B.E. (Civil Engineering)

7th & 8th Semester

Curriculum Structure & Syllabus

2018 – 22 Batch

(2018-19 Admission)

Professor & Head
School of Civil Engineering
KLE Technological University
Hubballi.

IV Year Bachelor of Engineering (Civil Engineering)

Curriculum Structure – 2016 Scheme

VII Semester B.E.

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	15ECVC401	Design of Steel Structures	PC	3-0-0	3	3	50	50	100	3 hours
2	15ECVE4**	Program Elective -2	PE	3-0-0	3	3	50	50	100	3 hours
3	15ECVE4**	Program Elective -3	PE	3-0-0	3	3	50	50	100	3 hours
4	15ECVE4**	Program Elective -4	PE	3-0-0	3	3	50	50	100	3 hours
5		Design Project	PW	6-0-0	6	3	50	50	100	3 hours
6	15ECVP401	Design Studio - Steel and RC Structures	PC	0-0-2	2	3	50	50	100	3 hours
7	15ECVE4**	Program Elective -5	PE	3-0-0	3	3	50	50	100	3 hours
8	15EHSN401	CIPE /EVS	HS	-	Audit	3	50	50	100	3 hours
Total				**21-0-2**	**23**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA** – End Semester Assessment, **PC**-Programme Core, **BS** – Basic Science, **ES**- Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **PW** – Project

Note: Student has to take two elective subjects from major Vertical and one elective subject from minor vertical.

Program Electives -2, 3 and 4

Vertical 1 - Structural Engineering	
15ECVE401	Design of Sub-structures
15ECVE402	Advanced RCC
15ECVE403	FEM Analysis

Vertical 2 - Construction Engineering & Management	
15ECVE404	Horizontal and Vertical Construction Methods
15ECVE405	Construction Economics & Management
15ECVE406	Construction Quality Management

Vertical 3 - Environmental Engineering	
15ECVE407	Solid Waste Management
15ECVE408	Advanced Waste Water Treatment
15ECVE409	Air Pollution

VIII Semester B.E.

No.	Code	Course		Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	15ECVE4**	Program Elective -6	Industry Internship 0-0-6	PE	3-0-0	3	3	50	50	100	3 hours
2	15ECVE4**	Open Elective - 1		OE	3-0-0	3	3	50	50	100	3 hours
5	15ECVW402	Project		PW	0-0-11	11	3	50	50	100	3 hours
		Total			**6-0-11**	**17**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA** – End Semester Assessment, **PC**-Programme Core, **BS** – Basic Science, **ES**- Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **PW** – Project

Open Elective – 1

15ECVO401- Nano Composite Materials	15ECVO402- Optimization Techniques

Program Electives -5 and 6

Vertical 1 - Structural Engineering	
15ECVE401	Design of Sub-structures
15ECVE402	Advanced RCC
15ECVE403	FEM Analysis

Vertical 2 - Construction Engineering & Management	
15ECVE404	Horizontal and Vertical Construction Methods
15ECVE405	Construction Economics & Management
15ECVE406	Construction Quality Management

Vertical 3 - Environmental Engineering	
15ECVE407	Solid Waste Management
15ECVE408	Advanced Waste Water Treatment
15ECVE409	Air Pollution

Course Title: Design of Steel Structures **Course Code: 15ECVC401**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Advantages and disadvantages of Steel structures, Loads and load combinations, Wind load calculation, Wind speed, Design wind speed, Design wind pressure. Structural forms, Design concepts. IS code provisions. Fire resistance and ductility of steel. ~~Introduction to working stress method.~~ **03 hrs**

2. Structural Fasteners

Bolted and welded connections, Strength of bolt and bolted joint. Design of bolted connections. Bracket connections. Welded connections, fillet and Butt welds, strength of a weld, Bracket connections. **07 hrs**

3.Design of Tension Members

Axially loaded tension members and their connections, design of lug angles, Design of truss ties and joints. **05 hrs**

Unit II

4. Design of Compression Members

Angle struts, Columns including built up sections, Laced and Battened systems. Column splicing, column bases- simple slab base, gusseted base. **09 hrs**

5. Design of Flexural Members

Simple and built up sections. Laterally supported and unsupported compression flange. Web crippling and web buckling, **06 hrs**

Unit III

~~**6. Design of Truss**~~

~~Wind load, dead load and other loads wind pressure, calculation of loads on nodes, design of members of the roof Truss, design, Design of purlins~~ ~~**05 hrs**~~

6. Design of Welded Plate Girders

Introduction, Design of Plate Girders (without intermediate stiffeners) **05 hrs**

7. Design of Gantry Girders

Introduction, Design of Gantry Girders **05 hrs**

Text Book

1. Bhavikatti, S.S, *Design of Steel Structures*, 5ed., New Age International , 2017
2. Duggal S.K, *Design of Steel Structures*, 2ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2016.

Reference Books:

1. Subramanian, N., *Design of Steel Structures*, 1ed., Oxford University Press, New Delhi, 2014.
2. Ramachandra & Virendra Gehlot, Design of Steel Structures, 12ed., Scientific Publishers, New Delhi, 2009.

3. P C Verghese, "Limit State Design of Reinforced Concrete", PHI Publications, New Delhi
4. Dayarathnam P, "Design of Steel Structures", S Chand and Company Ltd., New Delhi.

IS Codes

1. IS-800: 2007 *Guidelines for Design of Structural Steel.*
2. IS:875 (Part 3) 1987 *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures : Wind Loads.*

Course Title: Design of Sub-structures **Course Code: 15ECVE401**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Soil Exploration

Subsurface exploration programme for civil engineering projects. Interpretation of soil parameters. Tests on disturbed and undisturbed soil samples, Soil exploration report. **02 hrs**

2. Shallow Foundations

Design Criteria. Types of shallow foundations. Bearing capacity theories. Bearing capacity from field tests. Use of different foundation models. Design of individual and combined footings. Design of raft foundations - Conventional methods. Modulus of subgrade reaction. Beams on elastic foundations. Analysis of footings by Finite Difference. **07 hrs**

3. Pile Foundations

Load carrying capacity of pile. Design of pile and pile groups. Batter piles and under reamed piles. Design of pile cap. Design of axially and laterally loaded piles. **06 hrs**

Unit II

3. Drilled Piers and Caissons

Construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons. **06 hrs**

4. Well Foundation

Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. **05 hrs**

5. Foundations on Expansive Soils

Definition, Identification, Structure, Index properties of expansive soils, Swell potential and Swell pressure, Free swell, CNS layer, foundation treatment for structures in expansive soil. **05 hrs**

Unit III

6. Machine Foundations

Basic terminologies. Design criteria for machine foundations. Vibration analysis. Methods of analysis. Determination of soil parameters. Foundations for reciprocating machines. Foundations for impact type of machines. Vibration isolation. **05 hrs**

7. Foundations for Special Structures **04 hrs**

Foundations for tall structures - Water tanks, Chimneys, Antenna towers and Radar units.

Text Books

1. Bowles. J. E, *Foundation analysis and design*, 5ed, McGraw-Hill Company, Inc, New York, 2012.
2. Das. B.M, *Principles of Foundation Engineering*, 8ed., Thomson Business Information India (P) Ltd., India, 2014.
3. Murthy V.N.S., *Soil Mechanics and Foundation Engineering*, 4ed., UBS Publishers and Distributors, New Delhi, 2016.
4. Swami Saran, *Analysis and Design of Substructures: Limit State Design*, 2ed, oxford and IBH publishing co. Pvt. Ltd., 2006.

Reference Books:

1. Ghosh K.M., *Foundation Design in Practice*, PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Nainan Kurian., *Modern Foundations: An Introduction to Advanced Techniques*, Tata McGraw Hill Education Pvt. Ltd, New Dehli, 1982.
3. Som N. N., Das S. C., *Theory and Practice of Foundation Design*, PHI Learning Private Limited, New Delhi, 2009.
4. Srinivasulu, P. and Vaidyanathan, C.V., *Hand Book of Machine Foundations*, 1ed, Tata McGraw Hill Education Pvt. Ltd, New Dehli , 2002.
5. Tomlinson, M.J., *Pile Design and Construction Practice*, 6ed, CRC Press, 2014.
6. Winterkorn, H. F. and Fang H. Y., *Foundation Engineering Hand Book*, 2ed, Van Nostrand Reinhold Company, 1991.
7. Sharat Chandra Gupta, Raft *Foundations Design and Analysis with a Practical Approach*, New Age International (P) Ltd., Publishers, 1997.

IS Codes:

1. IS 2911 (Part 1/Sec 3) : 2010 - *Design And Construction Of Pile Foundations*
2. IS: 2950 (Part I) -1981 (Reaffirmed 2008) - *Code Of Practice For Design And Construction Of Raft Foundations*

Course Title: Advanced RCC Structures **Course Code: 15ECVE402**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1 Design of Combined and Raft Footing

Design of Combined footings: rectangular and trapezoidal Combined Footings. Design of raft footing as per IS:456:2000 Guidelines **10 hrs**

2. Design of Special type of slabs

Introduction to different types of slab system, Design of grid slab, Yield line analysis of slabs. **10 hrs**

Unit II

4. Retaining Walls **07 hrs**

Design of Cantilever and Counter-fort type of retaining walls.

5.Design of continuous beams **06 hrs**

Bending moment envelops moment redistribution as per IS Code provisions

Unit III

6. Design of Water tanks **07 hrs**

Design of circular and rectangular water tanks, resting on ground and underground overhead water tanks and design of Intz tank.

Text Books

1. Jain, A.K., *Limit State Method of Design*, 7ed., Nemichand and Bros., Roorkee, 2012.
2. Punmia B.C., Ashok Kumar Jain, and Arun Kumar Jain, *Limit State Design of Reinforced Concrete*, Laxmi Publications Pvt. Ltd., New-Delhi-2016.

Reference Books:

1. Bhavikatti S.S, *Advanced RCC Design (RCC Vol-II)*, New Age International Publishers, New Delhi, 2008.
2. Krishnaraju, N., *Design of Reinforced Concrete Structures (IS: 456 – 2000)*, 3ed., CBS Publishers, New Delhi, 2016.
3. Robert Park & Thomson, *Reinforced Concrete*, John Wiley & Bros Pvt. Ltd, 1975
4. Unnikrishnan Pillai S. and Devdas Menon, *Reinforced Concrete Design Third Edition,* Tata McGraw Hill Education Pvt Ltd., New-Delhi-2017.
5. P C Varghese, Limit State Design of Reinforced Concrete Vol-II, Prentice Hall of India

(P) Ltd, New Delhi.

6. Vazirani V N & M M Ratwani, Analysis of Structures- Vol-II, Khanna Publishers, New Delhi.
7. IS:456-2000, *Plain and Reinforced Concrete – Code of Practice (Fourth Revision)*, BIS, New Delhi, 2000
8. SP 16: *Design Aids for Reinforced Concrete to IS 456:1978.*

Course Title: Design Studio – Steel and RC Structures **Course Code: 15ECVP401**

Credits: 2 **Contact Hours: 6 Hrs/ week**

ESA Marks: 80 **Total Marks: 100**

Examination Duration: 3 Hrs

Unit – I

a. RCC Detailing **20 hrs**

b. Drawing and detailing of beams (Simply supported and Continuous beam), slab (One way and two way), column, footing (Isolated and combined) and stairs (Dog legged)

c. Retaining walls – cantilever and counter fort retaining walls

d. Water tanks – Underground, Ground level, Overhead (Intz tank)

e. Portal frame – Single bay

Unit – II

2. Drawings to be prepared for given structural details **12 hrs**

f. Connections: Bolted and welded, beam-beam, Beam-column, seated, stiffened and un-stiffened.

g. Columns: Splices, Column-column of same and different sections. Lacing and battens

h. Column Bases: Slab base and gusseted base.

i. Roof Trusses: At supports and different nodes.

Text Books

1. Bhavikatti, S.S., *Design of Steel Structures by Limit State of Method – As per IS 800-2007*, I.K. International Publishing House Pvt. Ltd., New Delhi, 2009

2. Ramachandra, *Design of Steel Structures,* Vol- 1 & 2, Standard Book House, New Delhi, 2009.

3. Subramanian, N., *Design of Steel Structures*, Oxford University Press, New Delhi, 2008.

4. Kazimi and Jindal, *Design of Steel Structures*, 2ed., Prentice Hall of India, New Delhi, 2000.

References

1. Arya and Ajmani, *Design of Steel Structures*, Nem Chand Bros, Roorkee, 1977.

2. Negi, L.S., *Design of Steel Structures*, Tata McGraw Hi11 Publishers,

2004.

IS Codes:

1. SP 6 (Part 1) Year: 1984 *Handbook for structural engineers - Structural steel sections*
2. SP: 34 Year1987 *Handbook on Concrete Reinforcement and Detailing*
3. IS:800-2007 *Code of Practice for general Construction in Steel*

Course Title: Finite Element Methods **Course Code: 15ECVE403**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction to Finite Element method.

Introduction, Basic concepts on finite element analysis, Introduction to nodes, elements, and shape functions, Steps in Finite Element Analysis, Key concepts and Terminologies. **05 hrs**

2. Element Properties.

Natural Coordinates, Triangular Elements, Rectangular Elements, Introduction to Weighted integrals, Integration by parts-Review, Gradient and Divergence Theorems, Functionals. **05 hrs**

3. Finite Element Formulation Technique. **05 hrs**

Virtual Work and Variational Principle (Rayleigh-Ritz Method), Weighted Integrals and Weak Formulation, Different types of weighted integral methods such as Galerkin Method, Petrov-Galerkin Method, Collocation Method and Method of Least-squares.

Unit II

4. Second Order Boundary Value Problem.

FEA formulation of 2^{nd} order boundary value problem, Development of element level equations, Assembly of element level equations and implementation of boundary conditions, Assembly process and Connectivity matrix. **08 hrs**

5 Applications of Second Order Boundary Value Problem. **10 hrs**

Radially symmetric problems, One-dimensional heat transfer problem, Euler-Bernoulli beam, Shear deformable beam, Eigen value problems, Introduction to time dependant problems.

Unit III

6. FEM Program

Structure of FEM program for FEM Analysis, Description of different modules in FEM software (ABAQUS), Introduction to different types of analysis, Pre and post processing. Comparison of manually solved problems with software results. **07 hrs**

Text Books

1. Reddy J.N., *An Introduction to Finite Element Method*, 3ed., McGraw- Hill Publishing Company Inc, New York, 2017.
2. Krishnamoorthy C. S., *Finite Element Analysis*, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2004.

Reference Books:

1. Rajasekaran, S., *Finite Element Analysis in Engineering Design*, S. Chand Group, 2006.
2. Pandit G.S. and Gupta, S.P., *Structural Analysis, A Matrix Approach*, 2ed., Tata McGraw- Hill Education Pvt. Ltd, New Delhi, 2008.
3. Cook R.D., Malkus D.S., Plesha M.E. and Witt R.J. *Concepts And Applications Of Finite Element Analysis*, 4ed., John Wiley and Jous, Inc., 2013.
4. Bathe K.J., *Finite Element Procedures*, Klaus-Jürgen Bathe; 2ed., 2014.
5. Bhavikatti S.S., *Finite Element Analysis*, New Age International Publication Pvt. Ltd., New Delhi, 2010.
6. Daryl L. Logan., *A first course in the Finite Element Method*, 5ed, Cengage Learning, 2010.
7. Tirupathi R. Chandrupatla and Ashok D. Belegundu, *Introduction to Finite Elements in Engineering*, 4ed, Pearson, 2011

Course Title: Horizontal and Vertical Construction Methods **Course Code: 15ECVE405**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Planning for earthwork construction

Planning, Graphical presentation of Earthwork, Earthwork quantities, Mass diagram and its applications, Pricing of earthwork operations. **04 hrs**

2. Compaction and Stabilization Equipment

Compaction of soil and rock, Types of compaction equipment, roller production estimating, Dynamic compaction, Soil stabilization, stabilizing soils with lime, Cement-soil stabilization. **05 hrs**

3. Excavators and loaders **06 hrs**

Hydraulic Excavators, selection of front shovels, calculating shovel production, height of cut effect on shovel production, angle of swing effect on shovel production, Loaders – introduction, Loader buckets/attachments, operating specifications, Loader production rates, calculating wheel loader production, Calculating track loader production, Loader safety.

Unit II

4. Drilled Shaft Foundations

Introduction, Construction of drilled shafts – dry method of construction, casing method of construction, wet construction method, Installation of casings, Steel cages, Placement of concrete, Dewatering, open dewatering systems, deep well systems, well point systems – Types, techniques, Basement waterproofing systems. **05 hrs**

5. Formwork Systems **06 hrs**

Introduction, formwork materials, shores and scaffolding, Vertical formwork systems – Conventional wall/columns forming systems, Modular panel column form, adjustable wraparound column forms, circular steel forms for round columns, wall panel system, single sided wall formwork, formwork ties, Horizontal formwork systems – conventional wood form and metal systems, cup-lock type scaffolding system, slab flex system, tunnel form, flying formwork system, crane-jumped formwork, automatic climbing formwork, self-rising core system, Monolithic Formwork System.

