., 2005. (ISBN: 9788122440393/8122440398).
2. V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers and Distributors, New Delhi, 2016. (ISBN- 9788123915067).
3. B. M. Das, Principles of Foundation Engineering, PWS Publishing Company, 2012. (ISBN- 978-8131518786).

## **Recommended Reading**

1. K. Terzaghi and R. B. Peck, Gholamreza Mesri, Soil Mechanics in Engineering Practice, Wiley and Sons, 1996. (ISBN-8126523816/978-8126523818).
2. A. Singh, Soil Mechanics and Foundation Engineering, Vol I & Vol II, Standard book House, 2013. (ISBN- 812390276X/978-8123902760).
3. H. Winterkorn and F.Y. Fang, Foundation Engineering Handbook, CBS Publishers & Distributors, New Delhi, 1990. (ISBN 9788123905457).
4. J. E. Bowles, Foundation Analysis and Design, McGraw-Hill Book Co, 2001. (ISBN- 0071188444/ 978-0071188449).
5. P. Shamsher and H. Sharma, Pile Foundations in Engineering Practice, Wiley and Sons, 1990. (ISBN-0471616532/978-0471616535).
6. J. K. Mitchell and K. Soga, Fundamentals of Soil Behavior, 3rd edition, John Wiley & Sons, New York, 2005. (ISBN-9780471463023/978-0471463023).
7. P. Purushothama Raj, Ground Improvement Techniques (HB), Laxmi Publication Pvt Ltd., New Delhi, 2005. (ISBN-9788170080985/978-8170080985).
8. M. R. Hausmann, Engineering Principles of Ground Modification McGraw-Hill Inc., US, 1990. (ISBN-0070272794/978-0070272798).
9. R.D. Holtz and W.D. Kovacs, An introduction to geotechnical engineering, Prentice Hall, 1981. (ISBN-9332507619/978-9332507616).
10. IS1892 (1979), Subsurface Investigation for Foundation.
11. IS6403 (1981), Determination of Bearing Capacity of Shallow Foundation.
12. IS8009 Part I (1978), Calculation of Settlement of Foundation and Shallow Foundation Subjected to Symmetrical Static Vertical Loads.

13. IS2911 Part I (2010), Design and Construction of Pile Foundations, Part I Concrete Piles.
14. IS1888 (1982), Method of Load Test on Soil.
15. IS1904 (1986), Design and Construction of Foundation in Soil – General Requirements.
16. IS15284 Part I (2003), Design and Construction for Ground Improvement – Guidelines, Part I – Stone Columns.

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4SE3004T</b>	
<b>Course Title</b>	<b>Concrete Technology</b>	
<b>Prerequisites</b>	<b>Construction Materials Laboratory</b>	

### Course Outcomes

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

1. Define the functional role of all ingredients of concrete and their use for normal and special purpose concrete.
2. Apply the principle of sustainability for the utilization of waste, novel and innovative materials for use in concrete.
3. Formulate concrete mix for normal and special purpose concrete.
4. Use of various non-destructive testing procedure for evaluation of concrete properties.

### Course Contents

#### 1. Properties of ingredients

Properties of coarse and fine aggregates and their influence on concrete, types of cement and their use, Grades of ordinary Portland cement, Portland pozzolana cement, rapid hardening Portland cement, hydrophobic cement, low heat Portland cement and sulphate resisting Portland cement as per relevant I.S. codes. Types of aggregates and their properties. Testing of aggregates as per relevant IS Codes.

#### 2. Properties of different types of concrete

Concrete for structural work, light weight concrete, high density concrete, biological concrete, workability, durability and strength requirements, effect of w/c ratio on properties of fresh and hardened concrete, acceptability criteria, laboratory testing of fresh and hardened concrete, Fire resistant properties of hardened concrete.

#### 3. Concreting methods

Process of manufacturing of concrete, transportation, placing, compaction and curing of concrete. Extreme weather concreting, special concreting methods, vacuum dewatering–underwater concrete, special form work., Plum Concrete , Self Compacting Concrete

#### 4. Admixtures

Plasticizers, Retarders, Accelerators and other Admixtures, Test on Admixtures, Chemistry and Compatibility with concrete. GGBS fly Ash, Metakaolin, Silica Fumes , crush sand,

## 5. Ready mix concrete

Requirements of ready mix concrete, properties of RMC, transit mixer details, Automation, instrumentation and Layout of RMC plant.

## 6. Concrete mix design

Mix Design for compressive strength by I.S. methods, road note method, British method, ACI Method, Mix design for flexural strength.

## 7. Concrete for repairs and rehabilitation of structures

High Performance concrete, Polymer Concrete, Fiber Reinforced Concrete, Light weight concrete and its manufacture, Polymer Impregnated Cement Concrete, Polymer Modified cement concrete and Ferro Cement, Special Tests for concrete used for repairs and rehabilitation.

## 8. Non-destructive testing of concrete

Rebound hammer test, Ultrasonic pulse velocity test, Magnetic particle testing, Liquid penetration testing, Visual testing, Laser Testing methods, Leak Testing, Impact echo test, carbonation test, Half cell potentiometer and corrosion of steel, Core test and relevant provisions of I.S. codes.

### Text Books

1. M.L. Gambhir, Concrete Technology, McGraw Hill Book Company, Fifth Edition, 2017. (ISBN-1259062554, 978-1259062551).
2. M.S. Shetty, Concrete Technology, Theory and Practice, S. Chand Publication, Sixth Edition, 2018. (ISBN- 9788121900034,978-8121900034)
3. B.L. Gupta and A. Gupta, Concrete Technology, Jain Book Agency, 2013. (ISBN- 8180140407, 978-8180140402).

### Recommended Reading

1. A.R. Santhakumar, Concrete Technology, Oxford University Press, New Delhi, 2018. (ISBN- 9780195671537, 978-0195671537).
2. A.M. Neville, Properties of Concrete, Pearson Publication, London, 2012. (ISBN- 978-0273755807, 9780273755807).
3. IS 10262-(2009) Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 2009.
4. IS10262 (2009), Mix Design
5. IS269 (2015), Ordinary Portland Cement (33 Grade).
6. IS12269 (2013), Ordinary Portland Cement (53 Grade).
7. IS650 (1991), Specification of Standard Sand. 8. IS383 (1970), Specification for Coarse and Fine aggregate.

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4SE3004P</b>	
<b>Course Title</b>	<b>Concrete and Soil Laboratory</b>	

### **Course Outcomes**

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

1. Determine physical and material properties of fresh and hardened concrete using destructive and non-destructive techniques.
2. Evaluate the properties of admixtures.
3. Carry out concrete mix design for ordinary and special concrete.
4. Evaluate the shear parameters of soil with appropriate selection of required tests.
5. Determine the compressibility parameters and California bearing ratio of soils.
6. Compile the experimental results and prepare the geotechnical report for a given site.

### **Course Contents**

#### **1. List of experiments for concrete technology**

1. To determine the effect of w/c ratio on workability (slump cone, compaction factor)
2. To determine the effect of w/c ratio on strength of concrete
3. Preparing of Concrete mix design using environmental friendly materials such as FlyAsh, Silica Fumes, Metakaolin & GGBS.
4. Study of various Non-destructive testing of concrete and some applications ( Rebound hammer, ultrasonic, carbonation)
5. Secant modulus of elasticity of concrete and indirect tensile test on concrete.
6. Study of admixtures and their effect on workability and strength of concrete.
7. Modulus of rupture of concrete.
8. Permeability test on concrete
9. Tests on polymer modified mortar / concrete Tests on fiber-reinforced concrete
10. Flexural test on concrete beam (central point load and two point load)
11. Shrinkage and creep test
12. Permeability test

## **2. List of experiments for geotechnical engineering**

1. Direct Shear Test under UU/CD condition.
2. Soaked California Bearing Ratio.
3. Unconfined Compression Strength Test.
4. Triaxial Test in UU condition.
5. Consolidation Test.
6. Geotechnical report writing based on test results or real-life problems.

### **Text Books**

1. M.L. Gambhir, Concrete Technology, McGraw Hill Book Company, Fifth Edition, 2017. (ISBN-1259062554, 978-1259062551).
2. M.S. Shetty, Concrete Technology, Theory and Practice, S. Chand Publication, Sixth Edition, 2018. (ISBN- 978-8121900034).
3. B.L. Gupta and A. Gupta, Concrete Technology, Jain Book Agency, 2013. (ISBN-8180140407/978-8180140402).
4. IS 2720, Various relevant parts.
5. T.W. Lambe and R.V. Whitman (1979). 'Soil Mechanics', John Wiley and Sons, New York, USA. (ISBN: 978-0-471-51192-2).
6. B.M. Das, Soil Mechanics Laboratory Manual, Oxford University Press, Ninth Edition, June 2015, (ISBN- 9780190209667).