6. Concrete and Conveying Systems **06 hrs**

Introduction, Concrete – Mixers, Concrete plants, Pre-tensioning and Post tensioning, Transporting and handling – Concrete chute, concrete mixer with lift, concrete skip, truck mixer concrete pumps, concrete belt conveyors, concrete pump truck, trailer pump and pipeline with tower-mounted boom, trailer mounted

pumps, pipeline system, mobile concrete placing booms, finishing.

Unit III

7. Cranes

Major cranes types, Mobile cranes, Crawler cranes, Telescoping-boom truck-mounted cranes, Lattice-boom truck-mounted cranes, Rough-terrain cranes, modified cranes for heavy lifting, crane booms, lifting capacities of cranes, Rated loads for lattice and telescopic boom cranes, Tower cranes – classifications, operation, Tower crane selection, Rated loads for tower cranes, rigging, slings, safety. **05 hrs**

8. Modular Construction Practices: **03 hrs**

Introduction to Modular Construction, Modular coordination, Modular Standardization, Modular System Building, Limitation and Advantages of Modular Construction

Text Books

1. S. C. Sharma, *Construction Equipment and Management,* Khanna Book Publications,2016
2. Peurifoy, *Construction Planning, Equipment & Method,* 7ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
3. Basem M, *Construction Technology for High-rise Buildings-Handbook*, 2014.

Reference Books:

1. Stephens W. Nunnally, *Managing Construction Equipment*, 2ed, Pearson Publications, USA, 2000.
2. Gupta B. L., Amit Gupta, *Construction Management and Machinary*, 5ed, Standard Publications, New Delhi, 2015.

Course Title: Advanced Project Management **Course Code: 21ECVE404**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Operation Research in Management

Introduction, definition, phases, scope, characteristics, limitations of operational research, and management decision making. Methodology and applications of operational research. Linear programming, applications, formulations of LP models. Graphical methods, Simplex method, Transportation Models-Balanced & Un-balanced type of problems **10 hrs**

2. Cost Control

Introduction, project costs – direct and indirect, cost optimization through networks, use of simplex and dual simplex methods of linear programming to optimize construction costs, project cost formulation. **05 hrs**

Unit II

3. Construction Site Layout

Introduction, Objectives of preparing a site layout, Factors affecting the site layout, documentation study before site layout, Storing and stacking of materials on site, Location of machinery and equipment, Stack size of common building materials, Preparation of a site layout. **05 hrs**

4. Construction Disputes and their Settlements

Introduction, development of disputes, types of disputes, modes of settlements, settlement by direct negotiations between the client and contractor, settlement through arbitration, arbitration act 1940, powers of an arbitrator as per 1940 act, settlement through courts. **05 hrs**

5. Risks and Insurance in Construction

Introduction, risk, risk identification in construction, risk analysis and evaluation process, response management process, insurance in construction, principles of insurance, project insurance, contractor's all risk insurance, fire policy, plant and machinery insurance, liquidity damages insurance, professional indemnity policy. **05 hrs**

Unit III

6. Construction Safety Management

Introduction, evolution of safety, Accident causation theories, unsafe conditions and acts, health and safety act and regulations, role of safety personal, causes of accidents, principles of safety, safety and health management system. **05 hrs**

7. Construction Labour and relevant Laws

Introduction, construction labour in India, payment of wages to labour, Labour Laws, payment of wages act 1936, minimum wages act 1948, workers compensation act 1923, contract labor act 1970, employees state insurance act 1948, bonus act, employee's provident fund act, trade unions and their role. **05 hrs**

Text Books

1. Kumar Neeraj Jha, *Construction Project Management: Theory and Practice*, 2ed., Edition, Pearson Publications, 2015.
2. S.C. Sharma, *Construction equipment and management,* new edition, 2019
3. P. Rama Murty, Operations Research, 2nd edition, 2007, New age international publishers

Reference Books:

1. P. Harris, *Planning and Scheduling Using MS Project* 2010.
2. Ursula Kuehn, *Integrated Cost and Schedule Control in Project Management,* 2ed.,2011.

Course Title: Construction Quality Management | **Course Code: 15ECVE406**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

Unit – I

1. Concept of Quality

Definition of Quality, Historical background of quality control, difference between Quality control and Quality Assurance (QA/QC). Total quality control (TQC) and Total Quality Management (TQM), Need for TQM in construction industry, TQM philosophy: Concept of Deming, Juran, Crosby, Imai, Ishikawa, Taguchi, Shingo philosophies. Models and frame works. **04 hrs**

2. Quality Control Tools

Cause and Effect diagrams, Check sheets, Control charts, Data collection, Flow charts, Histograms, Pareto analysis, Pie charts, Run chart, Scatter diagrams and Control charts (Concepts and examples in construction projects) - problems, Quality functions deployment (QFD), Benchmarking. **06 hrs**

3. Development of Human Resource and Quality Circles

Training and development, technical and managerial competencies necessary for achieving quality Cultural change, Innovation and learning, Leadership and commitment, Philosophy of quality circles, Organization of Quality Circles, Stages of Adoption, Areas of Interest to Quality circles, Essential Requirements for the success of circles, Gains from circles. Inspection reports, Monitoring and **05 hrs**

Control, 360 feedbacks for quality.

Unit – II

4. Study of ISO 9001- Quality System Standards.

Purpose of ISO Standards. Difference between ISO 9001 and ISO 9004.Certification process for ISO 9001 and ISO Certification, NABL certification. Certification bodies involved. Eight Principles of ISO-Basic meaning, Quality management system requirements. **04 hrs**

5. Quality Management System Procedures

Introduction, procedure for management review, Format for writing procedures, Procedure for preparing Quality plans/ work Instructions, Contract review, Design control, Document and data control, Document numbering system, Change request, purchasing, control of customer supplied product, product identification and traceability, process control, inspection and testing, measuring and test equipments, the control of non- conforming product, corrective and preventive action, handling, **09 hrs**

storage, packaging and delivery, control of quality records.

6. Work Instructions

Introduction -Document and Data Control, Material Procurement, Material Handling, Tendering and Estimating, Planning, Design, Training, Plant and Equipment, Bar Bending Schedule, Concrete Works, Earthworks and Compaction, Soil Investigation works, Survey works, Concrete Repair Works, Road Works, Painting Works, Water Proofing works, Drainage Works, Quality Assurance and Control, Patching and Transportation of Concrete. **03 hrs**

Unit – III

7. Method Statement

Introduction, Concrete Works, Earthworks and Compaction, General Soil Investigation works, Survey works, Concrete Repair Works, Concrete Demolition Works, Road Works, Fencing works etc. **04 hrs**

8. Job Description

Introduction, Job Description of: Managing Director, Project Manager, Site Manager, Site Engineer, QA/QC Engineer, Foreman, Typist/Clerk, Design Engineer, Planning Engineer. **03 hrs**

9. Introduction to Six Sigma

Introduction, Definition of Six Sigma, evolution – Historical aspects, Six Sigma methodology, Leadership principles, Six Sigma team, Six Sigma in construction projects, Application of Six Sigma tool to RCC Work in building. **03 hrs**

Text Books

1. Abdul Razzak Rumane, Quality Management Construction Projects, 2nd edition, CRC press, 2019
2. Rajendra Prasad, D.S., Quality Management System in Civil Engineering ISO 9001-2000, Sapna Book House, Bangalore, 2016
3. Besterfield Dale H, Total Quality Management, Pearson publications, 2018
4. Mohamed Zairi, Total Quality Management for Engineers, Woodhead publishing Limited. 2010
5. Craig Joseph Setter, Six Sigma, A complete step-by-step guide, Council of six sigma certification, 2018

Reference Books:

1. P.L.Jain, Quality Control and Total Quality Management, reprint. Tata Mcgraw Hill Publicaions, 2006
2. S. L. Tang, Construction Quality Management, 2005
3. Neville, A.M., *Properties of Concrete*, Pearson education India, 2012
4. Gary E. MacLean, Documenting Quality for ISO 9000 and other Industry Standards,,Tata McGraw-Hill Publishing Company Limited, 1993.
5. Yang, K. and El-Haik, B S., Design of Six sigma, Tata McGraw Hill,2009
6. Girdhar J. Gyani, Training Manual on ISO 9000-2000 and TQM, Raj Publishing House, 2006.
7. Feigenbaum Armand V., *"Total Quality Control"*, McGraw Hill International Edition,1991
8. http://gen.lib.rus.ec/book/bibtex.php?md5=057996440ECF0F315C3F127AD1B6C88D
9. http://gen.lib.rus.ec/book/bibtex.php?md5=22C6F54A31AF37AB6A4F718AE6F29522

IS Codes:

1. IS: 456-2000, *Indian Standard Specifications for Plain and Reinforced Concrete Code of Practice*, 4th Revision, Bureau of Indian Standards.
2. IS: 383-1990, *Indian Standard Specifications for Coarse and Fine Aggregates from Natural sources for Concrete*, Bureau of Indian Standards.
3. ISO 9001-2015, *Quality Management System in Civil Engineering*
4. ISO 9004:2018, *Quality management — Quality of an organization — Guidance to achieve sustained success*

Course Title: Solid Waste Management **Course Code: 15ECVE407**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Solid waste -Definition, Land Pollution -scope and importance of solid waste management, functional elements of solid waste management. SOURCES: Classification and characteristics- municipal, hospital / biomedical waste, Quantity -Generation rate, methods. Latest Trends in SWM: (1) Legacy wastes and landfill mining: Risks and Rewards (2) Centralized and decentralized SWM approach in Villages, ULBs and Metro cities: Pros and Cons. **05 hrs**

2. Collection and Transportation

Systems of collection, collection equipment, garbage chutes, transfer stations -bailing and compacting, route optimization **05 hrs**

3. Processing Techniques **05 hrs**

Components separation, volume reduction, size reduction, chemical reduction and biological processing

Unit II

4. Disposal Methods

Open dumping -selection of site, ocean disposal, feeding to hogs, composting, sanitary land. filling, merits and demerits. Construction/Demolition waste. **04 hrs**

5. Incineration **04 hrs**

Processes -3 T 's, factors affecting incineration process, incinerators -types, prevention of air pollution, pyrolysis.

6. Composting **05 hrs**

Aerobic and anaerobic composting, factors affecting, composting, Indoor and Bangalore processes, mechanical and semi-mechanical composting processes. Vermi composting

Unit III

7. Sanitary Land Filling

Definition, methods, trench area, Ramp and pit method, site selection, basic steps involved, cell design, prevention of site pollution, leachate collection and control methods, gas collection systems. **07 hrs**

8. Recycle and Reuse

Material and Energy Recovery Operations, Reuse In Other Industries, Plastic Wastes, Environmental Significance and Reuse **05 hrs**

Text Books

1. George Tchobanoglous, Hilary Theisen and Vigil S. A., *Integrated solid waste management: engineering principles and management issues*, McGraw-Hill Inc,US, 1993.
2. Bhide A. D. and , Sundaresan B. B., *Solid Waste Management in Developing Countries,* Indian National Scientific Documentation Centre, 2010.
3. Ministry of Environment and Forests, Govt. of India, The Municipal Solid Wastes (Management and Handling) Rules, 2000.

Reference Books:

1. Joseph L. Pavoni, John E. Heer, D. Joseph Hagerty, *Solid Waste Management, Van Nostrand Reinhold Co.,* 1973.
2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, *Environmental Engineering,* McGraw-Hill Publishing Company Inc., New York, 2017.
3. Ramesha Chandrappa, Jeff Brown, *Solid Waste Management – Principles and Practice,* Springer Science & Business Media, 2012.

Course Title: Advanced Waste Water Treatment **Course Code: 15ECVE408**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1.Introduction

Wastewater Characteristics, Effluent Quality Standards, Receiving Stream Quality **03 hrs**

2. Primary Treatment- Screening, Grit removal, Neutralization, equalization, Sedimentation, Flotation (oil & grease removal), **06hrs**

3. Secondary Treatment- Fundamental concept of reactors: Mass balance relationships, analysis and descriptions of reactors- batch, completely mixed flow and plug flow oxygen requirement in aerobic process. **06hrs**

Unit II

4. Biological Treatment : Activated Sludge Process: Substrate Utilization and Biomass Growth, Kinetic Parameters, Process Description and its Modification, Process Design , Biofilm Process: Trickling Filter, Rotational Biological Contactor **10 hrs**

Aerated lagoons, oxidation pond-operation and maintenance

5.Advanced Treatment Processes- Chemical Coagulation, Carbon Adsorption, Phosphorus Removal, Nitrogen Removal (Nitrification/Denitrification), Media Filtration, UV Disinfection **06 hrs**

Unit III

6. Solids Handling Processes- Gravity Thickening, Flotation Thickening, Dewatering, Pressure Filtration, Stabilization, Aerobic and Anaerobic Digestion, Composting, Drying, Incineration, Landfilling, Land Application **09 hrs**

Text Books

1. Eddy and Metcalf ,*Wastewater Engineering – Treatment and Reuse* ,Tata McGraw Hill Education Pvt Ltd., New Delhi, 2003.
2. Modi, P.N., *Sewage Treatment and Disposal Engg.*, Standard Book House, New Delhi, 2000.
3. Howard S. Peavy, Donald R. Rowe, George Techno Bano Glous, *Environmental Engineering*, McGraw Hill International, 2010.

Reference Books:

1. Qasim S.R., Motley E. M., *Wastewater Treatment Plants – Planning, Design and Operation*, Prentice Hall, New Delhi. 2002.
2. Davis, M.L. and Cornwell, D.A., *Introduction to Environmental Engineering*, Tata McGraw Hill Education Pvt. Ltd., New Delhi,. 2010
3. Hammer M.J., *Water and Waste Water Technology*, John Wiley and Sons, New York , 2000.

Course Title: Air Pollution **Course Code: 15ECVE409**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Definition -Classification and properties of Air pollutants, Primary and secondary Air pollutants, Concentrations of Air pollutants and sources. Behavior and Fate of Air Pollution: Chemical reaction in the Atmosphere, photochemical Smog. **05 hrs**

2. Effects of Air Pollution **05 hrs**

On human health, Animals, Plant and properties, Major Episodes.

3. Meteorology

Introduction -Meteorological Variables, Lapse Rate – Adiabatic - Dispersion, inversion, stability conditions, wind rose, general characteristics of stack plumes **05 hrs**

Unit II

4. Sampling and Analysis of Air Pollutants

Sampling and measurement of Gaseous and particulate pollutants, stack sampling, smoke and its measurements. **05 hrs**

5. Control of Air Pollutants **10 hrs**

Control methods -Particulate emission control, gravitational settling chambers, cyclone separators, fabric filters, Electrostatic precipitators, wet scrubbers, control of gaseous emissions (Design not requires)

Unit III

6. Air Pollution Due to Automobiles

Air pollution due to gasoline driven and Diesel driven engines, effects, control - direct and indirect methods. **02 hrs**

7. Global Environmental Issues **04 hrs**

Acid rain, Green House effect, Global warming, Ozone layer Depletion.

8. Environmental Impact Assessment

Environmental Impact Assessment in industrial plant locations and planning. Standards and legislation -Air quality and emission standards - legislation and regulation, Air pollution index **04 hrs**

Text Books

1. Rao, H.V.N., and Rao, M.N., *Air Pollution*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2007.
2. Rao, C.S., *Environmental Pollution Control*, New Age International Pvt. Ltd, New Delhi, 2006.

Reference Books:

1. A.O.C., Stem, *Air Pollution -Vol I -IV*; Academic Press., 2010.
2. Henry C Perkins, *Air pollution*, Tata McGraw Hill Education Pvt Ltd., New Delhi, 1974.

Open Elective -1

Course Title: Nano Composite Materials **Course Code: 15ECVO401**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Introduction to materials, traditional materials, development, properties, strength of and mechanical properties of materials , introduction, definition, classification and characteristics of composite materials - fibrous composites, laminated composites, particulate composites **06 hrs**

2. Fiber and matrices

Carbon fibers, glass fibers, silicon carbide and organic fibers. Polymer matrices, metal matrices and ceramic matrices. **05 hrs**

3. Fabrication and application

Polymer composites, metal composites and ceramic composites Application of composites: Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites. **05 hrs**

Unit II

4. An overview of Nanoscience & Nanotechnology

Historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications. **06 hrs**

5. Experimental Techniques and Methods

For investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes **05 hrs**

6. Introduction to Nanomaterials

Carbon Nanotubes , synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications **05 hrs**

Unit III

7. Introduction to nano-composite

Nano composite polymer matrix, nano composite ceramic matrix, nano composite metal matrix Applications in engineering, future scope of nano-composite, research , training in development of nano-composite materials. **05 hrs**

8. Safety and environmental aspects

Safety and environmental aspects of nano-materials, future challenge, cost optimization and fabrication process of nano composite materials **03 hrs**

Text Book:

1. Hull D. and Clyne T.W., *Introduction to Composite Materials*, Cambridge University Press, 2nd edition, 1996.
2. Pradeep T., *NANO: The Essentials – Understanding Nanoscience and Nanotechnology,* 1ed., Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2017

Reference Books:

1. Ventra M.,Evoy S., Heflin J.R., *Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology],* Springer (2006).
2. Chawla K.K., *Composite Material : Science and Engineering*, 3ed., Springer, 2012.
3. Linda Williams & Wade Adams *Nanotechnology Demystified,* McGraw-Hill Company Inc, New York, 2007.
4. Johns R.M., *Mechanics of Composite Materials*, 2ed., CRC Press, 2015.