### **Recommended Reading**

1. Dante Fratta, Jennifer Aguetant, Lynne Roussel-Smith, CRC Press, May 2007
2. IS10262 (2009), Mix Design.
3. IS269 (1989), Ordinary Portland Cement (33 Grade).
4. IS12269 (1987), Ordinary Portland Cement (53 Grade).
5. IS650 (1991), Specification of Standard Sand.
6. IS383 (1970), Specification for Coarse and Fine aggregate.
7. IS2720 Part (1 to 41), Determination of Physical Properties of Soil.
8. SP36 Part I (1987), Compendium of IS on Soil Engineering, Part I – Laboratory tests of Soils for Civil Engineering Purpose. Part II – Field Testing of Soils for Civil Engineering Purposes.
9. A.R. Santhakumar, Concrete Technology, Oxford University Press, New Delhi, 2018. (ISBN-978-0195671537).
10. A.M. Neville, Properties of Concrete, Pearson Publication, London, 2012. (ISBN- 978-0273755807).
11. IS 10262-(2009) Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 2009.



12. IS10262 (2009), Mix Design
13. IS269 (2015), Ordinary Portland Cement (33 Grade).
14. IS12269 (2013), Ordinary Portland Cement (53 Grade).
15. IS650 (1991), Specification of Standard Sand. 8. IS383 (1970), Specification for Coarse and Fine aggregate.
16. R F Craig, Soil Mechanics, Chapman & Hall. 2004. (ISBN-9780415327039/0415327032).
17. Venktatramaiah, Geotechnical Engineering, New Age International.2009. (ISBN-9386649705/978-9386649706).
18. A. Singh, Soil Engineering in Theory and Practice, Standard Publishers and Distributors, New Delhi. 2009. (ISBN-8123900392/978-8123900391).
19. Taylor D.W., Fundamentals of Soil Mechanics, Asia publications Bombay, 2013. (ISBN: 9781258766924, 1258766922).

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CE3002T</b>	
<b>Course Title</b>	<b>Building Drawing and Services</b>	
<b>Prerequisites</b>	<b>Construction Engineering and Infrastructure Projects</b>	

## Course Outcomes

After completion of course, students will be able to

1. Implement principles of planning of buildings
2. Design and draw various constructional drawing of the buildings.
3. Plan various building services.

## Course Contents:

### 1. Principles of Residential and Public Buildings:

Concept of built environment and its application in planning. Recommendation of National building code. Green building, Introduction-Benefits, National priorities, rating system, check list, Site selection and planning, Water efficiency, Energy efficiency, Materials, Indoor environmental quality, Innovation and design process.

### 2. Planning of Building:-

Preparation of constructional details and drawings-plan, elevation, section, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window.

Planning of building such as

Residential building –Load bearing structure, RCC framed structure.  
 Building for Education – school, college. Library  
 Building for health –Dispensary, Hospital Industrial structure  
 Building for entertainment-Theatre, club house, sports club. Other structure-  
 Office, Hostel, Guest house.

### 3. Building's Water Supply and Drainage & Solid Waste Collection and Disposal System:-

Design of water supply, waste water and storm water collection system for various types of buildings. Pumps and Pump House.

Wet and dry solid waste segregation, Vermi-composting etc. Provision of Chutes.

#### **4. Electrical Services:-**

Domestic Supply, Distribution Circuits, basic wiring systems. Design and planning: - Lighting of staircase, corridors. Automatic Water Level controller, Closed Circuit Security Monitors with Intercom/ EPBX facility, Common Dish TV antenna, Use of Solar Panels as source of power, Lightning Conductor for High-rise Buildings.

#### **5. Fire Protection System:-**

Introduction, Fire protection, requirement of water quantity estimation. Systems of fire fighting external and internal. Wet and dry risers, smoke alarm, Sprinkler system. Safety corridors in High-rise structures.

#### **6. Elevators:-**

Introduction, types of elevators. Essential features of lifts its size and requirement of minimum numbers, norms for safety doors, Operation and maintenance, Safety norms. Control systems, electrical requirement, and generator back-up, Escalators in Industry and in malls-multiplex.

#### **7. Heating Ventilation and Air Conditioning-**

Ventilation, functional requirement, Heat balance system of ventilation, General rules and regulations in artificial ventilation system, Central air conditioning: - ducting and glass claddings. Operation and maintenance.

#### **8. Building Management System :-**

Security Guard's Cabin, Postage collection boxes, Parking space.

#### **Text Books**

1. M.G.Shah, Kale, Patki, Building Drawing with an Integrated Approach to Built Environment, Tata McGraw-Hill Education India, 5th edition, 2011, (ISBN: 9780071077873, 0071077871).
2. Building Services Environmental And Electro Mechanical Services, Second Revised, 2014, (ISBN: 9788175259805)

#### **Recommended Reading:**

1. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989, (SP-41: ISBN: 8170610117)
2. Croome, J. D. & Roberts, B. M., "AIR-CONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon Press, (ISBN: 0080247792)
3. SP-35 (1987): Handbook of Water supply & drainage-BIS, (SP- 35: ISBN: 8170610095)
4. N.B.C.-2016, Volume 1 & 2, BIS, (ISBN: 8170610990)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CE3002P</b>	
<b>Course Title</b>	<b>Building Drawing and Services Laboratory</b>	
<b>Prerequisites</b>	<b>Construction Engineering and Infrastructure Projects Construction Engineering Laboratory</b>	

### Course Outcomes

After completion of course students will be able to

1. Draw various constructional drawings of buildings.
2. Use of ICT tools for preparing construction drawings.
3. Prepare Line plans for various public buildings
4. Prepare layout of various building services.

### Course Content:

1. Preparation of detailed constructional plan of a residential building.
2. Preparation of front elevation, detailed sectional view, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window.
3. Concept of perspective drawing- one point, two-point, three point and uses.
4. Preparation of line plans of various public buildings like:
  - Building for Education – School, College. Library
  - Building for health –Dispensary, Hospital Industrial structure
  - Building for entertainment-Theatre, Club House, Sports Club.
  - Other Structure- Office, Hostel, Guest house.
5. Prepare layout for water supply and drainage for a residential building and for multistoried buildings.
6. Building's Solid Waste Collection and disposal system: Wet and dry solid waste segregation, Vermi-composting etc. Provision of Chutes.
7. Fire Protection System : Design of emergency exits and emergency vehicle routes with fire protection symbols

### **Text Books**

1. Scott Onstott, AutoCAD 2018 and AutoCAD LT 2018 Essentials, Wiley (2017), (ISBN: 9788126569298)
2. M.G.Shah, Kale, Patki, Building Drawing with an Integrated Approach to Built Environment, Tata McGraw-Hill Education India, 5th edition, 2011, (ISBN: 9780071077873, 0071077871).
3. Building Services Environmental And Electro Mechanical Services, Second Revised, 2014, (ISBN: 9788175259805)

### **Recommended Reading:**

1. Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989, (SP-41: ISBN: 8170610117)
2. Croome, J. D. & Roberts, B. M., "AIR-CONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon Press, (ISBN: 0080247792)
3. SP-35 (1987): Handbook of Water supply & drainage-BIS, (SP- 35: ISBN: 8170610095)
4. N.B.C.-2016, Volume 1 & 2, BIS, (ISBN: 8170610990)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4HM3001L</b>	
<b>Course Title</b>	<b>Professional Communication Skills</b>	
<b>Prerequisites</b>		

### Course Outcomes

After completion of course students will be able to

1. Apply the principles and practices of business communication for communicating in a professional environment.
2. Design a technical document with correctness of language, appropriate vocabulary and style.
3. Display competence in oral and visual communication.
4. Demonstrate capabilities for self -assessment and development.

### Course Content:

1. Basics of Business Communication
  - a. Concept and meaning of communication
  - b. Verbal and Non-verbal communication
  - c. Barriers to the process of communication
  - d. Channels of communication
  - e. Role of communication in the age of Information Technology
2. Technical Writing
  - a. Technical writing process
  - b. Style and organization in technical writing
  - c. Objectivity, clarity, precision as defining features of technical communication
  - d. Language and format of various types of business letters, reports, proposals, emails, minutes of meeting, research papers.
3. Self Development and Assessment
  - a. Time Management
  - b. Perception and Attitude
  - c. Personal Goal Setting
  - d. Emotional Intelligence
  - e. Team Work
  - f. Creativity
4. Spoken Communication
  - a. Public Speaking
  - b. Group Discussion
  - c. Presentation
  - d. Interviews
  - e. Non verbal communication
  - f. Using Visual Aids

5. Business Ethics and Etiquettes
  - a. Business and Corporate Ethics
  - b. Social and Business Etiquettes
  - c. Interview Etiquettes

### **Text Books**

1. H. S. Mukherjee, Business Communication: Connecting at Work, Oxford University Press; Pap/Cdr edition (26 November 2012), (ISBN: 9780198073475)
2. A. Rizvi, Effective Technical Communication, McGraw Hill Education; 1 edition (27 June 2005), (ISBN: 0070599521)
3. M. Raman, P. Singh, Business Communication, Oxford; Second edition (6 August 2012), (ISBN: 9780198077053)

### **Recommended Reading:**

1. E. H. Mcgrath, Basic Managerial Skills for All, Prentice Hall India Learning Private Limited; 9 edition (2011), (ISBN: 9788120343146)
2. R. Subramanian, Professional Ethics, Oxford University Press; Second edition (17 April 2017), (ISBN: 0199475075)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – V</b>
<b>Course Code</b>	<b>R4CE3001S</b>	
<b>Course Title</b>	<b>Hydrology and Water Resource Engineering</b>	
<b>Prerequisites</b>	<b>Fluid mechanics, Mathematics for Engineers –I,II</b>	

## Course Outcomes

After completion of course, students will be able to

1. Measure and analyze rainfall, runoff and water losses
2. Construct and analyze different hydrographs
3. Use stream gauging techniques and determine ground water flow
4. Compute the water requirement of crops.
5. Carry out reservoir planning, describe hydraulic structures and design distribution systems

## Course Contents

### HYDROLOGY:

#### 1. Introduction

Hydraulic Cycle, Water Budget Equation, World Water Balance, History of hydrology, Applications in Engineering and Sources of Data.