Open Elective -2

Course Title: Optimization Techniques | **Course Code: 15ECVO402**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

UNIT – I

1. Introduction

Engineering applications, optimum design methods, Mathematical statement, Terminology and basic concepts, Classification of optimization problems, Optimization Techniques. **04 hrs**

2. Classical Optimization Techniques

Single variable optimization, Multivariable optimization without constraints, Multivariable optimization with constraints -Lagrange multiplier method and constrained variation method – Kuhntucker conditions. **05 hrs**

3. Linear Programming

Standard form LP, Geometry and solution of LP , Pivotal reduction Simplex method, two phase simplex method, revised simplex method **05 hrs**

UNIT – II

4. Non-linear Unconstrained Optimization Search Techniques

One dimensional problems, Elimination Methods - Fibonacci Method, Dichotomous Search, Golden Section Method, Interpolation methods - Quadratic Interpolation Method – Quadratic Interpolation Method, Direct Root Methods, Direct search method- Powell Flether method, Hooke and Jeeve's method, Descent methods. **08 hrs**

5. Non-linear Constrained Optimization Search Techniques

Direct Methods - Feasible Direction method, sequential linear programming techniques Indirect Method - Interior and Exterior penalty function method. **08 hrs**

UNIT – III

6. Geometric Programming

Posynomial, Unconstrained Minimization Problem by Differential Calculus, Constrained Minimization using Geometric Programming, **06 hrs**

7. Dynamic Programming

Multistage decision concert, principles of optimality. **04 hrs**

Text Book:

1. Rao S.S., *Engineering Optimization Theory and Application*, 3ed.,New Age International Pvt. Ltd., New Delhi, 2013.

2. Bhavikatti, S.S., *Fundamentals of Optimum Designs in Engineering*, 1ed., New Age Publishers, New Delhi, 2017.
3. Ravindran A, Ragsdel K.M., Reklaitis G.V., *Engineering Optimization: Methods and Applications*, 2ed., Wiley India Pvt. Ltd., 2006.
4. Rudra Pratap, *Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers*, Oxford Uni Press, 2010.

Reference Books:

1. Belegundu A., Chandrupatla T.R., *Optimization Concepts and Applications in Engineering*", 2ed., Cambridge University Press, 2011
2. Bishma Rao GSS, *Optimization Techniques*, Scitech Publication., 2003.
3. Mohan C. and Kusum Deep, *Optimization Techniques*, 1ed., New Age International Pvt. Ltd., New Delhi, 2009.

B.E. (Civil Engineering)

5th & 6th Semester

Curriculum Structure & Syllabus

2019 – 23 Batch

(2019-23 Admission)

Professor & Head
School of Civil Engineering
KLE Technological University
Hubballi.

III Year Bachelor of Engineering (Civil Engineering)

Curriculum Structure – 2017 Scheme

V Semester B.E.

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	15ECVC301	Structural Analysis-II	PC	3-0-0	3	3	50	50	100	3 hours
2	15ECVC302	Geotechnical Engineering	PC	3-0-0	3	3	50	50	100	3 hours
3	15ECVC303	Design of RCC Structures	PC	4-0-0	4	4	50	50	100	4 hours
4	15ECVC304	Transportation Engineering	PC	4-0-0	4	4	50	50	100	3 hours
5	15ECVC305	Construction Economics and Management	PC	3-0-0	3	3	50	50	100	3 hours
6	15ECVP301	Highway Engineering Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
7	15ECVP302	Environmental Engineering Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
8	17ECVP301	Design & Construction Workshop	PC	0-0-1	1	2	80	20	100	3 hours
9	15ECVW301	Mini Project	PW	0-0-3	3	3	50	50	100	3 hours
Total				**17-0-6**	**23**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA** – End Semester Assessment, **PC**-Programme Core, **BS** – Basic Science, **ES**- Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **HS** – Humanities, **PW** – Project

VI Semester B.E.

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	15ECVC306	Advanced Geotechnical Engineering	PC	3-0-0	3	3	50	50	100	3 hours
2	15ECVC307	Estimation and Costing	PC	3-0-0	3	3	50	50	100	3 hours
3	15ECVE3**	Program Elective -1	PE	3-0-0	3	3	50	50	100	3 hours
4	15EHSC301	Professional Aptitude & Logical Reasoning	HS	3-0-0	3	3	50	50	100	3 hours
5	15ECVP304	Geotechnical Engineering Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
6	15ECVP305	Computer Aided Design Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
7	15ECVP306	Construction Engineering & Management Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
8	15ECVW302	Minor Project	PW	0-0-6	6	6	50	50	100	3 hours
Total				**15-0-9**	**21**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA –** End Semester Assessment, **PC**-Programme Core, **BS** – Basic Science, **ES**- Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **HS** – Humanities, **PW** – Project

Program Elective -1:

1	16ECVE301	Pre Stressed Concrete
2	15ECVE302	Traffic Engineering
3	15ECVE303	Pavement Engineering
4	15ECVE304	**Engineering Hydrology and Hydraulic Structures**

5th Semester

Course Title: Structural Analysis-II | **Course Code: 15ECVC301**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

Unit I

1. Slope Deflection Method

Introduction, Sign convention, Development of slope-deflection equations and Analysis of Beams and Orthogonal Rigid jointed plane frames (sway and non sway) with kinematic redundancy less than/equal to three. (Members to be axially rigid) **08 hrs**

2. Consistency Deformation Method

Introduction, static indeterminacy, Analysis of continuous beam and frame by Consistency Deformation Method. **08 hrs**

Unit II

3. Stiffness Matrix Method

Degree of kinematic indeterminacy of one- and two-dimensional structures, generalized coordinates, Analysis of continuous beams with and without sinking of supports and portal frames kinematic redundancy ≤ 3. **08 hrs**

4. Flexibility Matrix Method

Development of element flexibility matrices, Development of global flexibility matrix, Analysis of continuous beams, and rigid plane frames to determine for internal forces and displacements. **08 hrs**

Unit III

5. Plastic Analysis

Introduction, plastic hinge and plastic moment capacity, Assumptions, Shape factor for general sections, Collapse load, Basic theorems for finding collapse loads, Methods of plastic analysis, Beam mechanism for continuous beam. **08 hrs**

Text Books

1. Bhavikatti S.S, *Structural Analysis II,* 4ed., Vikas Publishing House India Pvt. Ltd, Bangalore, 2016.
2. Pandit G.S. and Gupta S.P, *Matrix Method of Analysis* , 2ed., McGraw Hill Education India Pvt. Ltd, New Delhi, 2008.
3. Reddy C.S., *Basic Structural Analysis*, 3ed., Tata McGraw Hill Education India Pvt. Ltd New Delhi, 2017.
4. Ram chandra, *Design of steel structures-Vol II,* 12ed, Standard book house, New Delhi 2015

Reference Books:

1. Jain A.K., *Advanced Structural Analysis*, 3ed., Nemchand and Brothers, Roorkee, India, 2015.
2. Leet,, Uang, and Anne M., *Fundamentals of Structural Analysis*, 3ed., Tata McGraw Hill Publishing Company, New Delhi, 2017.
3. Noris, C.H. and Wilbur, J., *Elementary Structural Analysis*, 3ed., Tata McGraw Hill Publishing Company, New Delhi, 2005.
4. Bhavikatti S.S, *Matrix Methods of Structural Analysis*, 1ed., I K International Publishing House Pvt. Ltd., 2011.
5. Timoshenko, S.P., and Young, D.H., *Theory of Structures*, McGraw Hill Company, New York, 1965.
6. B. G. Neal, *The Plastic Methods of Structural Analysis*, Chapman and Hall, 1977

Course Title: Geotechnical Engineering **Course Code: 15ECVC302**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Introduction to soil mechanics, Phase Diagram, Voids ratio, Porosity, Percentage air voids, Degree of saturation, Moisture content, Specific gravity , Bulk density, Dry density, Saturated density, Submerged density and their inter relationships. **04 hrs**

2. Index Properties of Soils

Index Properties of soils, Activity of Clay, Laboratory methods of determination of index properties of soils. **05 hrs**

3. Classification of Soils

Purpose of soil classification, basis for soil classification, Particle size classification – MIT classification, IS classification, Unified soil classification, Plasticity chart and its importance, Field identification of soils. **03 hrs**

4. Clay Mineralogy and Soil Structure

Types of structure of soil, Valence bonds Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures. **03 hrs**

Unit II

5. Flow of Water through Soils

Darcy's law- assumption and validity, coefficient of permeability and its determination, factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, effective stress concept-total stress and effective stress, quick sand phenomena, Capillary Phenomena. Laplace equation-assumptions and limitations only, Characteristics and uses of flow nets, Methods of drawing flow nets for Dams and sheet piles. Estimating quantity of seepage and Exit gradient. Determination of phreatic line in earth dams with and without filter. Piping and protective filter, graded filter. **06 hrs**

6. Compaction of Soils

Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control, Proctor needle, Compacting equipments, method of compaction. **04 hrs**

7. Shear Strength of Soils

Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional and modified failure envelops, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay. Measurement of shear parameters- Direct shear test, unconfined compression test, Triaxial compression test and vane shear test, Test under different drainage conditions. **06 hrs**

Unit III

8. Stresses in Soils

Boussinesq's and Westergaard's theories for concentrated, circular, rectangular, line and strip loads. Comparison of Boussinesq's and Westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **04 hrs**

7. Shear Strength of Soils

Concept of shear strength, Mohr's strength theory, Mohr-coulomb theory, conventional and modified failure envelops, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay. Measurement of shear parameters- Direct shear test, unconfined compression test, Triaxial compression test and vane shear test, Test under different drainage conditions. **06 hrs**

Unit III

8. Stresses in Soils

Boussinesq's and Westergaard's theories for concentrated, circular, rectangular, line and strip loads. Comparison of Boussinesq's and Westergaard's analysis. Pressure distribution diagrams, contact pressure, Newmark's chart. **04 hrs**

9. Consolidation of Soils

Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations. Normally consolidated, under consolidated and over consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil (C_c, a_v, m_v and C_v), Time rate of consolidation. Laboratory one dimensional consolidation test, Determination of consolidation characteristics of soils-compression index, and coefficient of consolidation, determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method. **05 hrs**

Text Books

1. Alam Singh and Chowdhary G.R, *Soil Engineering in Theory and Practice,* 2ed., CBS Publishers and Distributors Ltd., New Delhi, 2014.
2. Braja M Das, *Principles of Geotechnical Engineering*, 8ed, Cenage Learning India Pvt. Ltd., India, 2014.
3. Punmia B. C., *Soil Mechanics and Foundation Engineering.*, 17ed., Laxmi Publications Co., New Delhi, 2018.

Reference Books:

1. Craig, R.F., *Soil Mechanics*, Spon Press Publishers, New York, 2004.

2. Gopal Ranjan and Rao A.S.R., *Basic and Applied Soil Mechanics*, New Age International Pvt. Ltd., New Delhi, 2016.
3. Murthy V.N.S., *Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2016.
4. Venkatrahmaiah C., *Geotechnical Engineering,* 6ed., New Age International Pvt. Ltd., New Delhi, 2018.
5. IS - SP-36 (Part – 1) -1987 (R 2006) Compendium of Indian standard on soil engineering – Laboratory Testing of Soils for Civil Engineering Purpose.
6. IS - SP-36 (Part – 2) -1988 (R 2006) Compendium of Indian standard on soil engineering – Field Testing of Soils for Civil Engineering Purpose.
7. Soil Mechanics fundamentals, Muni Budhu, Imperial version, 2010.

Course Title: Design of RCC Structures		**Course Code: 15ECVC303**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 4 Hrs**	

Unit I

1. General Features of Reinforced Concrete

Introduction, Philosophies of design (Brief on Working Stress method). Limit State Method of Design: Design Loads, Materials for Reinforced Concrete, Codal provisions, Concept of Safety: Design Philosophy – Limit State Design principles. Principles of limit states, Factor of Safety, Characteristic design loads, and Characteristic design strength. **05 hrs**

2. Ultimate Strength of R.C. Sections

General aspects of Ultimate strength, Stress block parameters for limit state of collapse, Ultimate flexural strength of singly reinforced and doubly reinforced rectangular sections, Ultimate flexural strength of flanged sections, Ultimate shear strength of RC sections, Concept of development length and anchorage. **11 hrs**

3. Flexure and Serviceability Limit States

General Specifications for design of beams for flexure -practical requirements, size of beam, cover to reinforcement-spacing of bars. General aspects of serviceability-Deflection limits in IS: 456 – 2000-Calculation of deflection, Cracking in structural concrete members, Calculation of deflections and crack width. **04 hrs**

Unit II

4. Design of Flexural members.

General consideration of design of slabs, rectangular slabs spanning one direction, Rectangular slabs spanning in two directions for various boundary conditions. Design of simply supported, cantilever slabs. Design procedures for critical sections for moment and shear. Anchorages of bars, check for development length, Reinforcement requirements, Slenderness limits for beams to ensure lateral stability, Design examples for Simply supported and Cantilever beams for rectangular and flanged sections. **13 hrs**

5. Design of Columns

General aspects, effective length of column, loads on columns, slenderness ratio of columns, minimum eccentricity, design of short axially loaded columns, design of column subject to combined axial load, uniaxial and biaxial moment using SP –16 charts **07 hrs**

Unit III

6. Design of Isolated footing

Design of isolated Footing subjected to axial load and uniaxial moment. Design of square footing, rectangular footing, rectangular footing with eccentric loads. **07 hrs**

7. Design of Staircase

General features, types of staircase, loads on stairs, effective span as per IS codal provisions, distribution of loading on different types of stairs, Design of stairs. **05 hrs**

Text Books

1. Jain, A.K., *Limit State method of design*, 7ed., Nemichand and Bros., Roorkee, 2012.
2. Punmia B.C., Ashok Kumar Jain, and Arun Kumar Jain *Limit State Design of Reinforced Concrete*, Laxmi Publications Pvt. Ltd., New-Delhi-2016.

Reference Books:

1. Bhavikatti, S. S., *Design of RCC Structural Elements Vol-I,* New Age International Publications, New Delhi, 2016.
2. Krishnaraju, N., *Design of Reinforced Concrete Structures (IS: 456 – 2000)*, 3ed., CBS Publishers, New Delhi, 2016.
3. Robert Park & Thomson, *Reinforced Concrete*, John Wiley & Bros, 2009.
4. S. Unnikrishnan Pillai and Devdas Menon, *Reinforced Concrete Design Third Edition,* Tata McGraw Hill Education Pvt. Ltd., New-Delhi-2017.

IS Codes

1. IS:456-2000, *Plain and Reinforced Concrete – Code of Practice,* (Fourth Revision) BIS, New Delhi, 2007
2. IS:875 (Part 1 & 2) - 1987, *Code of Practice for Design Loads (Other than earthquake) for building and structures*, BIS, 1987
3. SP 16: *Design Aids for Reinforced Concrete to IS 456:1978.*

Course Title: **Transportation Engineering** Course Code: **15ECVC304**

L-T-P : **4-0-0-0** Credits: **4** Contact Hrs: **4**

ISA Marks: **50** ESA Marks: **50** Total Marks: **100**

Teaching Hrs: **4** Exam Duration: **3 Hrs**

Unit – 1

1. Highway Network Planning

Different modes of transportation, Characteristics of road transport, Jayakar committee recommendations and implementation, Types of Roads, Road patterns, planning surveys and Phasing of road development in India, Salient features of 3rd and 4th 20year road development plans, Highway development authorities – NHAI, MoRTH, KSHIP, KRDCL, Present scenario of road development nationally and at state level – Bharatmala Project, NGHM, NHDP, PMGSY, Vision 2021, Introduction to highway economics and financing. 3 hrs

2. Highway Alignment

Environmental stewardship in selection of best natural landscape, the terrain or topographical features for road alignment, factors affecting in selection of highway alignment, Engineering surveys, Steps involved in Preparation of Detailed Project Report (DPR) for new highway alignment and realignment of highway. 3 hrs

3. Geometric Design of Highways

Functional design of highways, Cross Section Elements of highways, Sight Distance, Design of Horizontal and Vertical Curves. 14 hrs

Unit – 2

4. Traffic Engineering

Components of road traffic- vehicle, driver and road, Road user, vehicle and traffic characteristics, Methods of traffic study-equipment used, data collection, analysis and interpretation of speed studies, traffic volume count, origin – destination studies, parking studies, accident studies, Traffic flow and roadway capacity – traffic flow characteristics, traffic stream flow characteristics, speed-flow-density relations, concept of PCU, capacity and level of service, Traffic regulations and control - regulations and control on drivers, vehicles and traffic flow, traffic signs, traffic signals, types and design methods, Principles of design of at-grade intersections – channelized, rotary and signal intersections, Introduction to traffic flow theories, Features involved in road safety audit system, Introduction to grade separated intersections. Introduction to public transit system. 14 hrs

5. Pavement Materials 6 hrs

Desirable properties of subgrade soil, road aggregates and bituminous materials relevant to pavement applications. Requirements of pavement quality concrete (PQC), Bituminous mixes- preparation, design and testing. Sustainable management of natural resources in road construction.

Unit – 3

7.Pavement Design and Construction

Embankment / Subgrade, Granular sub base course, Granular base course, Prime Coat, Cementaceous Subbase/Base course, Bituminous base course, Tack Coat, Bituminous surface course, Dry Lean Concrete base course, Pavement Quality Concrete surface course, Compaction and Stabilization techniques in pavement construction, Construction of different types of joints in rigid pavement, Highway drainage system, Integration of science, technology and innovation into highway construction in order to develop a sustainable road project. 10 hrs

Pavement components and their functions -Factors influencing the design of pavements -Design principles -Design of flexible and rigid pavements as per IRC.

Course Project: Group Traffic Studies - Study on road safety measures, Evaluate existing Parking Facility in KLETU campus, Study on Pedestrian & Cycling facility in the campus Etc.

Text Books (List of books as mentioned in the approved syllabus)

1. Khanna S.K., and C.E.G. Justo, & A. Veeraragavan, Highway Engineering, 10th ed., Nem Chand and Bros. Publishers, Roorkee, 2016.
2. Kadiyali.L.R L.R., Traffic Engineering and Transportation Planning, 10th ed., Khanna Publishers, New Delhi,2017.
3. Kadiyali.L.R. Principles and Practices of Highway Engineering, 7th ed., Khanna Publishers, New Delhi, 2017.
4. Kasthurirangan Gopalkrishnan, Sustainable Highways, Pavements and Materials, Createspace Independent Publication, 2011.
5. Papacostas C.S. and Prevedourous, P.D., Transportation Engineering and Planning, 3 ed., Prentice-Hall India, New Delhi, 2002.

References

1. Fwa, Handbook of Highway Engineering, Taylor & Francis Group, Newyork, 2006.
2. C. Jotin Khisty, B.Kent lal, Transportation Engineering, PHI Learning Pvt. Ltd. New Delhi, 2014.
3. Ministry of Road Transport and Highways (MoRTH), Specification for Road and Bridge Works (5th revision 2014), Indian Road Congress, New Delhi.
4. IRC: 73-1980-Geometric Design Standards for Rural (Non Urban) Highways, Indian Road Congress, New Delhi.

5. IRC: 37-2012 –Guidelines for the Design of Flexible Pavements (Third Revision), Indian Roads Congress, New Delhi.
6. IRC: 58-2015- Guidelines for the Design of Plain jointed Rigid pavements for highway, Indian Roads Congress, New Delhi.
7. IRC SP: 93-2011, Guidelines on requirements for environmental clearance for road projects.
8. IRC SP: 99-2013, Manual of specification and standards for expressways.
9. IRC SP: 19-2001, Manual for survey, investigation and preparation of road projects, Indian Road Congress, New Delhi.
10. IRC SP: 31-1992, New traffic signs', Indian Roads Congress, New Delhi.
11. IRC 9-1994, Traffic census on Non-Urban Roads (First revision), Indian Roads Congress, New Delhi.
12. IRC 64-1990, Guidelines for capacity of roads in rural areas, Indian Roads Congress, New Delhi.
13. IRC 67-2012, Code of practice for road signs, Indian Roads Congress, New Delhi.
14. IRC 70-1977, Regulation and control of mixed traffic in urban areas, Indian Roads Congress, New Delhi.
15. IRC 93 – 1985, Guidelines on design and installation of road traffic signals, Indian Roads Congress, New Delhi.
16. IRC: SP: 44-1996, Highway safety code, Indian Roads Congress, New Delhi.
17. IRC: 102- 1988- Traffic studies for planning bypasses around town, Indian Roads Congress, New Delhi.
18. IRC 124-2017, Bus Rapid Transit (BRT) design guidelines for Indian cities, Indian Roads Congress, New Delhi.
19. IRC: 106- 1990, Guidelines for capacity of urban roads in plain areas, Indian Roads Congress, New Delhi.
20. IRC: 99 – 2018 – Guidelines for traffic calming measures in urban and rural areas, Indian Roads Congress, New Delhi.

Course Title: Construction Economics & Management		**Course Code: 21ECVC305**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Project Organization

Introduction, Forms of business organizations, Structure of construction organization, organizing for project management, management levels, traits of a project manager and project coordinator, Factors behind the success of a construction organization. **05 hrs**

2. Construction Economics

Introduction, economic decision making, Time Value of Money, Cash Flow Diagrams, Using Interest Tables, Evaluating Alternatives by Equivalence, Effect of Taxation on Comparison of Alternatives, Effect of Inflation on Cash Flow, Evaluation of Public Projects: Discussion on Benefit-cost Ratio **10 hrs**

Unit II

3.Project Control

Determination of unit costs and total cost of a typical construction project. Project Controls - Introduction, Project life cycle, Overview of project life cycle, earned value management, cost performance Index, Schedule performance index, forecasting methods and problems, resource utilization and cumulative curves, Cost loaded Schedules. **10 hrs**

4. Construction Material Management **05 hrs**

Introduction, Material procurement process in construction organization, material management functions, inventory management.

Unit III

6. Construction Accounts Management

Introduction, Principles of Accounting, Accounting process, Construction Contract Revenue Recognition, Construction contract status report, Limitations of accounting, Balance Sheet, Profit and Loss Account, Working Capital, Ratio Analysis, Funds Flow Statement. **06 hrs**

7. Construction Equipment Management

Introduction, Plant and Equipment Acquisition, Depreciation, Methods of Calculating Depreciation, Example of Depreciation Calculations for Equipment on Site, The Effect of Depreciation and Tax on Selection of Alternatives, Evaluating Replacement Alternatives. **04 hrs**

Text Books

1. Kumar Neeraj Jha, *Construction Project Management – Theory and Practice*, 2ed., Pearson Publication, 2015.

2. Gupta B. L., Amit Gupta, *Construction Management and Machinery*, 5ed, Standard Publications, New Delhi, 2017.

Reference Books:

1. Shrivastava U. K., *Construction Planning and Management*, Galgotia Publication Pvt. Ltd., New Delhi-2007.
2. Verma Mahesh, *Construction planning and Management*, Metropolitan Book Co., Delhi,1982.
3. Seetharaman S., *Construction Engineering and Management*, Umesh Publications, New Delhi, 2006.

Course Title: Highway Engineering Laboratory **Course Code: 15ECVP301**
L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2 Hrs/ week**
ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**
Teaching Hours: 30 **Examination Duration: 3 Hrs**

Unit I

Demonstration Experiment

1. Demonstration of fifth wheel bump integrator, Benkelman beam deflectometer (BBD), Axle load weighing bridge, Specific gravity test on Bitumen

Tests to characterize given aggregates as Highway Construction material

1. Determine the resistance of an aggregate to sudden impact due to moving traffic.
2. Relative measure of the resistance of an aggregate under a gradually applied compressive load through vehicular wheel.
3. Determine the resistance of an aggregate to wearing action caused by vehicular movement.
4. Determine the aggregate quality used in road construction through specific gravity and water absorption test.
5. Aggregate Shape Tests
   i. Flakiness Index on aggregate
   ii. Elongation Index on aggregate
   iii. Angularity Number of aggregate
6. Developing Job mix formula (JMF) for Bituminous Concrete layer by Rothfutch's method of aggregate proportioning and mid gradation method.

Tests to characterize given bitumen sample as Highway Construction material

1. Determine consistency of bitumen sample.
2. Measure the adhesive property of bitumen with aggregates and its ability to stretch by ductility test.
3. Softening temperature of given bitumen sample used in the paving jobs.
4. Classify the given bitumen sample based on viscosity grading method.
5. Determine flash and fire point of bitumen sample.
6. Effect of accelerated heating on given bitumen sample.

Structured Enquiry Test

1. Confirmation of Moorum as a road subgrade material by measuring its required strength through CBR test.
2. Marshall Mix Design and mix property analysis for bituminous concrete adopting mid gradation method.

Open Ended Experiments

1. Conduct Fatigue and rutting performance of Designed Bituminous Concrete mix specimen by using IDT setup and Wheel Tracking Machine.

Reference Books:

1. Khanna S.K., Justo C.E.G., and Veeraragavan, A., *Highway Materials and Pavement Testing*, Nem Chand and Bros, Roorkee

IS Codes

1. IS : (2386:1963)– *Methods of test for aggregates for concrete*
2. IS: 2720 (Part 16)-1997, *Laboratory Determination of CBR, Rev.2.* Indian standard method of test for soils
3. IS 383: 2016 *Indian standard specifications for coarse and fine aggregates from natural sources.*

4. IS 73: 2013, *Indian standard specifications for paving bitumen'.*

Course Title: Environmental Engineering Laboratory		**Course Code: 15ECVP302**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

1. Determination of Solids in Sewage: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids.
2. Electrical conductivity and pH.
3. Determination of Calcium, Magnesium and Total Hardness
4. Determination of Alkalinity, Acidity
5. Determination of Sulphates, Chlorides
6. Determination of Dissolved Oxygen and BOD.
7. Determination of COD.
8. Determination of Residual Chlorine.
9. Jar Test for Optimum Dosage of Alum, Turbidity determination
10. Determination of Iron.
11. Determination of Nitrate.
12. Determination of Fluorides.
13. Determination of MPN

Reference Books:

1. *Standard Methods for Examination of Water and Wastewater*, 22nd American Publication – Association, Water Pollution Control Federation, American Water Works Association, Washington DC., 2012

IS Codes

1. IS 10500:2012, *Drinking Water Specification*, BIS, New Delhi
2. IS 3025 (Part 62) : 2006 *Methods of Sampling and Test (Physical & Chemical) for water and waste water*, BIS, New Delhi
3. IS 3307:1977, *Tolerance Limits For Industrial Effluents Discharged on Land and Irrigation Purpose*, BIS, New Delhi

Course Title: Design & Construction Site Management Workshop. **Course Code: 17ECVP301**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2 Hrs/ week**
ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**
Teaching Hours: 30 **Examination Duration: 3 Hrs**

Preamble:

Through the courses in the preceding semesters (3rd, 4th and 5th), the students are studying the basics of many courses in the fields of construction engineering and management, structural engineering, geotechnical engineering, environmental engineering and transportation engineering. This course aims to bridge the gaps between theoretical concepts learned in classroom and their practical applications in the industry.

Course will be delivered through a series of site visits and guest lectures from industry experts.

Deliverables:

Student group will be given a hypothetical site where in their job profile will be of a project manager. Guest lectures from project managers and site engineers will provide the necessary tools and work cultures on the site, which the students have to apply to their project.

The students will learn the following concepts as practiced in the field:

1. Roles and responsibilities of various stakeholders involved like the owner, architect, structural consultant and the general contractor.
2. The material procurement process – quality and cost negotiation process. Costs involved in using RMC or procurement of raw materials to produce concrete on site etc.
3. Labour cost negotiations, roles and responsibilities, basic amenities to be provided and person-hour tracking.
4. Safety protocol followed in the jobsite.
5. Process of material delivery on the job site and coordination with the accounts department.
6. Technical problems encountered during execution – For example, deep well located during excavation – design changes to be made, concrete strength failure after 28 days – what measures to be taken, errors during surveying of the building, honeycombing or bulging of concrete etc.
7. Tracking of the progress – both time and cost. Creating of monthly progress reports.
8. Equipment management – renting vs owning, maintenance.
9. Roles and responsibilities on the project manager, site engineers, supervisors,

safety officers.

10. Store management.
11. On site testing and third-party testing – advantages and disadvantages.
12. Site layout for optimum utilization of construction space.
13. Reconciliation of materials like formwork, steel etc.

The student team will submit a comprehensive report about the management of a construction site and the difficulties and solutions employed to their sites and present their case.

References books:

1. Kumar Neeraj Jha, *Construction Project Management: Theory and Practice*, 2ed., Edition, Pearson Publications, 2015.
2. Robert. L Peurifoy and William B. Ledbetter, *Construction planning and Equipment& methods*, Tata McGraw Hill Pvt. Ltd, New Delhi, 3ed., 2010.
3. Ursula Kuehn, *Integrated Cost and Schedule Control in Project Management,* 2ed.,2011.

Course Title: Mini Project		**Course Code: 15ECVW301**
L-T-P: 0-0-3	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

(To be conducted in the beginning of 5th Semester for a period of 5 days, Viva voce conducted along with 5th semester exams)

An extensive survey training involving investigation and design of the following projects is to be conducted for 6 days. The student shall submit a project report consisting of designs and drawings.

1. General instructions

Reconnaissance survey of the sites and perform fly leveling to establish bench marks.

2. Water Supply and Sanitary Project

Examination of sources of water supply, Calculation of quantity of water required based on existing and projected population. Plotting of village map by using Total station. Location of sites for ground level RL's, overhead tanks underground drainage system surveys for laying the sewers.

3. Highway Project

Preliminary and detailed investigations to align a three alternative routes(min. 1 to 1.5 km stretch) between two given obligatory points. The investigations shall consist of topographic surveying of strip of land for considering alternate routes and for final alignment. Report should justify the selected alignment with details of all geometric designs for traffic and design speed assumed. Drawing shall include key plan initial alignment, final alignment, longitudinal section along final alignment, typical cross sections of road.

NOTE:

A) For the above works Total Station should also be used along with conventional instruments.

B) All relevant drawings to be prepared using AUTOCAD.

Reference Books:

1. Basak N.N., *Text Book of Surveying and levelling,* ,2ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
2. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2016.
3. *CPHEEO: Manual on water supply and treatment*, ministry of urban development, 3ed., 1999.
4. Duggal S.K., *Text Book of Surveying,* 4ed., Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2013.
5. Garg, S.K., *Water supply Engineering*, 7ed., Khanna Publishers, New Delhi, 2005.
6. Kadiyali, L.R., Traffic Engineering and Transportation Planning, 7ed., Khanna

Publishers, New Delhi, 2011.

7. Khanna, S.K., and C.E.G. Justo, & A. Veeraragavan, *Highway Engineering*, 10ed., Nemi Chand and Bros. Publishers, Roorkee, 2015.
8. Modi, P.N., *Sewage Treatment and Disposal Engg.,* 15ed., Std. Book House, New Delhi, 2015.
9. Punmia B.C., Jain, Ashok K. Jain, Arun K. *Surveying Vol. 1 and Vol-2*, Lakshmi Publishers, 2015.
10. *IRC: 37-2012, Guidelines for the Design of Flexible Pavements (Third Revision)*, Indian Roads Congress, New Delhi.
11. *IRC:15-2011, Construction of Concrete Roads,* Indian Roads Congress, New Delhi.
12. *IRC: 58-2015,Guidelines for the Design of Plain jointed Rigid pavements for highway*, Indian Roads Congress, New Delhi.

Course Title: Numerical methods and Statistics **Course Code: 15EMAB301**
L-T-P: 3-0-0 **Credits: 03** **Contact Hours: 40**
ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**
Teaching Hours: 04 **Examination Duration: 3hrs**

Unit I

1. Numerical Methods **08 hours**

Introduction to numerical methods. Roots of equations using Bisection Method, Newton-Raphson Method, Finite differences, Forward, Backward Operators. Newton Gregory forward and backward interpolation formulae. Newton's divided difference formula for un equal intervals. Numerical solution of first order ODE, Euler's and Modified Euler's method, Runge Kutta 4^{th} order method. Implementation using C-programming

2. Matrices and System of linear equations **08 hours**

Introduction to system of linear equations, Rank of a matrix by elementary row transformations. Consistency of system of linear equation solution of system by (i) Direct methods-Gauss elimination, Gauss Jordon method (ii) Iterative methods- Guass-Seidal method. Eigenvalues and Eigenvectors of a matrix. Largest Eigenvalue and the corresponding Eigenvector by power method. Implementation using C-programming.

Unit II

3. Curve fitting and regression **05 hrs**

Introduction to method of least squares, fitting of curves $y = a + bx$, $y = ab^x$, $y=a + bx +cx^2$, correlation and regression..

4. Probability **09 hrs**

Definition of probability, addition rule, conditional probability, multiplication rule, Baye's rule. (no proof) Discrete and continuous random variables- PDF-CDF- Binomial, Poisson and Normal distributions (Problems only).

Unit III

5. Sampling distributions

(a) Sampling, Sampling distribution, Standard error, Null and alternate hypothesis, Type-I and Type- II errors, Level of significance. Confidence limits for means (large sample). **05 hrs**

(b) Testing of hypothesis for means. large and small samples and student's t- distribution and Confidence limits for means (small sample). **05 hrs**

Text Books

1. Bali and Iyengar, *A text book of Engineering Mathematics*, 6ed, Laxmi Publications(p) Ltd, New Delhi,2003
2. Chapra S C and Canale R P, *Numerical methods for Engineers*, 5ed, TATA McGraw-Hill, 2007
3. Gupta S C and Kapoor V K, *Fundamentals of Mathematical Statistics*, 9ed, Sultan Chand & Sons, New Delhi, 2002

Reference Books:

1. Sastry S S, *Introductory method for numerical analysis*, 3ed, PHI, 2003.
2. J. Susan Milton, Jesse C. Arnold, *Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences*, 4^{th} ed, TATA McGraw-Hill Edition 2007.