#### 2. Precipitation:

Introduction , Forms of Precipitation, Weather systems of Precipitation , Characteristics of Precipitation in India, Measurement of precipitation , Rain Gauge Network, Preparation of Data, Presentation of rainfall Data, Mean precipitation over an area , Depth Area Duration Relationship, Frequency of Point rainfall, Maximum Intensity- duration-frequency relationship, PMP, Rainfall data in India, Evapo-transpiration, Transpiration, Measurement of EV

#### 3. Water losses

Evapo-transpiration, Transpiration, Measurement of Evapotranspiration, Evapotranspiration equations, AET, PET, Infiltration , Infiltration Capacity, Measurement of Infiltration capacity, Modeling of infiltration capacity, classification of infiltration capacity, Infiltration Indices.

#### 4. Rainfall – runoff process

Introduction , Hydrograph, Runoff Characteristics of Streams, Runoff Volumes, Flow duration Curve, Flow Mass Curve, Drought , surface water resources in India,

#### 5. Hydrograph analysis

Introduction, Factors affecting Flood Hydrograph, Components of Hydrograph, Base Flow separation, Effective Rainfall, Unit Hydrograph, Derivation of Unit Hydrograph, Unit



hydrograph of different duration, Use and limitation of Unit Hydrograph, Duration of Unit Hydrograph, Distribution graph, Synthetic unit hydrograph, IUH,

## **6. Stream gauging:**

Introduction , Measurement of stage , measurement of velocity, Area velocity Method, Dilution Techniques, Electromagnetic Method, Ultrasonic Method, Indirect method,

## **7. Flood and Flood Routing**

Introduction , Rational method, Empirical Formulae, unit Hydrograph Method, Flood Frequency Studies, Gumbell Method, Design Flood, Design Storm, Risk Reliability and safety Factor Introduction of flood routing , Basic equation, storage routing, reservoir routing, attenuation, hydrologic channel routing, hydraulic method of flood routing, Flood control, Flood control in India.

## **WATER RESOURCE ENGINEERING:**

### **1. Water requirement of crops:**

Irrigation systems: Need, minor and major, command area development , Crops and crop seasons in India, cropping pattern, duty and delta, Quality of irrigation water, Soil-water relationships: soil characteristics significant from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation, Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation

### **2. Reservoirs:**

Types, capacity of reservoir, fixing of control levels, yield of reservoir, reservoir regulation, erosion and sedimentation, economic height of dam, selection of suitable site, Reservoir Planning, Reservoir sizing, Sequent Peak Algorithm, Mass Flow Curve,

### **3. Dams and spillways:**

Embankment dams: Classification, selection of site for dam, design considerations, estimation and control of seepage, slope protection, failure of earthen dams

Gravity dams: forces on gravity dams, causes of failure, elementary and practical profile, structural joints, keys and water seals, galleries, outlets, Arch and buttress dams: types of Spillways: components of spillways, types, terminal structures, types of gates for spillway crests, Weir and barrage- types of weirs, Theories of seepage for design of weirs, failure of gravity dams.

### **4. Distribution system:**

Canal systems, alignment of canals, canal losses, estimation of design discharge

Design of channels: Kennedy's and Lacey's theory of regime channels

Canal Outlets: non-modular, semi-modular and modular outlets

Water logging: causes, effects and remedial measures, Lining of canals: economics of lining, types of lining, Drainage of irrigated lands: necessity, methods

## **5. Hydraulic structures:**

Surface and sub-surface flow considerations for design of canal structures: hydraulic jump, seepage forces, uplift forces

Canal falls, cross regulator, distributary head regulator, canal escapes: types, components and design considerations, Cross drainage works: need, types, design considerations, different units of headworks, sediment control in canals, river training for canal headworks,

### **Text books:**

1. G L Asawa, Irrigation Engineering, Wiley eastern, New Age International Publisher (1999) (ISBN: 8122412025)
2. K. Subramanya “Engineering Hydrology”, McGraw Hill Education; Fourth edition (1 July 2017), (ISBN: 1259029972)
3. S K Garg, Water Resources Engineering Vol. II Irrigation Engineering & Hydraulic Structures, Khanna Publishers (2017), (ISBN: 8174090479)
4. P N Modi, Irrigation Engineering & Hydraulic Structures, Standard Book House; Edition: 9th, Year-2014 edition (2014), (ISBN: 8189401297)
5. V.P. Singh, Elementary Hydrology, Prentice-Hall; Facsimile edition (13 December 1991), (ISBN: 0132493845)

### **Recommended Reading:**

1. R. S. Varshney, S. C. Gupta, R. L. Gupta, Theory and Design of Irrigation Structures, Nem Chand & Bros, (ISBN 13: 9788185240473)
2. Punmia B. C., Ashok Kumar Jain & Pande B. B. Lal, Irrigation Engineering and Water Power Engineering, Laxmi Publications; Revised edition (2016), (ISBN: 9788131807637)
3. J D Zimmerman, Irrigation, John Wiley & Sons; 99th edition (1 September 1966), (ISBN: 0471983799)
4. IS:1192-1981 Velocity area methods for measurement of flow of water in open channels (First Revision).
5. IS:2800 Code of Practice for Tube Well.
6. IS:3910-1992 Requirements for Water Flow Measurement in Open Channels- Rotating elements current meters (first revision).
7. IS:3918-1966 Code of Practice for use of Current Meter (cup type) for Water Flow Measurement.
8. IS:6936-1992 Methods for Determination of Evaporation from Reservoirs (first revision).

9. IS:3860-1966 precast cement concrete slabs for canal lining.(superseded by IS:10646).
10. IS:3872-1966 code of practice for lining of canals with burnt clay tiles.
11. IS:4410 glossary of terms relating to the river valley projects.
12. IS:4877-1968 canals structures, drains outlets jungle clearance, plantation and regulations(second revision)
13. IS: 5477 methods for fixing the capacities of reservoirs.

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester-V</b>
<b>Course Code</b>	<b>R4CE2010MA</b>	
<b>Course Title</b>	<b>Professional Ethics and Engineering Economics</b>	
<b>Prerequisites</b>		

## Course Outcomes

After completion of course, students will be able to:

- 1) Explain professional responsibilities
- 2) Relate ethical and unethical behavior
- 3) Debate economic evaluation of investments

## Course Contents

### Unit 1: Profession and Professionalism

Profession. Professionalism- criteria, characteristics, responsibilities, competencies, expectation and support. Professional associations. Role of a Professional. Professional risks. Professional accountability. Professional success. Image of a Profession.

Engineering profession. Technology and society. Engineering as social experimentation. Professional organizations, Roles of engineers. professional categories.

### Unit 2: Ethics in Engineering Profession

Moral and morality, ethics, values. Governing edicts- religious edicts, Social edicts, constitutional edicts and universality. Personal ethics. Professional ethics. Ethical dilemmas. Indian and global thoughts on ethics.

Engineering ethics. Balanced outlook on law. Business ethics. Environmental, Computer, and Research ethics.

### Unit 3: Responsibilities and Rights of Professionals

Rights and responsibilities as Citizens. Professional responsibilities- collegiality, loyalty, confidentiality, respect for authority, accountability, pride of profession, pride of employer, conflict of interest, gifts and bribes, collective bargaining, occupational crimes. Professional rights- rights of an employee, rights of a professional, whistle-blowing, discrimination.

### Unit 4: Human Values and Attitudes

Values, value system and attitude. Human value- classification of values, values and ethics, universality of values. Value system. Degeneration of Values. Acquiring values. Attitudes- components of attitude, types of attitude, attitude formation, and attitude change. Values, Attitudes and Professionals.

### Unit 5: Construction industry

A construction Project. Importance of construction and construction industry. Indian construction Industry. Globalization and MNCs, International trade.

### Unit 6: Fundamental Concepts of Economics

Demand and supply. Cost and revenue. Price and income. Consumer behavior: demand, elasticity of demand, demand forecasting, techniques of forecasting.

### **Unit 7: Economic Decision**

The rational decision-Making process. Economic decisions. Predicting the future. Role of engineers in business.

Types of strategic engineering economic decisions. Investment decisions. Identification of investment opportunities, project development cycle.

Time value of money. Present and future worth. Payback period and Internal rate of return.