6th Semester

Course Title: Advanced Geotechnical Engineering | **Course Code: 15ECVC306**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

Unit I

1. Subsurface Exploration

Importance of exploration program, Methods of soil exploration: Boring, sounding tests and geophysical Methods. Types of soil samples. Stabilization of boreholes. Typical bore log. Number and depth of borings for various civil engineering structures. Location of ground water table in fine and coarse grained soils. **03 hrs**

2. Lateral Earth Pressure

Active and Passive earth pressures, Earth pressure at rest, Earth pressure coefficients. Earth pressure theories- Rankine's and Coulomb's –assumptions and limitations, Lateral earth pressure in cohesive and cohesionless soils, Earth pressure distribution, Graphical solutions for active earth pressure Cullman's and Rebhann's methods. **06 hrs**

3. Stability of Earth Slopes

Types of slopes, causes and type of failure of slopes. Definition of factor of safety, Stability of finite and infinite slopes- Method of slices, Friction Circle method, Fellineous method, Taylor's stability number. **06 hrs**

Unit II

4. Shallow Foundation

Definitions of ultimate, net and safe bearing capacities, Allowable bearing pressure. Bearing capacity estimation – Analytical and Field methods. Effect of ground water table on bearing capacity. **06 hrs**

5. Deep Foundation

Types of Deep foundation - Piles, Drilled Piers and Caissons. Load carrying capacity of pile – Analytical and Field Test. Design of pile and pile groups. Negative skin friction. Introduction to under reamed piles. **06 hrs**

6. Foundation Settlement

Settlement Analysis, Data for settlement analysis, computation of settlement, Concept of immediate, consolidation and secondary settlements. Factors affecting settlement. Tolerance BIS specifications for total and differential settlements. Concept of contact pressure and active zone. Settlement of tank foundations. **03 hrs**

Unit III

7. Soil Stabilization and Reinforced soil

Introduction. Methods of soil stabilization. Reinforced soil - basic mechanism, choice of soil and reinforcement, Strength characteristics of reinforced soil. Design of Reinforced soil walls. Reinforced soil slab. **06 hrs**

8. Containment of solid waste in landfills

Waste containment. Landfills - Shapes and size of landfills, Types of landfills. Impervious barriers for liners and covers. Stability of landfills. Landfill construction and operation. Landfill selection and design aspects. **04 hrs**

Text Books

2. Alam Singh and Chowdhary G.R. (1994), *Soil Engineering in Theory and Practice,* 2ed, CBS Publishers and Distributors Ltd., New Delhi, 2014.
3. Braja M. Das, *Principles of Geotechnical Engineering*, 8ed., Cenage Learning India Pvt. Ltd., India, 2014.
4. Punmia B.C., *Soil Mechanics and Foundation Engineering*, 17ed, Laxmi Publications Co., New Delhi, 2018.

Reference Books:

1. Das. B.M, *Principles of Foundation Engineering*, 8ed., Thomson Business Information India (P) Ltd., India, 2014
2. Gopal Ranjan and Rao A.S.R., *Basic and Applied Soil Mechanics*, 3ed, New Age International (P) Ltd., New Delhi, 2016.
3. Knappett J.A and R.F Craig, *Soil Mechanics*, 8ed., Van Nostrand Reinhold Co. Ltd., 2012.
4. Murthy, V.N.S., *Soil Mechanics and Foundation Engineering*, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2016.
5. Som N.N. and Das S.C, *Theory and practice of foundation engineering*, PHI learning Pvt Ltd, 2009.
6. Sashi K Gulhati and Manoj Datta, *Geotechnical engineering*, Tata Mcgraw Hill Education Pvt. Ltd., New Delhi, 2016.
7. Swami Saran, *Analysis and Design of Substructures: Limit State Design*, 2ed, oxford and IBH Publishing Co. Pvt. Ltd, 2006.
8. Sivakumar Babu G. L., *Introduction to Soil Reinforcement and Geosynthetics*, Universities Press, Hyderabad, 2006.
9. Venkatrahmaiah, C., *Geotechnical Engineering*, 6ed., New Age International (P) Ltd., New Delhi, 2018.
10. Soil Mechanics and Foundations 3rd ed., Muniram Budhu, ISBN: 978-0-470-55684-9, John Wiley & Sons Publishers, 2011.

IS Codes

5. IS 8403 : 1981 (Reaffirmed 2002) *Code of practice for Determination of Bearing Capacity of Shallow Foundations.*
6. IS 2911:1985 Part I to IV (Reaffirmed 1995) *Code of Practice for Design and Construction of Pile Foundations.*
7. IRC-SP-102-2014-*Guidelines for design and construction of reinforced soil*

walls.

8. SP-36 (Part – 2) -1988 (R 2006) *Compendium of Indian standard on soil engineering – Field Testing of Soils for Civil Engineering Purpose*

Course Title: Estimation and Costing | **Course Code: 15ECVC307**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Different type of estimates, study of various drawing attached with estimates, important terms, units of measurement, Schedule of rates: Substituted items; Recasting of estimate; External services; Prime cost; Day work; Provisional sum; Taking off in Quantity Surveying; Bill of quantities abstract, approximate methods of estimating buildings, cost from materials and labour equations recommended by CBRI –examples. **05 hrs**

2. Methods of Estimation

Methods of taking out quantities and cost -center line method, long and short wall method or crossing method. **03 hrs**

3. Preparation of Estimates for Building Components

Preparation of detailed and abstract estimates for the following Civil Engineering works -Buildings -Masonry structures and framed structures with flat, sloped RCC roofs. Building components (Beams, Columns and Column Footings, RCC Roof Slabs etc) **08 hrs**

Unit II

3. Preparation of Estimates for Truss & Culverts

Wooden and Steel truss, RCC slab culverts, Manhole and Septic tanks, **04 hrs**

4. Specifications

Definition of specifications, objective of specifications, standard specifications, essentials of specifications, general and detail specifications of item of works in buildings, specifications of aluminum and wooden partitions, false ceiling, aluminum and fiber doors and windows, various types of claddings. **04 hrs**

5. Rate Analysis

Definition and purpose, Types of rate analysis, Working out quantities and rates for the following standard items of works -earth work in different types of soils, cement concrete of different mixes, bricks and stone masonry, flooring, plastering, RCC works, centering and form work for different RCC items, wood and steel work for doors, windows and ventilators. **07 hrs**

Unit III

6. Estimation of Roads

Methods for computation of earthwork -cross sections -mid section formula, trapezoidal or average end area or mean sectional area formula, prismoidal formula, for different terrains. Estimation of bituminous road and cement concrete roads. **05 hrs**

7. Department (PWD) Procedures / Processes

Types of contract -essentials of contract agreement - legal aspects, penal provisions on breach of contract. Definition of the terms -Tender, E-governance, Standard Bid Document (SBD), E-procurement, KTTP Act, earnest money deposit, security deposit, tender forms, documents and types. Comparative statements, acceptance of contract documents and issue of work orders. Duties and liabilities, termination of contract, completion certificate, quality control, right of contractor, refund of deposit. Administrative approval -Technical sanction. Nominal muster roll, measurement books -procedure for recording and checking measurements - preparation of bills, Arbitration. **04 hrs**

Text Books

1. Dutta B.N., *Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and Valuation*, 28 Rev., ed., CBS Publishers' and Distributors Pvt. Ltd., 2021.
2. Dutta B.N., *Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and Valuation*, 28Rev., ed., UBS Publishers' Distributors Pvt. Ltd., 2016.

Reference Books:

1. Birde, G.S.; *Text book of Estimating & Costing*, Dhanpath Rai and Sons. New Delhi, 2014.
2. Kohli D.D. and Kohli, R.C., *Text Book of: Estimating and Costing (Civil),* 12ed., S. Chand Co. New Delhi, 2013.
3. Public Works Department Schedule of Rates 2018-19.
4. Rangawala S.C., *Estimating, Costing and Valuation,* Charotar Publishing House, 17ed., 2017.
5. Karnataka Public Works Department Code 2014

Program Elective -1

Course Title: Pre-Stressed Concrete | **Course Code:16ECVE301**

L-T-P: 3-0-0 | **Credits: 3** | **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 | **ESA Marks: 50** | **Total Marks: 100**

Teaching Hours: 40 | **Examination Duration: 3 Hrs**

Unit I

1. Introduction

Definition, Pre tensioning and Post tensioning, Materials for prestressing, Need of High strength concrete and steel, Stress-strain characteristics and properties. Methods of prestressing — **3 hrs**

2. Analysis of Sections for Flexure

Basic principles of prestressing: fundamentals, load balancing concept, stress concept and strength concept. Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles, Pressure line and thrust line. — **7 hrs**

3. Deflection of Beams

Prediction of short term and Deflections long term deflections of un-cracked members. — **5 hrs**

Unit II

4. Design of Beams

Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of prestressing force and eccentricity, limiting zone of pre-stressing force cable profile. Analysis of PSC members for shear as per IS 1343-1984. — **9 hrs**

5. Analysis of Continuous Beam

Secondary moments in continuous beams, Concordant cable profile for straight and parabolic cable profile. — **6 hrs**

Unit III

6. Design of End Blocks

Transmission of pre stress in pre tensioned members, transmission length, Anchorage stress in post- tensioned members. Bearing stress and bearing tensile force-stresses in end blocks-Methods, I.S. Code, provision for the design of end block reinforcement — **5hrs**

7. Losses of Prestress

Various losses encountered in pre- tensioning and post tensioning methods, determination of jacking force. — **5hrs**

Text Books

1. 1. Krishna Raju, N, *Pre-stressed Concrete*, Tata Mc. Graw Publishers, 2012
2. 2. Rajagopalan N, *Prestressed Concrete*, Narosa book distributers, 2010

Reference Books:

1. Sinha, N .C. & Roy, S.K, *Fundamentals of pre-stressed concrete*, S Chand publications, 2011
2. Lin, T. Y., and Ned H. Burns, *Design of Pre-stressed Concrete Structures*, Wiley India Private limited, 2010
3. Dayarathnam, P Sarah, *Pre-stressed Concrete structures*, Medtech, 2017
4. Ramamrutham, *Pre-stressed Concrete*, Dhanapatrai Publications, 2017

Course Code: **15ECVE304**	Course Title: **Traffic Engineering**	
L-T-P: 3-0-0	Credits: **3**	Contact Hrs: 3hrs/week
ISA Marks: 50	ESA Marks: **50**	Total Marks: 100
Teaching Hrs: 30		Exam Duration: 3 hrs

Content	Hrs
Unit – 1	
1. Traffic Stream Characteristics Introduction to traffic engineering: Road user characteristics, human and vehicle characteristics; Fundamental parameters and relations of traffic flow: speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams	4
2. Microscopic Traffic Characteristics Time headway and Time headway distribution and classification. Random, Constant, Intermediate Headway state. Vehicular speed trajectories, speed characteristics under uninterrupted flow conditions, distance headway characteristics, Vehicle Arrivals, Car-following theories and applications. Traffic stability.	7
3. Macroscopic Traffic Characteristics Temporal, spatial and modal flow patterns, uninterrupted and interrupted traffic flow applications. Speed and travel time variations, travel time and delay study techniques. Density measurement techniques, estimation of total travel time and traffic demand.	4
Unit – 2	
4. Capacity Analysis Capacity and Level of service LOS: Definitions, highway capacity, factors affecting LOS, HCM (Indo-HCM) methods; Urban Street: Classification, operational performance measures, congestion management; Multilane highways: Characteristics, capacity and level of service; Freeway operations: Operational considerations, capacity and level of service of a basic freeway segment, weaving operation; Ramp metering: Merging and diverging areas; gap acceptance, speed at ramps; fixed,	6

reactive, and predictive systems; Corridor analysis: Segment capacity, free flow travel time, queue delay, transit corridor.	
5.Traffic Systems Management Traffic Management- Traffic System Management (TSM) and Travel Demand Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Tidal flow operations, Bus priority techniques. Evaluation of traffic management plan.	4
6. Traffic Stream Models Greenshields's model, Greenberg's logarithmic model, Underwood's exponential model, pipe's generalized model, multi-regime models; Moving observer method. Problems	5
Unit – 3	
7. Shock wave and Queueing Analysis Introduction to shock waves, Shock wave equation, shockwaves at signalized intersections, along a highway, along a pedestrian-way. Deterministic queueing and stochastic analysis.	4
8. Traffic simulation models - Calibration and validation Fundamentals of Traffic Simulation; Concepts of microscopic models. A basic methodological approach for calibrating and validating a microscopic traffic simulation model. Calibration and validation guidelines. Calibration, validation and data availability. Goodness-of-fit measures. Time series analysis comparisons for the validation. Traffic Simulator: MITSIM, VISSIM; Traffic simulation models for mixed traffic conditions.	6

Text Books:

1. Khanna S.K., and C.E.G. Justo, & A. Veeraragavan, Highway Engineering, 10th ed., Nem Chand and Bros. Publishers, Roorkee, 2016.
2. Kadiyali.L.R L.R., Traffic Engineering and Transportation Planning, 10th ed., Khanna Publishers, New Delhi,2017.
3. May, Adolf D. Traffic Flow Fundamentals. Englewood Cliffs, New Jersey: Prentice-Hall, 1990. ISBN 0139260722.

References:

1. Matson, T.M., Smith W.S., Hurd, H.W. "Traffic Engineering", McGraw Hill Book Co.Inc.,New York,2005.
2. Nicholas J Garber & Hoel, "Traffic and Highway Engineering", 4th ed, 2009.

3. Drew, D.R. "Traffic Flow Theory and Control ", McGraw Hill Book CO.2002
4. Wiiliam R. McShane and Roger P, Roess, "Traffic Engineering", Prentice Hall, New Jersey,2000.
5. Barceló, J. "Models, Traffic Models, Simulation, and Traffic Simulation". Barceló, J. ed. Fundamentals of traffic simulation. New York: Springer, 2010. P. 1.
6. Papacostas, C.A., "Fundamentals of Transportation Engineering." Prentice-Hall of India Private Limited, New Delhi,2000.
7. Whol, Martin Traffic Systems Analysis for Engineers and Planners, McGraw Hill, London.
8. IRC SP: 31-1992, New traffic signs', Indian Roads Congress, New Delhi.
9. IRC 9-1994, Traffic census on Non-Urban Roads (First revision), Indian Roads Congress, New Delhi.
10. IRC 64-1990, Guidelines for capacity of roads in rural areas, Indian Roads Congress, New Delhi.
11. IRC 67-2012, Code of practice for road signs, Indian Roads Congress, New Delhi.
12. IRC 70-1977, Regulation and control of mixed traffic in urban areas, Indian Roads Congress, New Delhi.
13. IRC: 99 – 2018 – Guidelines for traffic calming measures in urban and rural areas, Indian Roads Congress, New Delhi.
14. IRC 93 – 1985, Guidelines on design and installation of road traffic signals, Indian Roads Congress, New Delhi. IRC 124-2017, Bus Rapid Transit (BRT) design guidelines for Indian cities, Indian Roads Congress, New Delhi.
15. IRC: 106- 1990, Guidelines for capacity of urban roads in plain areas, Indian Roads Congress, New Delhi.
16. IRC: SP: 44-1996, Highway safety code, Indian Roads Congress, New Delhi.
17. IRC: 102- 1988- Traffic studies for planning bypasses around town, Indian Roads Congress, New Delhi.

Course Title: Pavement Engineering **Course Code: 15ECVE303**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 **Examination Duration: 3 Hrs**

Unit I

1. Fundamentals of Pavement Design

Types of Pavements – Flexible, Rigid & White topping, Desirable characteristics of pavement, requirements of airfield pavements, Functions of individual layer, difference between Highway pavement and Air field pavement. **06 hrs**

Factors affecting design and performance of flexible pavement – Design life, Design wheel load, Traffic factors, Climatic factors, subgrade strength and Drainage, ESWL concept and analysis (Stress criteria, deflection criteria and graphical method), EWLF concept and analysis.

2. Stresses and Deflections in Flexible Pavements

Application of elastic theory, stresses, deflections / strains in single, two and three layer system, Applications in pavement design. **08 hrs**

Unit II

3. Modern Flexible Pavement Design

Flexible pavement design: Empirical, Semi- empirical and Theoretical design approaches, Principle, Advantages and Application. Detail Design of Flexible pavement as per IRC: 37-2012 Guidelines, comparative study of IRC: 37-2001 and IRC: 37-2012 as differences, Software used for analysis are IITPAVE and KENPAVE. **10 hrs**

4. Stresses in Rigid Pavement

Factors considered – Wheel load and its repetition, subgrade strength & proportion, strength of concrete – modulus of elasticity, Analysis of stresses in the rigid pavement, Westergaard's analysis – Modified Westergaard's equations, Critical stresses in the rigid pavement. **05 hrs**

5. Design of Rigid Pavement

05 hrs

Design of Rigid pavements as per IRC: 58 -2015.

Unit III

6. Flexible & Rigid Pavement Failures, Maintenance and Evaluation

Types of failures, Causes, Maintenance measures, Functional Evaluation of flexible pavements by Condition survey and roughness study using Bump Integrator, Structural Evaluation of Flexible pavements by BBD, FWD, GPR method. Design of Overlay thickness by BBD method. **06 hrs**

Text Books

1. Yoder E.J. and Witczak, *Principles of Pavement Design*, 2ed. John Wiley and Sons, 1975.

2. Khanna, S.K., Justo C.E.G., & A. Veeraragavan, *Highway Engineering,* 10ed. Nem Chand and Bros. Publishers, Roorkee, 2014.
3. Kadiyali L.R. and Dr. Lal N.B., *Principles and Practices of Highway Engineering*, Khanna publishers, 2016.

Reference Books:.

1. T. Fwa, *The Handbook of Highway Engineering*, Taylor & Francis Group, Newyork, 2006.
2. Ministry of Road Transport and Highways, *Specification for Road and Bridge Works* (Fifth revision 2014), Indian Road Congress, New Delhi.
3. IRC: 37-2012 -*Guidelines for the Design of Flexible Pavements* (Third Revision), Indian Roads Congress, New Delhi.
4. IRC: 58-2015- *Guidelines for the Design of Plain jointed Rigid pavements for highway*, Indian Roads Congress, New Delhi.
5. IRC 81-1997- *Guidelines for strengthening of flexible road pavements using Benkelman beam deflection technique,* Indian Roads Congress, New Delhi.
6. IRC 101-1988-*Guidelines for Design of Continuously Reinforced Concrete Pavement with Elastic Joints*, Indian Roads Congress, New Delhi.

Course Title: Engineering Hydrology and Hydraulic Structures		Course Code: 15ECVE304
L-T-P: 3-0-0	Credits: 3	Contact Hours: 3 Hrs/ week
ISA Marks: 50	ESA Marks: 50	Total Marks: 100
Teaching Hours: 40	Examination Duration: 3 Hrs	

Unit I	
1. Hydrology and Its Statistics: Flow duration curves, Stage Discharge Curves, Hydrologic Routing, Risk, reliability, and safety factor, Flood frequency studies; Flood forecasting: Rational method, Time Area curves.	**07 hrs**
Introduction top Water Resources: Basic concepts of systems, need for systems approach in water resources,	**02 hrs**
2. Reservoir sedimentation: Reservoir Design Studies: Area-volume curves, types of reservoirs and zones of storage, storage capacity of reservoirs, Mass curve technique, Reservoir flood routing, sedimentation of reservoirs. Development of storage-yield-reliability The process of erosion, factors affecting erosion. Trap efficiency and numerical problems. Reservoir sedimentation, life of a reservoir.	**07 hrs**
Unit II	
1. Gravity Dams and Earthen Dams: Introduction, forces acting on a gravity dam, types of joints. Stress analysis in gravity dam, design of gravity dam, stability analysis and drainage galleries in gravity dams. Introduction, types of Earth dams, Design criteria for Earth dams, causes of failure of earth dams, section of dams, preliminary design criteria and problems on it, control of seepage through earth dams.	**10 hrs**
2. Cross Drainage works and Spillways: Types of cross drainage works. Features of design of cross drainage works. Design of siphon aqueduct. Introduction, essentials of a spillway, Energy dissipation below spillways.	**06 hrs**
Unit III	
3. Diversion Head Works: Introduction, Khosla's theory, method of independent variables, elements of design for surface flow. Design of vertical drop weir on Bligh's theory. Function of canal head regulator.	**08 hrs**

Text Books

1. Ven Te Chow, Hand Book of Hydrology – M'c Graw Hill Publications, New Delhi, 1987.
2. Larry W. Mays, Water Resources Engineering - John Wiley & Sons, Inc, Tokyo, 2010
3. Garg S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna

Publications, New Delhi, 2005.

4. Punmia B.C. and Pande Lal, *Irrigation and Water Power Engineering*, 16ed., Laxhmi Publications, New Delhi, 2009.
5. Sharma R.K., *Text Book of Irrigation Engineering and Hydraulic Structures*, S. Chand, New Delhi, 2002.
6. Sathyanarayana Murthy Challa, *Water Resources Engineering*

Reference Books:

1. Modi P.N., *Irrigation, Water Resources, and Water Power Engineering*, Standard Book House, New Delhi, 2004.
2. Madan Mohan Das & Mimi Das Saikia, *Irrigation and Water Power Engineering,* PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Balasubramanya N., *Hydraulic Structures & Irrigation Design Drawing* Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2015.
4. Sathya C, Narayana Murthy, *Design of Minor Irrigation and Canal Structures* Wiley eastern limited, New Delhi, 1990.

Course Title: Geotechnical Engineering Laboratory		**Course Code: 15ECVP304**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Exercise

1. Tests for determination of specific gravity and moisture content.
2. Grain size analysis of soil sample (sieve analysis).
3. In situ density by core cutter and sand replacement methods.
4. Consistency Limits – Liquid Limit (Casagrande and Cone Penetration Methods), plastic limit and shrinkage limit.
5. Standard Proctor Compaction Test and Modified Proctor Compaction Test.
6. Coefficient of permeability by constant head and variable head methods.
7. Strength Tests
   a) Unconfined Compression Test.
   b) Direct Shear Test.
   c) Triaxial Compression Test (undrained).
8. Consolidation Test- Determination of compression index and coefficient of consolidation.

Demonstration

a) Demonstration of miscellaneous equipment's such as Augers, Samplers, Rapid Moisture meter, Proctor's needle.

b) Demonstration of Hydrometer Test.

c) Demonstration of Free Swell Index and Swell Pressure Test

d) Demonstration of determination of relative density of sands.

e) Laboratory vane shear

Open ended experiment

To use soil as foundation material and construction material.

Reference:

1. Braja M. Das., *Soil Mechanics Laboratory Manual*, 8th edition, Oxford University press, 2015.
2. Lambe T.W., *Soil Testing for Engineers*, Wiley Eastern Ltd., New Delhi, 1951.
3. Shamsher Prakash and P.K.Jain, *Engineering soil testing*, Nem Chand and Bros, Roorkee, 2013.
4. IS - SP-36 (Part – 1) -1987 (R 2006) *Compendium of Indian standard on soil engineering – Laboratory Testing of Soils for Civil Engineering Purpose.*

Course Title: Computer Aided Design Laboratory		**Course Code: 15ECVP305**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Students should be able to write coding in MS Excel using VBA, compile the same and run, for simple numerical in various civil engineering fields. They should be able to document the laboratory work in the forms of Flow charts, Algorithms, coding, output of results in tabular/graphical formats.

Also they should be able to use the available software (SAP) to analyse a simple structures and present the results in tabular/ graphical formats and generate reports.

Using MS Excel and VBA to solve Civil Engineering Problems

Structural Engineering

1. Calculating and plotting shear force and bending moment diagrams for cantilever, simply supported and fixed beams subjected to a combination of loads.
2. Calculation of deflection diagrams for cantilever and simply supported beams subjected to single point loads and UDL.
3. Design of singly and doubly reinforced rectangular sections subjected to bending moment and shear force by using design sheets developed using VBA.
4. Stability of dams.

Surveying

5. Balancing of closed traverse using transit rule
6. Computation of volume of earthwork in cutting and filling.
7. Setting out a horizontal curve by different methods – (i) Offset from long chord (ii) Perpendicular offset from tangents (iii) Radial offsets from tangents

Transportation Engineering

8. Design of super elevation
9. Design of horizontal and vertical alignment

Geotechnical Engineering

10. Analysis of cantilever retaining wall.
11. Calculation of shear parameters

Fluid Mechanics

12. Most economical section for a canal
13. Water hammer analysis
14. Head over Ogee weir

Use of Structural Analysis Software

The student shall analyse the following structures in SAP:

15. Plane truss subjected to dead loads, live loads and wind loads
16. Continuous beam with at least three spans subjected to dead loads and live loads
17. Plane frame subjected to dead loads, live loads and lateral loads.
18. Analysis of two bay two storey structure under static loading conditions (concrete frame).
19. Analysis of long span steel truss.

Reference Book:

Microsoft Excel 2010 Formulas, John Walkenbach, Wiley-India pvt. Ltd.

Course Title: Construction Engineering & Management Laboratory		**Course Code: 15ECVP306**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

1. Introduction to project management software such as Primavera P6, MS Project, etc.
2. Develop a Work Break-down Structure (WBS) for a residential building of 3 storey.
3. Create and add activities to the WBS and assign relationships as per the logic of the precedence diagram for the residential building. Determine the duration of the project.
4. Apply constraints and filters to the developed activities to develop two-week, one-month and three-month look-ahead schedule.
5. Develop different roles and resources in the resource library and assign to the various activities along with their unit rates.
6. Develop the cost-loaded schedule and create baseline of the project.
7. Perform earned value analysis to track and monitor the project.
8. Building a 3D model of a typical building in AutoCAD Revit 2018 and Synchro (Architectural, Structural and Construction Details)
9. Conduct simulations in Microsoft Visio process simulator to determine most efficient excavation cycles on large scale projects.
10. Conduct Monte-Carlo simulation in Microsoft Excel to perform risk analysis for the project.

Reference Books:

1. Kim Heldman & William Heldman, *Microsoft Excel for Project managers 2007.*
2. P. Harris, *Planning and Scheduling Using Primavera P6 2010.*

Course Title: Minor Project		**Course Code: 15ECVW302**
L-T-P: 0-0-6	**Credits: 6**	**Contact Hours: 6 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Functional and architectural design of a building from, but not restricted to one of the following category: Educational institutions, Administration buildings, Industrial buildings, Commercial buildings, Public facilities such as bus terminus, rail station, hospitals, cinema halls, auditorium etc.

The students shall identify a building for case study and collect data of the building and compare it with HDMC By-laws, NBC-2016 codes and IS codes. Further, students will carry out functional design for their proposed building through bubble diagrams and circulation diagrams and consider aspects such as orientation, aspect, best use of site conditions. The project shall include calculation of loads and analysis and design of components including foundations, columns, beams and slab. Simplified computer aided analysis should be performed.

The student shall submit the following:

- Identification of Project.
- Bubble diagrams and Circulation diagrams
- Logic used to arrive at room dimensions based on ergonomics, furniture sizes and placement, equipment etc.
- Architectural plans, elevations, sections and building services fit for submission to approving authorities
- Preliminary soil investigation.
- Results of structural analysis and design of selected components
- Drawings showing structural details of components designed
- Develop WBS, calculate productivity, create precedence diagram, develop cost-loaded schedule and create a baseline.
- Collection of progress data, update the schedule, perform earned value analysis.

Expected Deliverables:

Identify project details, bubble diagrams and circulation diagrams, complete architectural plans, Soil investigation report, Final structural design drawings and calculations, detailed WBS, productivity calculations, precedence diagram, Initial cost-loaded schedule (Primary Baseline), 1st progress report and earned value report.

Reference:

1. IS 1172 – 1971 Code of Basic Requirements for Water Supply, Drainage and Sanitation (Second Rev.), BIS.
2. IS 1642 – 1960 Code of Practice for Fire Safety in Buildings (General): Materials and Constructions in Buildings, BIS.
3. IS 1648 – 1961 Code of Practice for Fire Safety in Buildings (General): Fire fighting Equipment and its maintenance, BIS.
4. IS 1742 – 1972 Code of Practice for Building Drainage, BIS.
5. IS 2065 – 1972 Code of Practice for Water Supply in Buildings (First Rev.) BIS.
6. IS 3861 – 1975 Method of Measurement of Plinth, Carpet and Rentable Area of Buildings(First Rev.) BIS.
7. IS 4326 – 1993 Earthquake Resistant Design and Construction of Buildings – Code of Practice (Second Rev.)
8. IS 7564 – 1974 Recommendations for Co-ordination of Dimensions in Buildings – Arrangement of Building Components.
9. IS:456-2000, Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi, 2000
10. IS:875 (Part 1) - 1987, Code of Practice for Design Loads (Other than Buildings and Structures – Dead Loads, BIS, 1987
11. IS:875 (Part 2) - 1987, Code of Practice for Design Loads (Other than r Buildings and Structures – Live Loads, BIS, 1987.
12. Kraners, Sieverts and Partners. 1977. Open – Plan Offices, UK: McGraw Hill. (English Translation Ritchie, J.L.)
13. Leonard, M. and Cunliffe, R. 1962. Office Buildings, New York: Reinhold
14. National Building Code of India 2016, Bureau of Indian Standards, New Delhi
15. SP:1983 National Building Code of India (First Rev.) BIS.
16. Subramaniyam, T.N. (edited by) n.d. Architects, Engineers and Builders Handbook, Madras: Fairhaven Printers.

B.E. (Civil Engineering)

3rd & 4th Semester

Curriculum Structure & Syllabus

2020 – 24 Batch

(2020-24 Admission)

Professor & Head
School of Civil Engineering
KLE Technological University
Hubballi.

II Year Bachelor of Engineering (Civil Engineering)

Curriculum Structure – 2019 Scheme

III Semester B.E.

No.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	20EMAB202	Laplace Transform and Statistics	BS	4-0-0	4	4	50	50	100	3 hours
2	15ECVC201	Building Technology & Services	PC	3-0-0	3	3	50	50	100	3 hours
3	15ECVC202	Surveying	PC	4-0-0	4	4	50	50	100	3 hours
4	15ECVF201	Mechanics of Fluids	ES	4-0-0	4	4	50	50	100	3 hours
5	15ECVF202	Mechanics of Materials	ES	4-0-0	4	4	50	50	100	3 hours
6	16ECVF203	Engineering Geology	ES	2-0-0	2	2	50	50	100	3 hours
7	17ECVP201	Survey Practice I	PC	0-0-1	1	2	80	20	100	3 hours
8	17ECVP202	Building Engineering Drawing	PC	0-0-2	2	4	80	20	100	4 hours
Total				**21-0-3**	**24**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA** – End Semester Assessment, **PC**-Programme Core, **BS** – Basic Science, **ES**- Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **HS** – Humanities, **PW** – Project

IV Semester B.E.

lo.	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA Marks	ESA Marks	Total Marks	Exam Duration
1	15EMAB207	Numerical methods and Partial differential equations	BS	4-0-0	4	3	50	50	100	3 hours
2	15ECVC203	Structural Analysis-I	PC	4-0-0	4	3	50	50	100	3 hours
3	15ECVC204	Environmental Engineering	PC	4-0-0	4	3	50	50	100	3 hours
4	15ECVC205	Concrete Technology	PC	3-0-0	3	3	50	50	100	3 hours
5	15ECVC206	Construction Project Management	PC	3-0-0	3	3	50	50	100	3 hours
6	15ECVC207	Hydrology & Irrigation Engineering	PC	3-0-0	3	3	50	50	100	3 hours
7	15ECVP204	Survey Practice - II	PC	0-0-1	1	2	80	20	100	3 hours
8	15ECVP205	Material Testing Laboratory	PC	0-0-2	2	4	80	20	100	3 hours
9	17ECVP203	Engineering Computation Laboratory	PC	0-0-1	1	2	80	20	100	3 hours
		Total		**21-0-4**	**25**					

Note: L – Lecture, T – Tutorial, P – Practical, ISA – In Semester Assessment, **ESA –** End Semester Assessment, **PC-**Programme Core, **BS** – Basic Science, **ES-** Engineering Science, **OE** - Open Elective, **PE** - Program Electives, **HS –** Humanities, **PW** – Project

Course Title: Building Technology and Services		**Course Code: 15ECVC201**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs/ week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40	**Examination Duration: 3 Hrs**	

Unit I

1. Components of a Building

Introduction, types of building as per NBC, Components of a building – Foundations, RCC components like columns, beams, slabs. Floor structures, roof structures, doors, windows and other openings, building finishes. **05 hrs**

2. Building Materials

Introduction. Properties of concrete and its ingredients, building stones, Clay products, Bricks and tiles; Timber, Plywood, Allied products, Plastics and glass, Paints, Steel, Gypsum and Allied products, Adhesives. Alternate building materials – Sustainability, need, types, applications. **07 hrs**

3. Types of Foundations

Preliminary investigations of soil, Presumptive bearing capacity of soils, Masonry footings, Isolated footings, Grillage footings, Strap footings, Raft foundations, Pile foundations. **05 hrs**

Unit II

4. Stone and Brick Masonry

Rubble masonry, Ashlar masonry, Bonds in brick work (English and Flemish bond). Load bearing and partition walls. Damp proof construction. **03 hrs**

5. Floors and Roofs

Types of flooring (Materials and method of laying), Granolithic, Mosaic, Ceramic, Marble, Polished Granite, Industrial flooring, Flat Roof (R.C.C.), Sloped roof (R.C.C. and Tile roof), Lean to roof, Steel trusses, Water and Weather proof course. **03 hrs**

6. Stairs, Doors and Windows

Types (Classifications) and technical terms in stairs, Requirements of a good stair. Geometric Design of RCC Dog Legged and open well stairs. (Plan and sectional elevation of stairs) Paneled doors, Glazed doors, Flush doors, Collapsible and rolling shutters, Louvered doors, Revolving, sliding and swing doors, Windows, Types, Paneled, Glazed, Bat window, Dormer window, Louvered and corner window, Ventilators. **04 hrs**

7. Building Services

Plumbing Services: Water Distribution, Sanitary – Lines & Fittings; Ventilations: Functional requirements systems of ventilations. Air-conditioning – Essentials and Types; Acoustics – characteristic – absorption – Acoustic design; Fire protection – Fire Hazards – Classification of fire-resistant materials and construction. **04 hrs**

Unit III

8. Plastering and Painting

Purpose of Plastering, Materials of plastering, Lime mortar, Cement Mortar, Methods of plastering, Stucco plastering, Lath plastering, Purpose of Painting, Distemper, Plastic emulsion, Enamel, Powder coated painting to walls and iron and steel surfaces, Polishing of wood surface. **05 hrs**

9. Introduction to cost effective construction and services

Necessity, Advantages, Pre fabrication techniques, Pre cast doors and windows (Pre cast frames and shutters), Alternative Building Materials, Hollow concrete blocks, Stabilized mud blocks, Micro concrete tiles, Precast roofing elements. Water supply and sanitation. Electricity illuminated. Modern services & Air condition, fire detection and protection. **04 hrs**

Text Books

1. Bhavikatti.S.S, *Building Materials,* Vikas Publishing House Pvt Ltd, 2012.
2. Punmia, B.C., Jain A.K., *Building Construction*, 10ed., Lakshmi Publications, New Delhi, 2008.
3. Rai, M. and Jai Sing, *Advanced Building Materials and Construction*, CBRI Publications, Roorkee, 2014.
4. Sushilkumar, *Building Construction*, 20ed., Standard Publisher and Distributors, Delhi, 2014.