#### **Text Books**

1. R, Subramanian, Professional Ethics, Oxford University Press, New Delhi, 2013, (ISBN: 0198086342)

2. Chan S.Park, Contemporary Engineering Economics, Prentice Hall of India, 2002. Donald.G. Newman, Jerome.P.Lavelle, Engineering Economics and analysis Engineering. Press, Texas, 2002.

3. Jha, Kumar Neeraj, Construction Project Management: Theory and Practice, Pearson Education India; 2 editions (2015), (ISBN: 9332542015)

#### **Recommended Reading**

1.Chandra, Prasanna, Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata Mcgraw Hill, New Delhi, 2009, (ISBN: 0070680086)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3005T</b>	
<b>Course Title</b>	<b>Design of Reinforced and Pre-stressed concrete</b>	
<b>Prerequisites</b>	<b>Mechanics of Solids, Structural Analysis I &amp; II</b>	

### Course Outcomes

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

1. Implement concept of working stress method for analysis and design of RCC structural elements.
2. Implement concept of limit state method for analysis and design of RCC structural elements.
3. Apply principles of pre-stressed concrete for design of PC sections.

### Course Contents

#### 1. Working stress method and ultimate load method of design

Reinforced Concrete Fundamentals (working Stress Method): Concept of reinforced concrete, stress strain characteristics of concrete and steel reinforcement, elastic theory, singly reinforced, balanced section, under reinforced section and over reinforced section.

#### 2. Limit state method of design

Concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to limit states of collapse in flexure, direct compression, shear and limit states of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure. Design of members in shear and bond. Design of columns for Axial Load, Uni-axial bending moment and Bi-axial bending moment as per IS Code method. Design of one-way and two-way slabs. Design of beam subjected to bending and torsion. Design of Isolated square and rectangular footings subjected to axial load and moments, Design of combined foundations. Design of Doglegged, Open well type staircases. Design of Flat slab and Post tensioned slab

#### 3. Pre-stressed concrete

Basic principles of pre-stressed concrete: materials used and their properties, methods and systems of pre-stressing. Losses in pre-stress, analysis of various types of sections subjected to pre-stress and external loads. Prestressed and post tensioned members, Different types of Prestressed sections , BoxSection, Girder

### **Text Books**

- 1 Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).
- 2 V. L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN- 9788190371711/8190371711).
- 3 N. Krishna Raju, Pre-stressed Concrete, Tata McGraw Hill. (ISBN-9789387886209/9387886204).

### **Recommended Reading**

1. P. Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).
2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-9788126528035/978-8126528035).
3. P.D. Arthur and V. Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler &Co. Pvt Ltd. (ISBN- 0273403230, 978-0273403234).
4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239, 978-0273010234).
5. IS456 (2000), Plain and Reinforced Concrete.
6. IS 875 (1987), Part I- Design Loads (Other than earthquake) for Buildings and Structures (Dead Loads).
7. IS 875 (1987), Part II- Design Loads (Other than earthquake) for Buildings and Structures (Imposed Loads).
8. IS 875 (2015), Part III- Design Loads (Other than earthquake) for Buildings and Structures (Wind Loads).
9. IS 875 (1987), Part IV- Design Loads (Other than earthquake) for Buildings and Structures (Snow Loads).

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3005P</b>	
<b>Course Title</b>	<b>Design of RCC Laboratory</b>	
<b>Prerequisites</b>	<b>Mechanics of Solids</b>	

### **Course Outcomes**

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

1. Analyze and design beam, column, slab, foundation, staircases and cantilever and counterfort retaining walls.
2. Draw detailed structural drawings for slab, beam, column, foundation, staircases and cantilever and counterfort retaining walls.

### **Course Contents**

1. Design and drawing of singly reinforced, doubly reinforced rectangular and T-section simply supported and continuous beam.
2. Design and drawing of one way, two way simply supported and continuous slab system.
3. Design and drawing of Dog-legged and open wall type staircases.
4. Design and drawing of columns and foundation.
5. Design and drawing of Retaining wall. (Cantilever and counterfort)

### **Text Books**

1. Jain and Jaikrishna, Plain and Reinforced Concrete, Vol. I, Nemchand Brothers.(ISBN-8185240086/978-8185240084).
2. V.L. Shah and Karve, Limit State Design - Reinforced Concrete Structures Publications. (ISBN- 9788190371711/ 8190371711).
- 3.K. Raju, Pre-stressed Concrete, Tata McGraw Hill.(ISBN- 9789387886209/9387886204).

### **Recommended Reading**

1. P.Dayaratnam, Design of Reinforced Concrete Structures, Oxford & IBH. (ISBN-9789386479785/9386479788).
2. T.Y. Lin, Design of Prestressed Concrete Structures, John Wiley and Sons Inc., 2010. (ISBN-9788126528035/8126528036).
3. P.D.Arthur and V.Ramkrishnan, Ultimate Strength Design for Structural Concrete, Wheeler&Co. Pvt Ltd. (ISBN- 0273403230/978-0273403234).
4. B.P. Hughes, Limit State Theory for Reinforced Concrete Design, Pitman. (ISBN-0273010239/978-0273010234).



<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester VI</b>
<b>Course Code</b>	<b>R4CE3004S</b>	
<b>Course Title</b>	<b>Environmental Engineering</b>	
<b>Prerequisites</b>	<b>Applied Hydraulics, Environmental Studies</b>	

### Course Outcomes

After completion of course, students will be able to

1. Identify and describe various elements of the water supply, sewerage, solid waste and air & noise pollution.
2. Use and apply knowledge of various types of pollutions with their sources, effects on environment and quantifications.
3. Analyze various types of pollution with their plans to control / treatment measures.
4. Design and compare sewerage systems and storm water drains.

### Course Contents

#### 1. Water:

Water Supply systems: Need for planned water supply schemes, Sources of Water, Water demand and Potable, industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, various valves used in W/S systems, service reservoirs and design.

#### 2. Sewage:

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage: Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems Storm Water: Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, recycling of sewage – quality requirements for various purposes.

#### 3. Air:

Composition and properties of air

Quantification of air pollutants, Monitoring of air pollutants, Air pollution - Occupational hazards, Urban air pollution: automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship.

Air quality standards, Control measures for Air pollution, construction and limitations

#### **4. Noise**

Basic concept, measurement, effects and various control methods

#### **5. Municipal solid waste:**

Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW.

Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water and health hazards. Disposal of solid waste: segregation, reduction at source, recovery and recycle Disposal methods; integrated solid waste management

#### **6. Hazardous Waste**

Types and nature of hazardous waste, HW Schedules of regulating authorities.

#### **7. Legal Provisions**

Government authorities and their roles along with the legal aspects related to water supply, sewage disposal, solid waste management and monitoring and control of environmental pollution Building (Energy conservation building code compliant/GRIHA/Svagriha)

#### **Text Books**

1. P. Aarne Vesilind, Susan M. Morgan, Introduction to Environmental Engineering, Cengage Learning; 003 edition (May 19, 2009), (ISBN: 0495295833)

#### **Recommended Reading**

1. Terrence J. Mcghee, E. W. Steel, Water Supply and Sewerage, McGraw-Hill College; 6<sup>th</sup> Revised edition, (ISBN: 0070609381)
2. CPHEEO Manual on Water Supply & Treatment
3. Manual on Water Supply and Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
4. Manual on Wastewater Treatment, (latest Ed.), Ministry of Works & Housing, New Delhi.
5. Tchobanoglous, Theissen & Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw-Hill Higher Education; 2 edition, (ISBN: 0070632375)
6. H. S. Peavy, D. R. Rowe, G. Tchobanoglous, Environmental Engineering, Tata-Mcgraw Hill (1991), (ISBN: 9351340260)
7. IS 10500: 2012 Drinking Water – Specification
8. IS 3025 Method of Sampling and Test (Physical and Chemical ) For Water and Waste Water
9. IS 656: 2006 Hazard Identification and risk analysis
10. IS: 2296-1982 Tolerance Limits for Inland Surface waters subjected to pollution (Surface water quality standards)
11. IS 14489:1998 - Occupational health and safety audit

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester-VI</b>
<b>Course Code</b>	<b>R4CE3006T</b>	
<b>Course Title</b>	<b>Quantity Survey and Estimation</b>	
<b>Prerequisites</b>	<b>Construction Techniques</b>	

### Course Outcomes

After completion of course, students will be able to:

1. Estimate quantities of different items of civil engineering works.
2. Prepare specifications for different items of civil works.
3. Analyze rates for various items of works.
4. Prepare tender documents for civil works.
5. Perform valuation of different civil engineering structures.

### Course Contents

#### 1. Introduction

Estimate, purpose, types, comparison, units of measurements, rules for deductions as per IS 1200

#### 2. Approximate Estimates

Various types, their relative importance. Factors to be considered, purpose, different methods. Estimation by various methods

#### 3. Detailed Estimates

Methods of preparation of estimates for projects such as Building R.C.C and load bearing, Roads, miscellaneous works like Manhole, water storage tank, septic tanks etc. Bar bending schedules, Mass haul Diagrams, Earthwork Calculations, work charged establishment, schedule of rates, provisional sum, Bill of quantities, centage charges, contingencies, Administrative approval, technical sanction, Market survey of basic materials, thumb rules for computation of different materials for buildings. Percentage break up of costs.