Reference:

1. Arora, S.P. and Bindra, S.P., *A Text Book of Building Construction Technology*, Dhanapat Rai Publications (P) Ltd., New Delhi, 2014.
2. Jagadeesh, K.S., Venkatarama Reddy B.V. and Nanjunda Rao K.S., *Alternative Building Materials and Technologies*, New Age International (P) Ltd., New Delhi, 2007.
3. National Building Code of India 2016, Bureau of Indian Standards

Course Title: Surveying **Course Code: 15ECVC202**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs / week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 **Examination Duration: 3 Hrs**

UNIT-I

1. Overview and Measurement of directions — 06 hrs

Basic principle of surveying, classification of surveying, Measurement of distance: chain surveying. chain and their types, tapes and their types.

Errors in chain surveying and tape corrections. Introduction of map sheet numbering, coordinate and map projection.

Compass surveying: Difference between prismatic and surveyor's compass, bearings and their types. Calculation of included angles from bearings. Corrections to measured bearings – local attraction. Plotting a traverse, closing error and its adjustment by Bowditch's rule. Traverse computations – Latitude and departure (omitted measurements).

2. Measurement of elevations and contouring — 07 hrs

Levelling - Terminologies, Types of levelling instruments viz Dumpy level, Auto level, electronic or digital level and their temporary adjustments, taking observations.

Methods of calculating reduced levels – HI method and rise and fall method.

Types of leveling curvature and refraction correction, sensitiveness of bubble tube.

Contours and contouring, characteristics of contours, contour interval, Contouring methods – Direct and indirect. Interpolation of contours. Preparation of contour maps. Uses of contour maps.

3. Theodolite surveying and Trigonometric levelling — 04 hrs

Theodolite surveying, terminologies used in theodolite, ~~parts of a vernier theodolite, temporary adjustments.~~ Measurement of horizontal angle, vertical angle and other theodolite applications. Theodolite traversing, locating landscape details.

Basic principles, calculation of heights and distances using single plane method and double plane method

4. Tacheometric Surveying — 04 hrs

Basic principle of stadia tacheometry; tacheometric equations for horizontal line of sight, inclined line of sight (LOS), when staff vertical to LOS and when staff normal to LOS; Analectic lens, tangential method of tacheometry, subtense bar, and Beaman's stadia arc; determination of tacheometric constants.

Unit II

5. Curve surveying **06 hrs**

Types of curves, circular curve-terminologies, elements of a simple curve, methods of setting out simple curve- linear method, angular method; compound curves- elements of a compound curve, setting out of compound curve; Reverse curve-element of elements of a reverse curve, setting out of reverse curve; Transition curve- requirements of a transition curve, elements of transition curve, setting out of transition curve;

6. Modern Surveying Instruments: Theodolite, EDM and Total Station **08 hrs**

Modern theodolites- Micro-optic theodolites, electronic theodolites, digital theodolite Electromagnetic spectrum radar, electromagnetic distance measurement (EDM), EDM equipment- Geodimeter, tellurometer, mekenometer, distomat. Corrections to measurements; Total station- principles and working, temporary adjustments, application- angle measurement, distance measurement (horizontal, vertical and slope)

7. Areas and Volumes **06 hrs**

Computation of areas: Area from co-ordinates, latitude and departures, Mid-ordinate method, average ordinate method, Trapezoidal rule, Simpson's rule, Computation of volumes: Volumes from cross sections, Prismoidal formula, and Trapezoidal formula capacity of reservoirs volume of borrow pits, Construction surveying / setting out works: Prerequisites, instruments and methods.

Laying out buildings, Setting-out of culverts, Setting-out bridges – locating the center line – locating bridge piers, Setting-out tunnels – Transferring alignment, transferring bench marks or levels, Setting out Sewer lines

Unit III

8. Introduction to Photogrammetry and Remote Sensing: Terrestrial and Aerial photographs, Photo interpretation, Stereoscopy. **05 hrs**

Remote Sensing: Principle, Idealized remote sensing system, Types, applications. Introduction and applications of LIDAR.

9. Modern methods of Surveying **05 hrs**

Area from digital planimeter, Satellite based positioning system, Global Positioning System (GPS), basic principles, Satellite configuration, positioning using satellite signals, receivers; Functions - determining position, navigation, tracking, mapping, precise time determination; Application in surveying.

Introduction to GIS (Geographic Information System): Components, software, data, users, features, subsystems, data acquisition, data processing and analysis, communication, management, capabilities, operations, Applications of GIS in civil engineering.

Text Books:

1. Punmia. B.C., Ashok. K. Jain and Arun .K. Jain 'Surveying Vol1, Lakshmi Publications, 2014.
2. Bhavikatti S. S, Surveying and levelling, Volume I and II, I. K, International Publishers, New Delhi, 2008.

3. Duggal. S.K, 'Surveying' Volume I and II, Tata McGraw Hill, 2013, New Delhi.
4. W. Schofield 'Engineering Surveying' Fifth Edition, Butterworth-Heinemann, 2001.
5. Lille Sand, John Wiley and Sons, Remote Sensing and Image Interpretation, 7th Edition, 2015.
6. Chandra, A.M., Plane Surveying, 3ed. New Age India Ltd. 2015.

Reference Books:

1. Anderson, J. M. and Mikhail E. M., Introduction to Surveying, TMH, New York, 1985.
2. M. Anjireddy, Remote Sensing and Geographical Information Systems, 4th Edition, BS Publications, 2012.
3. Roy, S.K., Fundamentals of Surveying, Prentice Hall of India, 2010.
4. E-notes: https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2080, 2015.

Course Title: Mechanics of Fluids **Course Code: 15ECVF201**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Fluid Properties and Classification of Fluid

Introduction to fluid mechanics, Systems of units, Properties of fluid - Mass density, Specific Volume, Specific Weight, Relative density, Viscosity, Newton's law of viscosity, Compressibility, Vapor pressure, Surface tension, Capillarity. Newtonian and Non-Newtonian Fluids, Ideal and Real fluids. **05 hrs**

2. Fluid Pressure and its Measurement

Definition of pressure with its units and dimensions, pressure at a point. Pascal's law, Hydrostatic pressure law. Different types of pressures, Measurement of pressure, Classification- Simple manometers, Differential manometer and Micro Manometer **05 hrs**

3. Hydrostatics

Definition of total pressure, Center of pressure, Centroid, depth of center of pressure, Hydrostatic force on plane surface submerged horizontally, vertically and inclined. Hydrostatic force on submerged curved surface. Archimedes principle. **05 hrs**

4. Kinematics of Fluids

Description of fluid flow - Lagrangian and Eulerian approaches. Classification of flow; Definition of path line, streamline, streak line, stream tube. Acceleration of flow in one dimensional flow. Continuity equation in differential form. Velocity potential, Stream functions, Stream line, Equipotential line. Relation between velocity potential and stream function. Laplace equation. **05 hrs**

Unit II

5. Dynamics of Fluid Flow

Concept of inertia force and other forces causing motion. Derivation of Euler's equation and Bernoulli's equation with assumption and limitation. Application of Bernoulli's equation on Venturimeter, Orifice meter, Pitot tube. **10 hrs**

Impulse - Momentum equation and its application. Basics of hydraulic machines, specific speed of pumps and turbines

6. Flow through Pipes and open Channels

Introduction; Reynolds number, Definition of hydraulic gradient, energy gradient. Major and minor losses in pipe flow, Equation for head loss due to friction (Darcy's-Weishbach equation).

10 hrs

Uniform flow in open channels, Geometric properties of Rectangular, Triangular, Trapezoidal and Circular channels. Chezy's equation, Manning's equation. Most economical open channels. Specific energy of flowing liquid and critical depth of flow, hydraulic jump, type of flows.

Unit III

7. Dimensional Analysis and Model Studies

Introduction, Systems of units, Dimensions of quantities, Dimensional Homogeneity of an equation. Analysis- Raleigh's method, Buckingham's Π theorem. Non-dimensional numbers: Froude Models, Reynold's models **05 hrs**

8. Discharge Measurements

Flow through orifices and its classification, hydraulic coefficients and their relationship, Flow through mouthpieces and its classification. Classification of notches and weirs. Discharge over rectangular, triangular and trapezoidal notches or weirs. Discharge over a broad crested weir, Ogee weir and submerged weir. Current meter and its applications. Estimation of discharge with electronic or sensor devices. **05 hrs**

Text Books

1. Arora, K. R., *Fluid Mechanics, Hydraulic and Hydraulics*, Standard Book House, New Delhi,9th ed 2010.
2. Bansal, R. K., *Fluid Mechanics and Hydraulic Machines*, Revised 9ed. Lakshmi Publications, New Delhi, 2017.
3. *Daugherty, R.L., Franzini, J.B., Finnemore, E.J. Fluid Mechanics with Engineering Applications, 10th edition,* McGraw Hill Publishing Co.Inc, New York, 2001.
4. Modi, P.N. and Seth S.M., *Hydraulics and fluid mechanics*, 2ed., Standard book house, New Delhi, 2010.

Reference Books:

1. Douglas J.F., Gasiorek J.M., and Swaffield J.A.., *Fluid Mechanics*, 5ed., Pearson Education, India, 2006.
2. Streeter V.L. and Wylie E. B., *Fluid Mechanics*, McGraw Hill Education, London, 9ed., 2010.

Course Title: Mechanics of Materials **Course Code: 15ECVC202**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 Hrs **Examination Duration: 3 Hrs**

Unit – I

Chapter 1: Introduction to Material Science

Introduction, Properties of Materials, Stress, Strain, Hooke's law, Poisson's Ratio, Stress – Strain Diagram for structural steel and non-ferrous materials, Principles of superposition, Elongation due to self – weight. Total elongation of tapering bars of circular and rectangular cross sections, **06 hrs**

Chapter 2: Stress, Strain for Composite Section

Composite section, Volumetric strain, expression for volumetric strain, Elastic constants, relationship among elastic constants, Thermal stresses (including thermal stresses in compound bars). **06 hrs**

Chapter 3: Bending Moment and Shear Force in Beams

Introduction, Types of beams loadings and supports, shearing force in beam, bending moment, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for cantilever beams, simply supported beams and overhanging beams considering point loads, UDL, UVL and Couple, **06 hrs**

Unit – II

Chapter 4: Bending Stress, Shear Stress in Beams

Introduction – Bending stress in beam, Assumptions in simple bending theory, Pure bending derivation of Bernoulli's equation, Modulus of rupture, section modulus, Flexural rigidity, Expression for horizontal shear stress in beam, Shear stress diagram for rectangular, symmetrical 'I' and 'T' section, Flitched/Composite beam. **06 hrs**

Chapter 5: Deflection of Beams

Introduction – Definitions of slope, deflection, Elastic curve derivation of differential equation of flexure, Sign convention, Slope and deflection for standard loading classes using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and Couple. **06 hrs**

Chapter 6: Columns and Struts

Introduction – Short and long columns, Euler's theory on columns, Effective length, slenderness ration, radius of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula and problems. Analysis and sketching of various stresses in beams (2-D and 3-D). **08 hrs**

Unit – III

Chapter 7: Torsion of Circular Shafts

Introduction – Pure torsion-torsion equation of circular shafts, Strength and stiffness, Torsional rigidity and polar modulus, Power transmitted by shaft of solid and hollow circular sections, Stepped and compound bar subjected to torque. **05 hrs**

Chapter 8: Compound Stresses

Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses, Mohr Circle, thin cylinders subjected to pressure, change in length, diameter and volume, thick cylinders - Lame's equations (excluding compound cylinders). **07 hrs**

Text Books

1. B.S. Basavarajaiah and P. Mahadevappa, *"Strength of Materials in SI units"*, 3rd Edition, CBS Publishers, New Delhi, 2011.
2. Bhavikatti, S.S., *"Strength of Materials"*, 4th Edition, Vikas Publishers, 2013.
3. Hibbeler R.C., *"Mechanics of Materials"*, 9th Edition., Pearson Education Ltd., 2014.
4. Punmia B.C., Jain A.K and Jain A.K, *"Strength of Materials"*, 10th Edition., Lakshmi Publications, New Delhi, 2018.

References

1. James M. Gere, *"Mechanics of Materials"*, 8th Edition., Thomson Learning, 2014.
2. Bansal R.K, *"A Text book Strength of materials"*, 6th Edition, Laxmi Publication, 2017
3. S. Timoshenko *"Strength of Materials: Elementary Theory and Problems - Vol. I"*, , 3rd Edition, CBS Publisher, 2004

Course Title: Engineering Geology **Course Code: 16ECVF203**

L-T-P: 2-0-0 **Credits: 2** **Contact Hours: 2 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 30 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Physical Geology

Geology in civil engineering – branches of geology – structure of earth and its composition – weathering of rocks – scale of weathering – soils – landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics. **05 hrs**

2. Minerology

Physical properties of minerals – Quartz group, Feldspar group, Pyroxene – hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals. **03 hrs**

3. Petrology

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist. **03 hrs**

Unit II

4. Structural Geology and Geophysical Methods

Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering. **03 hrs**

5. Application of Geological Investigations

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings – Failed dam projects, Standard guidelines for major dam and reservoir investigation. Coastal protection structures. Investigation of Landslides, causes and mitigation. **06 hrs**

6. Geological Exploration and Environmental Hazards

Geological Formations; Preparation of Hazard Maps; Role of Engineering Geologist in Planning, Design and Construction Stages in Civil Engineering Works. **03 hrs**

Unit III

7. Earthquake and Seismic Hazards

Earthquake and volcanic activity, effects of earthquakes to civil engineering **07 hrs**

structures. Seismic source, paleo-seismology, ground motion, site effects, instrumentation in India, seismic hazards in India, Case studies.

Text Books

1. Chenna Kesavulu N., *Textbook of Engineering Geology*, Macmillan India Ltd., 2009.
2. Gokhale K.V.G.K, *Principles of Engineering Geology*, B.S. Publications, Hyderabad 2011.
3. Parbin Singh. A, *Text book of Engineering and General Geology,* Katson publishing house, Ludhiana 2009.
4. Varghese, P.C., *Engineering Geology for Civil Engineering*, Prentice Hall of India Learning Private Limited, New Delhi, 2012.

Reference:

1. Blyth F.G.H. and de Freitas M.H., *Geology for Engineers*, Edward Arnold, London, 2010.
2. Bell F.G.. *Fundamentals of Engineering Geology*, B.S. Publications. Hyderabad 2011.
3. Dobrin M.B, *An introduction to geophysical prospecting*, Tata McGraw Hill Pvt. Ltd, New Delhi, 1988
4. Venkat Reddy. D., *Engineering Geology,* Vikas Publishing House Pvt. Lt, 2010
5. IS: 15662 (2006): *Geological exploration for gravity dams and overflow structures – Code of Practice*.

Course Title: Survey Practice - I		**Course Code: 17ECVP201**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs / Week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Demonstrations

1. Study of chain, tape, Ranging rod, Direct Ranging, Dumpy level, Compass and EDM device.
2. Use of planimeter and demonstration of minor instruments like clinometer, hand level, box sextant.
3. To locate contour by direct and indirect method.
4. Introduction to total station

Experiments

1. Plot the boundary layout of a building by using direct ranging and set out the perpendiculars using chain, tape and cross staff.
2. To mark the center line for different types of civil engineering structures (using closed traverse methods) having different shapes.
3. To locate the various positions of objects (trees, electric pole, drainage) along the center line of a road.
4. To setup the temporary bench marks for a given topography using Auto level.
5. To determine difference in elevation between two points using reciprocal leveling and determine the collimation error.
6. To conduct profile leveling for water supply / sewage line / road alignment and to draw the longitudinal section to determine the depth of cut and depth of filling for a given formation level using auto level and total station.