#### 4. Specifications

Types, requirements and importance, drafting of specifications, detailed specifications for the buildings, roads, minor bridges and industrial structures.

#### 5. Rate analysis

Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment, rate analysis of common building items

#### 6. Contract and Tender

Preparation of tender documents, importance of inviting tenders, tender notice, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and items, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation.

Methods of registration of contracts ,Online process,Documents required, E tendering Procedures, Various types of contracts and tender Accepting Procedure

B1 Percentage Rate

B2 Item rate

C Lump sum Basis

EPC Engineering Procurement and construction

AMC Annual Maintenance Contract

Hybrid Annuity Module

Swiss Challenge Method

## **7. Valuation**

Different terms used, the role of a valuer, purpose and necessity of the same. Capitalised Value, Years purchase, sinking fund, depreciation, types of values, Purpose of valuation, Different methods of valuation for (i) open plots, (ii) open plots with existing residential & commercial structures, (iii) lease hold properties. Use of valuation tables and formulae.

Arbitration Cases, Taxation in Construction Industry

## **8. Project Implementation**

Agency involved in Implementation, methods of implementation like BOT ,BOOT, BOO, BOLT , EPC etc

9. Estimates and Costing of Bridges ,Roads, DPR Preparation,Socio Economic Impact, ENV, Clearances, Statutory bonds,

### **Text Books:**

1. M Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Chakraborti (2006), (ISBN: 818530436X)
2. Dutta B. N., Estimating and Costing In Civil Engineering, UBS Publishers' Distributors Pvt Ltd; 28th Revised Edition edition (2016), (ISBN: 8174767703).
3. Patil B.S., Building & Engineering Contracts, Mrs. S. B. Patil; 2011 edition (2011), (ISBN: 8190979701).
4. Joy P. K., Handbook of Construction Management, Macmillan Publishers India (2000), (ISBN: 0333926935)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester-VI</b>
<b>Course Code</b>	<b>R4CE3006P</b>	
<b>Course Title</b>	<b>Quantity Survey and Estimation Lab</b>	
<b>Prerequisites</b>	<b>Construction Techniques</b>	

### **Course Outcomes**

After completion of course, students will be able to:

1. Formulate specifications for different items of civil engineering works
2. Prepare Estimate of civil engineering structures.
3. Analyze the rates.

### **COURSE CONTENTS**

1. To prepare estimate of a residential building
2. To compute the quantities of reinforcement from bar bending schedules
3. To prepare the estimate of a septic tank
4. To prepare the estimate of road work
5. To draft the specifications for various civil engineering works
6. To analyze the rates for various items of works

### **Text Books**

- 1 M Chakraborti, Estimating, Costing, Specification & Valuation in Civil Engineering, Chakraborti (2006), (ISBN: 818530436X)
- 2 Dutta B. N., Estimating and Costing In Civil Engineering, UBS Publishers' Distributors Pvt Ltd; 28th Revised Edition (2016), (ISBN: 8174767703).
- 3 Joy P. K., Handbook of Construction Management, Macmillan Publishers India (2000), (ISBN: 0333926935)

### **Recommended Reading**

- 1 IS 1200 : Methods of Measurements of Building and Civil Engineering Works

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3007T</b>	
<b>Course Title</b>	<b>Pavement Engineering</b>	
<b>Prerequisites</b>	<b>Construction Engineering and Infrastructure Projects</b>	

### Course Outcomes

After completion of course, students will be able to

1. Use knowledge on Traffic study, highway planning, geometric design of pavements.
2. Acquire the basic knowledge of Construction techniques of Flexible and Concrete pavements.
3. Plan various highway cross sectional element.
4. Carry out structural design flexible and rigid pavements.
5. Design pavement material mix for flexible and rigid pavements.

### Course Contents:

#### 1. Highway Planning

Classification of roads, brief history of road development in India, present status of roads in India, road patterns, saturation systems, highway alignment: basic requirements for an ideal alignment, factors governing highway alignment, highway location surveys and studies, highway alignment in hilly areas, drawings and reports, highway project preparation

#### 2. Geometric Design of Highways

Terrain classification, design speed, vehicular characteristics, highway cross-section elements Sight distance: introduction to sight distance, reaction time, analysis of safe sight distance, analysis of overtaking sight distance, Intermediate sight distance

Design of horizontal alignment: horizontal curves, design of super elevation and its provision, radius at horizontal curves, widening of pavements at horizontal curves, analysis of transition curves

Design of vertical alignment: different types of gradients, grade compensation on curves, analysis of vertical curves, summit curves, valley curves

Intersection: at grade and grade separated intersections, speed change lanes, Canalization, Design of rotary intersection and mini roundabout, Intersection Design, Determination of optimal signal time by Webster method

### **3. Traffic Engineering & Control**

Traffic engineering definitions: functions, organization and importance, necessity of understanding the behavior of road user and vehicle characteristics, human factors governing the road user behavior- power performance and other vehicular characteristics

Traffic studies and surveys:

Speed studies: presentation of data, journey time and delay study, uses and various methods, relative merits and demerits

Vehicular volume counts: types, various available methods, relative merits and demerits, planning of traffic counts, vehicle occupancy surveys

Origin: destination surveys, need and uses, various available methods, checks for accuracy, presentation of data

Parking surveys: needs and types

Study of various photographic techniques available for traffic studies

Traffic Furniture: Traffic signs and marking: types, location, height etc., miscellaneous traffic control aids like roadway delimiters, hazard markers, object marker, speed breakers, rumble strips etc., Street lighting: needs, definitions, laws of illumination, methods of discernment, glare problem, light lantern arrangement, types of lamps, planning and designing

Highway Capacity, PCU, Level of Service, Factors affecting Highway capacity and level of Service

### **4. Pavement Materials**

Stone aggregates: desirable properties, tests, requirements of aggregates for different types of pavements

Bituminous materials: types, tests on bitumen, desirable properties, selection of grade of bitumen

Bituminous mix design by Marshall Stability principle, methods, modified binder

### **5. Design of Pavements**

Types of pavements, comparison of different types of pavements, functions of pavement components, pavement design factors, design wheel load, equivalent single wheel load, repetition of loads, equivalent wheel load factors, strength characteristics of pavement materials, climatic variation;

design of flexible highway pavement as per IRC approach, Stresses in rigid highway pavements, critical load positions, stresses due to loads, stresses due to temperature change, combined loading and temperature stresses, Joints in rigid pavements: transverse joints, longitudinal joints, fillers and sealers

## **6. Highway Construction**

Equipment used for construction, embankment design and construction, construction of different Types of roads: water bound macadam, different types of bituminous pavements, cement concrete pavements,  
Modern Techniques for construction of Roads (Bituminous and concrete roads)

## **7. Highway Drainage**

Necessity, surface draining, highway sub drainage, draining of city streets

## **8. Highway Maintenance & Rehabilitation**

Pavement failures: flexible pavement failures, rigid pavement failures, maintenance of different types of pavements: assessment and need for maintenance, pavement management system, evaluation of pavements: structural evaluation of pavements, functional evaluation of pavements, strengthening of existing pavements: object of strengthening, types of overlays, design of different types of overlays

### **Text Books**

- 1 L R Kadiyali, N B Lal, Principles and Practice of Highway Engineering, Khanna Publications, 2005 (ISBN- 9788174091659)
- 2 Partha Chakroborty, Principles of Transportation Engineering, PHI Learning, 1st edition 2011, (ISBN-9788120320840)
- 3 Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, John Wiley, Principles of Highway Engineering and Traffic Analysis, 4th Edition, (ISBN-9781118120149)

### **Recommended Reading**

- 1 Morlok, E. R., An Introduction to Transportation Engineering and Planning, McGraw Hill Kagakusha International Student Edition, (ISBN: 0070431329)
- 2 Hay, W. W., Introduction to Transportation Engineering. John Wiley and Sons, New York, (1988), 2nd edition, (ISBN: 0471364339)
- 3 Papacostas, C. S., Fundamentals of Transportation Engineering, Prentice Hall of India, New Delhi, (1987), (ISBN: 0133448703)
- 4 IRC 37 –Design of Flexible Pavement 2012,
- 5 IRC-58- Design of Rigid Pavement 2002
- 6 IRC-SP62 Design of Low volume roads-2014



<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3007P</b>	
<b>Course Title</b>	<b>Transportation Engineering Lab</b>	
<b>Prerequisites</b>	<b>Construction Materials Laboratory</b>	

## Course Outcomes

After completion of course, students will be able to

1. Perform quality control Test needed for pavement construction and maintaince.
2. Prepare mix design for pavements.
3. Plan and conduct traffic studies for estimating traffic flow characteristics.
4. Conduct physical evaluation of pavements using modern tools and equipments.

## Course Contents

### 1. Bituminous / Asphalt Pavement Design:

Mix design for pavements: Water Bound Macadam, Bituminous Macadam, and Asphalt concrete.

### 2. Traffic Studies:

Spot Speed Study

### 3. Physical Evaluation of Pavements:

Roughness Index Measurement: Benkelman Beam Test, Bump Integrator Test.  
Skid Resistance Test, Ground Penetration Radar: Underground utility mapping test.

### 4. Evaluation of soil subgrade for flexible pavements

C.B.R test (soaked and unsoaked Lab , Field

## Text Books

1. Khanna S.K, Justo C.E.G. and Veeraraghavan A, Highway Material Testing, New Chand Publications, New Delhi, 2013, (ISBN: 9788185240213)
2. Ministry of Road Transport and Highways, fifth revisions, by Indian Road Congress, 5th Revision 2013, reprint July 2016, (ISBN: 9788193293201).
3. Asphalt Institute Manual Series No.2 (MS-2) Mix design methods for Asphalt concrete and other hot mix types Lexington Ky, 7<sup>th</sup> edition.

## Recommended Reading

Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, Principles of Highway Engineering, sixth edition

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3008L</b>	
<b>Course Title</b>	<b>Site Visit</b>	
<b>Prerequisites</b>	<b>Construction Engineering and Infrastructure Projects, Construction Engineering Laboratory</b>	

## **COURSE OUTCOMES**

**After completion of course students will be able to**

CO 1: Describe the process of construction activities

CO2: Examine the quality checks for various items of work

CO3: Relate the construction activities with working drawings .

## **Course Contents**

The sites should be selected in such a way that during various visits, they should be able to observe / study most of the activities related to building construction like, concreting of footings and columns, bar bending, concreting of slab, flooring, plastering, plumbing, painting, cladding, false ceiling, air conditioning and interpret the working drawings.

The entire class will be divided in to a group of 5-6 students .They will be assigned one ongoing project site .The group will visit the site alternate week & will do presentation alternate week on progress of work on site.

In addition to this ,two to three common site visits will be arranged amongst the following sites:

- High rise building
- Flyover Bridge site
- Metro road / rail project
- Structural steel fabrication and erection
- Ground improvement methods
- Tunneling by conventional method or by TBM
- Cassion foundations and piling.
- Asphalt laying and concreting of roads
- Ready mix concrete plant / ready mix asphalt plant

- Earth work for dam or transport project
- Fabrication and erection of pre-cast concrete elements
- Mass concreting (roller compacted concrete / hot weather concrete / cold weather concrete / under water concrete)
- Mechanized canal construction (excavation, leveling and lining)
- Repairs, rehabilitation works
- Pre-stressing
- Any other ongoing construction site

The students are expected to observe method of work, operations involved, tools used, quality checks, record keeping, site layouts, productivity of workmen, gang size, equipment used etc.

The student shall prepare and submit detail report for every site visited during Semester VI. The report should clearly indicate observations made during such visits supplemented with ample sketches / drawings/photographs.

#### **Text Books**

- 1 A to Z of Practical Building construction and its Management, Mantri Institutions of development and Re Pune
- 2 Joy P K, Handbook of Construction Management, Macmillan

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3101S-1</b>	
<b>Course Title</b>	<b>Geographical Information System (P. Elective-I)</b>	
<b>Prerequisites</b>	<b>Geomatics , Geospatial Laboratory</b>	

## Course Outcomes

After completion of course, students will be able to

1. Acquire a basic understanding of GIS modeling concepts, components, requirements and applications
2. Create spatial and non-spatial models for presentation, analysis and decision-making
3. Use of GIS software modules
4. Design and execute a workflow using GIS techniques appropriate to an applied field

## Course Contents

### 1 Basic concepts of GIS

Information systems, spatial and non-spatial information, geographical concepts and terminology, advantages of GIS, basic components of GIS, commercially available GIS hardware and software, organization of data in GIS

### 2 GIS data

Field data, statistical data, Maps, aerial photographs, satellite data, points, line and area feature, vector and raster data, advantages and disadvantages, data entry through keyboard, digitizers and scanners, digital data, preprocessing of data-rectification and registration, interpolation techniques, use of different plugins.

### 3 Data management

DBMS, various data models, run-length encoding, quadtrees, data analysis-data layers, analysis of spatial and non-spatial data, data overlay and modeling, data processing: raster based and vector based, data presentation –hardcopy devices, softcopy devices

### 4 Remote sensing and GIS integration

Principles of electromagnetic remote sensing, imaging characteristics of remote sensing systems, extraction of metric and descriptive information from remotely sensed images, integration of remote sensing and GIS

### 5 Application of GIS

Map revision, land use land cover (LULC), agriculture, forestry, archeology, municipal geology, water resources, dam site selection, canal site selection, catchment area detection, rivers and its tributaries location finding, Environmental Impact Assessment,

Oceanography, soil erosion, land suitability analysis, change detection

### **Text Books**

1. Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, 2<sup>nd</sup> edition, Prentice Hall India (August 20, 2006), (ISBN: 013149502X).
2. Kang-tsung Chang, Introduction to Geographic Information Systems, Tata mcGraw Hill, 2007- 7<sup>th</sup> edition, (ISBN: 9780078095139)

### **Recommended Reading**

1. Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, 2<sup>nd</sup> edition, Prentice Hall India (August 20, 2006), (ISBN: 013149502X).
2. Kang-tsung Chang, Introduction to Geographic Information Systems, Tata mcGraw Hill, 2007- 7<sup>th</sup> edition, (ISBN: 9780078095139)
3. K. Anji Rao, Remote sensing and Geographical Information System, BS Publications, 3<sup>rd</sup> edition, 2008, (ISBN: 9788178001357)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3101S-2</b>	
<b>Course Title</b>	<b>Advanced Hydrology (P. Elective-I)</b>	
<b>Prerequisites</b>	<b>Engineering Hydrology</b>	

## Course Outcomes

After completion of course, students will be able to

1. Measure and analyse the meteorological data
2. Model surface and subsurface water flow
3. Optimize the water resource system.

## Course Contents:-

### 1. Introduction and Basic Concepts:

System Components, Planning and management, Concept of a system, Advantages and limitations of systems approach, Modelling of Water Resources Systems, Simulation and optimization, Economics in water resources, Challenges in water sector

### 2. Measurement and Processing of meteorological Data

Measurement and Processing of Rainfall Data, Stream flow Data , Meteorological Data, Ground Water data , Data acquisition and management of spatial data, Hydrological databases and Dissemination of Data , Statistical Analysis of Data : Regression, Correlation and Data Generation

### 3. Measurement of flow

Techniques, latest methods for measuring depth, current-meter types, calibration, numerical examples on mid/ mean section methods, stage discharge rating curve, coefficient of correlation.

### 4. Surface flow modelling techniques

Hydrological and hydraulics flow model, Reservoir routing, channel routing, general operation of flood forecasting, forecasting methods adopted in India, forecasting by unit hydrograph method.

### 5. Subsurface flow modelling techniques

Yield, transmissibility, Darcy's law, Dupuit's theory of unconfined flow, steady flow towards fully penetrating wells in case of confined and unconfined aquifers.

## 6. Optimization

Economics in water resources, Modelling of water resources systems, Constrained and unconstrained optimization, Linear programming with applications to reservoir sizing, reservoir operation, Dynamic programming with applications to water allocation, capacity expansion, reservoir operation

### Text books:

1. G L Asawa, Elementary Irrigation Engineering, New Age International Publisher (1999), (ISBN: 8122412025)
2. S K Garg, Irrigation Engineering & Hydraulic Structures, Khanna Publishers 2017, (ISBN: 8174090479)
3. P N Modi, Irrigation Water Resources & Water Power Engineering, Standard Book House; Edition: 9th, Year-2014 edition (2014), (ISBN: 8189401297)
4. V.P. Singh, Elementary Hydrology, Prentice Hall of India Pvt. Ltd. , New Delhi-110001, 1994, (ISBN: 0132493845)

### Recommended Reading

1. J D Zimmerman, Irrigation, John Wiley & Sons; 99th edition (1 September 1966), (ISBN: 0471983799)
2. Varshney, Gupta & Gupta, Theory and Design of Irrigation Structures, Nem Chand & Bros, (ISBN: 8185240485)
3. Punmia B C & Pande B Blal, Irrigation Engineering and Water Power Engineering, Laxmi Publications; Revised edition (2016), (ISBN: 9788131807637)

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3101S-1</b>	
<b>Course Title</b>	<b>Advanced Structural Analysis (P. Elective-I)</b>	
<b>Prerequisites</b>	<b>Mechanics of Solids, Structure Analysis I and II</b>	

## Course Outcomes

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

- 1 Analyze frames and trusses using direct and matrix forms of stiffness method.
- 2 Analyze frames and trusses using matrix flexibility method.
- 3 Apply approximate methods for analysis of 2D building frames.
- 4 Analyze structural steel sections and to evaluate collapse loads of steel structures using the concept of plastic analysis.
- 5 Draw the Influence Line Diagram for indeterminate structures using the Muller Breslau's Principle.

## Course Contents

### 1. Introduction to stiffness method in matrix form

Definition of Stiffness coefficient, member stiffness matrix for prismatic truss and beam elements, properties of the member stiffness matrix, coordinate transformation matrix, stiffness matrix in local and global coordinate axes system. Global stiffness matrix, Boundary conditions, calculation of equivalent joint loads. Solution of Equilibrium equations for displacements. Evaluation of Internal forces in members. Application of matrix stiffness method to beams, pin jointed trusses and rigid jointed plane frames.

### 2. Conventional form of stiffness method, moment distribution method

Application to frames involving sway, consideration of symmetry and anti-symmetry of loads on symmetric structures, modification of stiffness and carryover factors for symmetric and anti - symmetric loads.

### 3. Flexibility method in matrix form

Definition of Flexibility coefficient, Selection of primary determinate structure, Structure flexibility matrix, compatibility equations. Evaluation of Redundant forces, computation of internal forces and joint displacements. Applications to continuous beams, pin jointed trusses and rigid jointed plane frames.

### 4. Conventional form of flexibility method

Elastic Centre method and its application to rigid jointed portal frames, box frames and fixed arches. Column analogy method and its application to the determination of stiffness coefficients, carry over factors and fixed end moments for non-prismatic members.

### 5. Muller Breslau principle



Application of Muller Breslau Principle for influence line diagrams for statically indeterminate structures such as propped cantilevers, fixed beams and continuous beams.

#### **6. Approximate methods for analysis of building frames**

Substitute frame, cantilever and portal methods applied to 2D Frames.

#### **7. Introduction to plastic analysis of steel structures**

Concept of plastic Hinge. Calculation of plastic moment carrying capacity and shape factor for a given structural steel cross section. Determination of collapse load for single and multiple span steel beams.

#### **Text Books**

1. C.S. Reddy, Elementary Structural Analysis, McGraw Hill Education India Pvt.Ltd, 2010. (ISBN-0070965676/978-0070965676)
2. Gupta and Pandit, Structural Analysis Vol. I and Vol. II, Tata McGraw Hill, 2015 (ISBN-13:9780070667358)

#### **Recommended Reading**

1. R.K. Livesley, Matrix Methods of Structural Analysis, Pergamon Press 1964. (ISBN-0080188885).
2. J.M. Gere and W. Weaver, Analysis of Framed Structure, Van Nostrand, 1965. (ISBN-8123911513/978-8123911519).
3. Wilbur, Elementary Structural Analysis, Literary Licensing, 2012. (ISBN-1258242907/978-1258242909).
4. S.A. Raz, Analytical Methods in Structural Analysis, New Age Int. Publishers, 2001. (ISBN-8122413048/978-8122413045).
5. B.N. Thadani, Modern Methods in Structural Mechanics, Asia Publishing House 1964. (ISBN-021026957X/978-0210269572).
6. B.G. Neal, Plastic Methods of Structural Analysis, Chapman and Hall, 1985. (ISBN-0412214504/978-0412214509).
7. Laursen, Structural Analysis, Tata McGraw Hill, 1988. (ISBN- 9789332901476/9332901473).
8. C.K. Wang, Intermediate Structural Analysis, Tata McGraw Hill, 2016. (ISBN-13:978-070702493).
9. Pandit and Gupta, Matrix Method in Structural Analysis, Tata McGraw Hill, 2015. (ISBN-0070667357/978-0070667358).

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3101S-2</b>	
<b>Course Title</b>	<b>Advanced Foundation Engineering (P. Elective-I)</b>	
<b>Prerequisites</b>	<b>Soil Mechanics &amp; Geotechnical Engineering</b>	

### Course Outcomes

After completion of this course, students shall be able to,

- 1 Evaluate shear strength behavior of soil under different drainage conditions and compressibility potential under complex pore pressure conditions.
- 2 Determine stresses due to applied loads for the analysis of settlement.
- 3 Explain the advanced methods of computation of bearing capacity for homogenous, layered and sloping soil deposit under the axial or eccentric/inclined loads and settlement for different types of soil.
- 4 Evaluate techniques of axial load carrying capacity of piles embedded in soil and weathered rock and lateral load capacity in granular soil.
- 5 Illustrate the methods of ground improvement technique for improvement of weak soil.

### Course Contents

#### 1. Consolidation & stress and strain behavior of soil

Terzaghi's theory of One-Dimensional Consolidation – derivation of equation (solution for different conditions of excess pore water pressure), degree of consolidation and average degree of consolidation, Field consolidation curves, Consolidation settlement of NC and OC clays, practical applications. Mohr – Coulomb's criteria, Shear strength of sand and clays. Skempton's pore pressure parameters. Soil elastic modulus.

#### 2. Estimation of stresses

Boussinesq's theory, Westergard's theory, Newmarks charts.

#### 3. Bearing capacity and settlement analysis of shallow foundations:

Bearing Capacity theories – Terzaghi solution (detailed approach), Vesic's theory. IS 6403 (1981) method and Skempton's method, Meterhof's theory. Assumptions in estimates of ultimate loads, Effect of shape, embedment of footing, eccentricity and inclination in loading. Effect of compressibility (including critical rigidity index), Bearing capacity of non-uniform soils (Meyerhof & Hamna). Foundation on Sloping Ground., Settlement Analysis: Elastic theory by Steinbrenner factor, Schmertmman's method, Secondary settlement. Bearing capacity of foundation on compact and weathered rock. Introduction to Raft foundation.

#### 4. Pile foundations:

Pile load tests using girders and anchors, Separation of skin friction and end bearing capacity. Capacity from in-situ tests (SPT and SCPT). Piles in weathered rock: IS 14593 (1998), empirical methods, Special auguring tools & machines for forming the piles, Pile termination criteria. Piles subjected lateral load (Rees and Matlock Method). Introduction of pile raft and Uplift Capacity.

## **5. Ground improvement:**

Dynamic compaction, basics of vacuum consolidation. Geological properties of reinforced soils, Design of Reinforced Earth wall using Geogrid using BS 8006 or other relevant codes, soil nailing. Instrumentation – mainly pore pressure gauges and settlement gauges and their applications.

## **6. Introduction to soil structures interaction**

Introduction to soil - Foundation interaction problems, Soil behavior, Foundation behavior, Interface, behavior, soil response models, Winkler, Elastic continuum.

### **Text Books**

1. B.M. Das, Shallow Foundation- Bearing Capacity & Settlement, Taylor & Francis. (ISBN- 9788131518786).
2. V.N.S. Murthy, Advanced Foundation Engineering, CBD Publishers and Distributors, New Delhi, 2010. (ISBN- 9788123915067/978-8123915067).
3. B.M. Das, Advanced Soil Mechanics, CRC Press, 4th Edition, Taylor & Francis 2012. (ISBN- 978-8131518786).

### **Recommended Reading**

4. K. Terzaghi and R.B. Peck, Soil Mechanics in Engineering Practice, Wiley and Sons, 1996. (ISBN- 8126523816/978-8126523818).
5. A. Singh, Soil Mechanics and Foundation Engineering, Vol I & Vol II, Standard book House, 2013. (ISBN-8123900392/978-8123900391).
6. R.D. Holtz and W.D. Kovacs, An introduction to geotechnical engineering, Prentice Hall, 1981. (ISBN-10: 9332507619/978-9332507616).
7. H. Winterkorn and F.Y. Fang, Foundation Engineering Handbook, CBS Publishers & Distributors, New Delhi, 1990. (ISBN 9788123905457).
8. J.E. Bowles, Foundation Analysis and Design, McGraw-Hill Book Co, 2001. (ISBN-13: 978-0071188449).
9. P. Shamsher and H. Sharma, Pile Foundations in Engineering Practice, Wiley and Sons, 1990. (ISBN-13: 978-0471616535).
10. R. Purushothama, Ground Improvement Techniques (HB), Laxmi Publication Pvt Ltd., New Delhi, 2005. (ISBN-10: 9788170080985/978-8170080985).
11. M.R. Hausmann, Engineering Principles of Ground Modification McGraw-Hill Inc., US, 1990. (ISBN-978-0070272798).
12. R.M. Koerner, Designing with Geosynthetics, (Third Edition), Prentice Hall, 1997.

13. S. Saran, Soil Dynamics and Machine Foundations, Galgotia Publications pvt.ltd. (ISBN 81-7515-266-4).
14. IS1892 (1979), Subsurface Investigation for Foundation.
15. IS6403 (1981), Determination of Bearing Capacity of Shallow Foundation.
16. IS8009 Part I (1978), Calculation of Settlement of Foundation and Shallow Foundation Subjected to Symmetrical Static Vertical Loads.
17. IS2911 Part I (2010), Design and Construction of Pile Foundations, Part I Concrete Piles.
18. IS14593(1998), Design and Construction of Bored Cast-in-situ Pile Founded on Rocks-Guidelines.
19. IS 12070 (1995) Code and Practices for Design and Construction of Shallow Foundations on Rocks.
20. IS1888 (1982), Method of Load Test on Soil.
21. IS1904 (1986), Design and Construction of Foundation in Soil – General Requirements.
22. IS15284 Part I (2003), Design and Construction for Ground Improvement – Guidelines, Part I – Stone Columns.

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3101S-3</b>	
<b>Course Title</b>	<b>Soil Dynamics and Machine Dynamics (Elective-I)</b>	
<b>Prerequisites</b>	<b>Soil Mechanics, Geotechnical Engineering</b>	

Course Outcomes:

After completion of course, students will be able to,

1. Apply theory of vibrations to solve dynamic soil problems
2. Calculate the dynamic properties of soils using laboratory and field tests
3. Analyze and design behavior of a machine foundation resting on the surface, embedded foundation and foundations on piles by elastic half space concept.
4. Analyze and design vibration isolation systems
- 5.

Course Contents:

1 Introduction

Vibration of elementary systems-vibratory motion-single degree freedom system- free and forced vibration with and without damping

2 Waves and wave propagation

Wave propagation in an elastic homogeneous isotropic medium- Raleigh, shear and compression waves-waves in elastic half space

3 Dynamic properties of soils

Elastic properties of soils-coefficient of elastic, uniform and non-uniform compression - shear-effect of vibration dissipative properties of soils-determination of dynamic properties of soil- codal provisions

4 Machine foundation

Types, Design criteria, Permissible amplitudes and Bearing pressure, Degrees of freedom, Analysis under different modes of vibration of block foundation Design criteria-dynamic loads – simple design procedures for foundations under reciprocating machines - machines producing impact loads - rotary type machines.

5 Vibration isolation

Vibration isolation technique-mechanical isolation-foundation isolation-isolation by location isolation by barriers- active passive isolation tests.

Text Books:

1. S. saran, “Soil Dynamics and Machine Foundations”, Galgotia Publications Pvt. Ltd., 2016. (ISBN: 9788175157279/8175157275).

2. S. Prakesh and V.K Puri, Foundation for machines, McGraw-Hill 1998.(ISBN-0471846864/978-0471846864).
3. S.L.Kramar, “Geotechnical Earthquake Engineering”, Prentice Hall International series, Pearson Education (Singapore) Pvt. Ltd. (ISBN: 9788131707180, 8131707180).
4. K. Rao, Dynamics Soil Tests and Applications, Wheeler Publishing, New Delhi, 2003.(ISBN-8175442034/978-8175442030).
- 5.

Recommended Readings:

1. K. Rao, “Vibration Analysis and Foundation Dynamics”, Wheeler Publishing, New Delhi,1998.(ISBN 8175440015).
2. IS code of Practice for Design and Construction of Machine Foundations, McGraw-Hill,1996.
3. P.J.Moore, “Analysis and Design of Foundation for Vibration”, Oxford and IBH,1995.(ISBN-9061915252/978-9061915256).
4. Barkan, “Dynamics of Bases and Foundations”, 2nd Edition McGraw Hill Publishing,1970.(ISBN-9780070036505/978-0070036505).
5. Richart, Hall and Woods, “Vibration of Soils and Foundations”, Prentice Hall,1981. ShamsherPrakash, “Soil Dynamics”, 3rd Edition, John Wiley,2000.(ISBN- 0139417168/978-0139417160).

<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4SE3003S-1</b>	
<b>Course Title</b>	<b>Numerical Methods in Civil Engineering (Open Elective-I)</b>	
<b>Prerequisites</b>	<b>Mathematics for Engineers</b>	

### Course Outcomes

After completion of this course, students will be able to

- 1 Identify and use of the attributes to model any phenomenon or situation in the field of Civil engineering into a set of mathematical equations.
- 2 Identify the suitable methods and obtain the solution of various types of mathematical equations.
- 3 Perform curve fitting into a data set and perform extrapolation and interpolation of data from a given data set.
- 4 Apply the principles of optimization to get optimal solutions to problems in civil engineering.

### Course Contents

#### 1. Mathematical model

Model, Purpose of modelling, Types of model, Steps in modelling process - Problem definition, Purpose definition. Errors in engineering calculations (sources of errors, significant digits, rounding off, propagation of maximum error, propagation of variance, bias & precision).

#### 2. Root finding

Bisection Methods, False position Methods, Newton – Raphson Methods, Secant Methods.

#### 3. Interpolation and extrapolation

Langrange's Interpolation, Newton's Interpolation - Forward, Backward; Applications to Civil Engineering like elevation contour map, iso-hyetal map.

#### 4. Numerical differentiation and numerical integration

Newton Raphson method, Modified Newton - Raphson method, Trapezoidal rule, Simpson's rules ( $\frac{1}{3}$  rd,  $\frac{3}{8}$  th), Gauss Quadrative Techniques.

#### 5. Curve fitting and errors

Least square curve fitting (linear regression) procedures for linear and non-linear curves. Quantifying errors in curve fitting.

#### 6. Numerical solution of ordinary differential equations

Solution of Initial value problems by Euler's method, Taylor's series, Runge – Kutta Method of order 2 and 4.

### **7. Finite difference and finite element method**

Basics of Finite Difference Method (numerical solution to partial differential equations) and Finite Element Method (limited to 1D elements). Basic understanding of finite element method including elements types and their formulation.

### **8. Optimization**

Concept of Optimization, Linear Programming, Application of numerical method in the different area of Civil Engineering such as Environmental Engineering, Water Resources Engineering, Structural Engineering.

#### **Text Books:**

1. M. K. Jain, SRK Iyengar, R K Jain, Numerical Methods for scientific and engineering computation, New Age International(P) Ltd., Fourth Edition, 2012. (ISBN: 9788122433234/8122433235).
2. S. S. Rao, Engineering Optimization Theory and practice, New Age international(P) Ltd. Third edition 2004. (ISBN-9788126540440/8126540443).

#### **Recommended Reading:**

1. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2007. (ISBN-8180545288/978-818054528).
2. S.C Chapra, and, R. P. Canale, Numerical methods for Engineers, McGraw hill Int.2012. (ISBN-9780073401065/978-0073401065).
3. Y. M. Desai, T. I. Eldho and A. H. Shah, Finite Element Method with Applications in Engineering, Dorling Kindersely Pvt. Ltd., Licensees of Pearson Education in South Asia. 2011. (ISBN-9788131724644/978-8131724644).
4. J. N. Sharma, Numerical Methods for Engineers and Scientists, 2nd Edition, Narosa Publishing House, New Delhi. 2007. (ISBN-10: 1842653652, ISBN-13: 978-1842653654).
5. T. J. Akai, Applied Numerical Methods for Engineers, John Wiley & Sons, Singapore, 1994. (ISBN-0471575232/978-0471575238).



<b>Programme Name</b>	<b>Bachelor of Technology in Civil Engineering</b>	<b>Semester – VI</b>
<b>Course Code</b>	<b>R4CE3003S-1</b>	
<b>Course Title</b>	<b>Project Appraisal (Open Elective I)</b>	
<b>Prerequisites</b>		

### **Course Outcomes:**

After completion of course students will be able to

1. Explain concepts of project formulation.
2. Illustrate application of tools of data analysis for appraisal.
3. Articulate arguments to justify projects in view of various aspects.
4. Analyze and explain risks involved in undertaking a project.

### **Course Contents**

#### **1 Project development**

Projects, Capital expenditure: Importance and difficulties, Phase of capital budgeting, project development cycle, aspects of appraisal.

#### **2 Project preparation**

Project Conception, scouting for ideas and alternatives, Preliminary screening

#### **3 Technical appraisal**

Materials and other resources, choice of technology, selection of site, plans and works schedules

#### **4 Market analysis**

Demand, past, present and future, govt. policies, demand forecasting techniques

#### **5 Financial estimates and projections**

Project estimates, sources of financing, cost and financing, financial projections – balance sheet, sources and uses of funds, cash flow statement

## **6 Financial appraisal**

Urgency, payback period, accounting rate of return, net present value, internal rate of return

## **7 Risk analysis**

Measures of risk, mathematical analysis of cash flows, sensitivity and scenario analysis, decision tree analysis, Social cost benefit analysis :- rationale, different approaches.

### **Text Books:**

- 1 P. Chandra, Project Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill, 3<sup>rd</sup> edition, 1987. (ISBN: 978-0074516287/0074516280)
- 2 Policy guidelines: Guidelines for the Preparation of Feasibility reports of Industrial Projects, Controller of Publications, New Delhi.

### **Reference Books:**

1. I. M. Pandey, Financial Management, Vikas Publishing House Pvt Ltd, 11<sup>th</sup> edition, 2015. (ISBN: 9789325982291)
2. D. Newnan, T. G. Eschenbach and J. P. Lavelle, Engineering Economics Analysis, Oxford University Press, 2015. (ISBN: 9780190296902)
3. R Panneerselvam, Engineering Economics, PHI Learning Pvt. Ltd, 13<sup>th</sup> edition, 2012. (ISBN: 9788120317437)
4. F. Harris and R. McCaffer, Modern Construction Management, Blackwell science, 17<sup>th</sup> Edition.
5. R. Pilcher, Principles of Construction Management, McGraw Hill London, 3<sup>rd</sup> edition. (ASIN: B01K2RD6K6)
6. United Nations Guidelines for Project Evaluation Oxford & IBH Publishing Co. Pvt. Ltd.
7. A.H. Taylor & H Shearing, Financial and Cost Accounting for Management, Trans-Atlantic Publications, London, 8<sup>th</sup> edition. (ISBN: 978-0712106337/0712106332)