Open Ended Experiments:

- Your company has received a tender on survey work to fix up the plinth level for proposed residential building on a sloping terrain, produce a detailed report for the same.

Reference:

1. Bhavikatti S.S., *Surveying and Levelling Vol-I & II,*.2nd ed., Wiley Publishers, New Delhi, 2019.
2. Punmia, B.C., Ashok.K Jain, Arun.K., *Surveying Vol. 1 & 2*, 15ed., Laxmi Publishers, New Delhi- 2016.
3. Duggal S. K, '*Surveying' volume I & II*, 4th ed., Tata McGraw Hill, 2017, New Delhi
4. https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2080
5. SP:7, *National Building Code of India*, Bureau of Indian Standards, 2016

Course Title: Building Engineering Drawing		**Course Code: 17ECVP202**
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 4 Hrs**	

1. Introduction to NBC, Building Bye Laws, Model space and paper space, Bubble diagram, Zoning regulations and Commercial Development Plan (CDP)

2. Bubble diagram with circulation for a residential building

3. Draw plan, front elevation, section, site plan and write schedule of openings, as per Bye Laws, using AutoCAD, for a given site dimensions for different types of buildings and calculate FAR, Plinth area and Carpet area;

i. Residential Building
ii. Office Building
iii. School Building
iv. Hospital Building
v. College Building

4. Draw water supply, sanitary system and rainwater recharging and harvesting system using By Layer command in AutoCAD for different types of buildings.
5. Draw bubble diagram with circulation suing AutoCAD for different types of buildings.

Open Ended Experiment

A client has approached to construct a residential building on a sloping terrain, produce an engineering drawing for the project, collect all/any required data as per the need for the project.

References

1. Bethune, J. D., *Engineering Graphics with AutoCAD,* Pearson Education Publishers, 2017.
2. Chandra, A.M and Chandra, S., *Engineering Graphics with AutoCAD*, 2ed., Pearson Education Publishers, 2004.
3. Gurcharan Singh., *Civil Engineering Drawing*, 7ed., Standard Publishers Distributors, 2014.
4. N. Kumara Swamy, A. Kameswara Rao, *Building Planning and Drawing*, Charator Publishing House Pvt. Ltd., 2007.
5. Shah, M.H and Kale, C.M, *Building Drawing*, Tata Mc Graw Hill Publishing Co. Ltd., 2012.
6. Malik R S and Meo G S, *Civil Engineering Drawing*, 2ed, Asian Publishers/Computech Publications Pvt Ltd, 2010.
7. SP:7, *National Building Code of India*, Bureau of Indian Standards, 2016

Course Title: Engineering Geology Laboratory		**Course Code: 15ECVP203**
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30 Hrs	**Examination Duration: 3 Hrs**	

1. Describe and identify the minerals based on their physical, special properties, chemical composition and uses.
2. Describe and identify the rocks based on their physical, special properties, and uses.
3. Study of geological maps and their sections: interpreting them in terms of selecting the sites for folded strata.
4. Study of geological maps and their sections: interpreting them in terms of selecting the sites for faulted strata.
5. Study of geological maps and their sections: interpreting them in terms of selecting the sites for various civil engineering structures.
6. Dip and strike (Surface method) problems: Determination of true dip direction and true dip amount for civil engineering structure
7. Dip and strike (Surface method) problems: Determination of Apparent dip direction and apparent dip amount for civil engineering structure
8. Bore hole problems (sub surface dip and strike): three point ground method
9. Bore hole problems (Horizontal ground level) :three point ground method
10. Thickness of strata (out crops) problems: To determine the true thickness, vertical thickness and the width of outcrops on different topographic terrain.

Reference Books:

1. Marutesha Reddy, M.T., *A Text book of Applied Engineering Geology*, New Age International Publishers, 2008.

4th Semester

Course Title: Structural Analysis-I **Course Code: 15ECVC203**

L-T-P: 4-0-0 **Credits: 3** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Structural Systems

Forms of structures, Conditions of equilibrium, Degree of freedom, Linear and Nonlinear structures, one, two, three dimensional structural systems, Static and Kinematics determinacy of structures. Theorem of minimum potential energy Law of conservation of energy Principle of virtual work. **6 HRS**

2. Deflection of Beams

Slope and deflection of simply supported and cantilever beams by Moment area method and Conjugate beam method. **6 HRS**

3. Strain Energy

Strain energy and complimentary strain energy, Strain energy due to axial load, bending and shear, Principle of virtual work, Unit load method, The first & second theorem of Castigliano, Betti's law, Clarke - Maxwell's theorem of reciprocal deflection, Problems on beams frames and trusses. **7 HRS**

Unit II

4 Analysis of beams and trusses

Analysis of beams (Propped cantilever and trusses) by strain energy and unit load method. **8 HRS**

5. Arches and cables

Three hinged circular and parabolic arches with supports at same levels and at different levels. Determination of thrust, shear and bending moment, Analysis of cables under point loads and UDL, length of cables - Supports at same level and at different levels. **6 HRS**

6. Consistent deformation method

Analysis of propped cantilever and fixed beams. **6 HRS**

Unit III

7. Influence Line Diagrams

Influence line diagrams for simply supported, cantilever and over hanging beams, Influence line diagrams for girders supporting floor beams, Use of Influence line diagrams, Maximum S.F. and B.M. values due to moving loads — **6 HRS**

8. Two hinged arches:

Parabolic and circular arches — **6 HRS**

Text Books

1. Bhavikatti S.S, *Structural Analysis I*, 4ed., Vikas Publishing House Pvt. Ltd, Bangalore, 2011
2. Punmia, B. C. Ashok Kumar Jain and Arun Kumar Jain, *Mechanics of Materials,* Laxmi Publications Pvt. Ltd Ltd, New Delhi, 2005.

Reference Books:

1. Reddy C.S., *Basic Structural Analysis,* 3ed., Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2017.
2. A.K. Jain, *Advanced Structural Analysis*, 3ed., Nemchand and Brothers, Roorkee, India, 2015.
3. Leet,, Uang, and Ánne M., *Fundamentals of Structural Analysis*, 3ed., Tata McGraw Hill Publishing Company Inc., New York, 2017.
4. Pandit G. S. and Gupta S. P, *Theory of Structures*, Vol I & II, Tata McGraw- Hill Publishing Company, New Delhi, 2017.
5. Ramamruthum, S. and Narayan, R., *Theory of Structures*, Dhanpat Rai Publishing Company, New Delhi, 2017.
6. Prakash Rao D. S., *Structural Analysis, A unified approach*, 1ed., University Press Limited, Hyderabad, 1996.
7. Timoshenko, S. P. and Young, D. H., *Theory of Structures*, Tata McGraw Hill Book Company, New York, 1965.

Course Title: Environmental Engineering **Course Code: 15ECVC204**

L-T-P: 4-0-0 **Credits: 4** **Contact Hours: 4 Hrs/ week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 50 Hrs **Examination Duration: 3 Hrs**

Unit I

1.Introduction

Major causes of global environmental change of key life support systems. Need for protected water supply. **02 hrs**

2. Demand and conveyance of water

Types of water demands, population forecasting- arithmetical, geometrical, incremental increase and simple graphical method. Surface and subsurface sources. Design of the economical diameter of the rising main. **04 hrs**

3. Quality of Water

Concept of safe wholesome and palatability of water, Sampling of water, Examination of Water–Physical, chemical and Biological Examinations. Drinking water standards BIS & WHO guidelines. Health significance of Fluoride, Nitrates and heavy metals like Mercury, Cadmium, Arsenic etc. **04hrs**

4.Water Treatment

Treatment flow-charts. Aeration- Principles, types of Aerators. Sedimentation aided Coagulant, design, jar test, Theory of filtration, slow sand, rapid sand and pressure filters, design – excluding under drainage system .Theory of disinfection, types of disinfection. **10 hrs**

Unit II

5.Miscellaneous Treatment and Distribution of Water

Softening methods of removal of hardness by lime soda process and zeolite process. Adsorption technique, reverse osmosis technique, fluoridation and defluoridation. **05 hrs**

System of supply, service reservoirs and their capacity determination, methods of layout of distribution systems.

6. Sewerage systems

Types of sewerage systems. DWF, estimation of storm flow, design of storm water drain. Design of sewers - self cleansing and non-scouring velocities. Design of hydraulic elements for circular sewers flowing full and flowing partially full **06 hrs**

7. Sewage characteristics

Physical, Chemical and Biological characteristics, CNS cycle. BOD and COD their significance **03 hrs**

8. Disposal of Sewage

Self-purification phenomenon, Zones of purification, Sewage sickness, Sewage farming. Streeter Phelps equation - Oxygen sag curve. **04 hrs**

Unit III

9. Sewage Treatment and sludge disposal

Flow diagram of municipal waste water treatment plant. Preliminary & Primary treatment: Screening, grit chambers, primary sedimentation tanks – Design. Theory and design of biological unit operation- Trickling filter and Activated sludge process Sludge digestion process, Sludge drying beds. **09 hrs**
Concepts of Oxidation pond and RBC

Text Books

1. Birdie, G.S., *Water Supply and Sanitary Engineering*, Dhanpath Rai and Son Publishers, New Delhi, 2003
2. Garg, S.K., *Sewage disposal and Air Pollution Engineering*, Khanna Publishers, 2003.
3. Garg, S.K., *Water supply Engineering*, 7ed., Khanna Publishers, New Delhi, 2005.
4. Modi, P.N., *Sewage Treatment and Disposal Engineering,* 15ed., Standard Book House, New Delhi, 2015.
5. Punima, B. C., and Jain Ashok, *Environmental Engineering-I,* 2ed., Laxmi Publications, New Delhi., 2008.
6. Punmia, B. C., Ashok K Jain and Arun Kumar Jain, *Wastewater Engineering*, Laxmi Publications, New Delhi, 2016.

Reference Books:

1. Metcalf & Eddy, *Wastewater Treatment Engg. & Reuse*, Tata McGraw Hill Publications, 2003.
2. Fair, G.M., Geyer J.C., Okan D.A., *Elements of Water Supply and Wastewater Disposal*, John Wiley and Sons Inc. 2000.
3. Hammer M.J., *Water and Waste Water Technology*, John Wiley and Sons, New York, 2000.
4. Howard S. Peavy, Donald R. Rowe, George Techno Bano Glous, *Environmental Engineering*, McGraw Hill International, 1995.
5. IS:10500-2012,Drinking water- Specification.
6. *Ministry of Urban Development, Manual on Waste Water Treatment - CPHEEO*, New Delhi.
7. Srinivasan, D., *Environmental Engineering*, PHI Learning Pvt. Ltd., New Delhi, 2008.
8. W.K. Berry, *Water Pollution*, CBS Publishers Pvt. Ltd., New Delhi, 2016.

Course Title: Concrete Technology		**Course Code: 15ECVC205**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3 Hrs /Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**	

Unit I

1. Concrete Ingredients

Cement, Chemical composition, hydration of cement, Types of cement, manufacture of OPC by wet and dry process. Tests on cement, Grades of cement, quality of mixing water. Tests on fine and coarse aggregate. **08 hrs**

2. Fresh concrete

Workability - factors affecting workability, Measurement of workability, Slump cone test, Compaction factor and vee-bee consistometer test, Segregation and bleeding. **08 hrs**

Process of manufacture of concrete, Curing of concrete. Chemical admixtures- Super plasticizers, Accelerators, Retarders, Air entraining agents. Mineral admixtures - Fly ash, GGBS, Silica fume, Rice husk ash.

Unit II

3. Hardened concrete

Factors affecting strength, w/c ratio, gel/space ratio, maturity concept. Effect of aggregate properties, relation between and compressive strength, and tensile strength, bond strength, modulus of rupture. Accelerated curing. Modulus of Elasticity of concrete, Creep, Shrinkage, Factors affecting creep and shrinkage, Extensibility of concrete, Durability - definition, significance, permeability, sulphate attack. Chloride attack, carbonation, freezing and thawing. Factors contributing to cracks in concrete settlement cracks, **10 hrs**

4. Concrete Mix design

Concept of Mix design, variables in proportioning exposure conditions, Methods of Concrete Mix design, Procedure of mix design as per IS 10262-2019, Numerical examples of Mix design with river sand and M-sand, Mix Design and testing of SCC, Pavement quality concrete mix design as per IRC guidelines. **06 hrs**

Unit-III

5. Special concretes and concreting methods

Constituents, properties and applications of Light weight concrete, High density concrete, High strength and high-performance concrete, Self-Compacting Concrete, EFNARC standards, Fiber reinforced concrete and Ready mixed concrete. Ferro cement - Constituents, properties and applications. Guniting and shotcreting. Pavement Quality concrete, Green concrete for sustainable environment - Geopolymer concrete and concrete wall panel, **05 hrs**

6. Non-Destructive testing of concrete

Principles, applications and limitation of Rebound hammer test and Ultrasonic pulse velocity test, interpretation of test values, Rebar test. **03 hrs**

Text Books

1. Bhavikatti S. S., *Concrete technology,* I.K. International Publishing House, 2015.
2. Neville A. M. and Brooks J. J., *Concrete technology, 2ed,* Prentice Hall Publisher, 2010.
3. Shetty M.S., *Concrete technology - Theory and practice*, 1ed., S.Chand and company, New Delhi, 2008.

Reference Books

1. Kumar Mehta P., Paulo J. M. Monteiro - *Concrete: Microstructure, Properties, and Material,* McGraw Hill publications, 2013.
2. Gambhir M. L., "*Concrete Technology*", 3ed., Tata McGraw hill Publishers Pvt. Ltd, New Delhi, 2008.

IS Codes

1. IS-10262-2019, *Recommend guidelines for concrete mix.*
2. IS-383:2016, *Specifications for Concrete mix aggregates from natural resources for concrete (Third revision).*
3. IS-456:2000, *Code of practice of plain and reinforced concrete,* 4ed., August 2000.
4. IS-516: *Method of Tests for Strength of Concrete*, 2013.
5. IS-13311-2 (1992): *Method of non-destructive testing of concrete-methods of test, Part 2: Rebound hammer*

Course Title: Construction Project Management		**Course Code: 21ECVC206**
L-T-P: 3-0-0	**Credits: 3**	**Contact Hours: 3Hrs / Week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 40 Hrs	**Examination Duration: 3 Hrs**	

Unit I

1. Introduction to Construction Project Management

Phases of construction project, importance of construction and construction industry, Indian construction Industry, Construction project management and its relevance, stakeholders of a construction project. **04 hrs**

2. Drawings and Specifications

Types of Drawings-Architectural and Structural, Study of Scales Used, sequence of dimensioning, dimension lines and figures, Importance of Specifications, General specifications detailed specifications of a typical building. Scope definition using drawings and specifications. **05 hrs**

3. Work Breakdown Structure

Concept of WBS, Common usage of terms, preparing a WBS, Factors to be considered, WBS measurement considerations, Challenges to be considered, WBS level of Detail, WBS life-cycle considerations, Project risk and the WBS, Resource planning and management with WBS, Problems – Detailed WBS of a residential building. **06 hrs**

Unit II

4. Project Management through Networks

Introduction, project feasibility, planning methods of projects– Objectives, planning stages. Scheduling, Bar charts and mile stone charts. Introduction, Terms & definitions, Elements of network, types of networks, drawing the network. CPM – Event times, Activity times, floats, critical activity and critical path. Problems. PERT – Introduction, time estimates, expected time, earliest expected time, latest allowable occurrence time, slack, critical path. Probability of completing the project. Problems. Updating of network. Problems. Contraction of network. Problems, The Role of the Scheduler in Construction Management, Linear Construction Operations and Line of Balance, Scheduling for Large Programs, Lean Design in Construction Scheduling. **11 hrs**

5. Resource Allocation

Introduction, Objectives of resource allocation, Methods of resource allocation, Resource smoothing, Steps in resource smoothing, Resource levelling, Steps in resource levelling. **04 hrs**

Unit III

6. Sustainability in Construction Industry

Introduction, Objectives of sustainability, recent advances in sustainability in construction industry, green buildings, cost and profitability, sustainability rankings – LEED. **05 hrs**

7. **Technology Trends in Construction and BIM**

Concept and application of Building Management System (BMS) and Automation. Overview of IT Applications in Construction – Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software. Introduction – Parametric modeling – Visualisation – Completion of building modeling – 4D simulation using Navis works – Navigation and Clash detection. **05 Hrs**

Text Books

1. Kumar Neeraj Jha, *Construction Project Management: Theory and Practice*, 2ed., Edition, Pearson Publications, 2015.

Reference Books:

1. Robert. L Peurifoy and William B. Ledbetter, *Construction planning and Equipment& methods*, Tata McGraw Hill Pvt. Ltd, New Delhi, 3ed., 2010.
2. Verma Mahesh, *Construction planning and Management*, Metropolitan Book Co. Delhi, 1982.

Course Title: Hydrology & Irrigation Engineering **Course Code: 15ECVC207**

L-T-P: 3-0-0 **Credits: 3** **Contact Hours: 3Hrs / Week**

ISA Marks: 50 **ESA Marks: 50** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

Unit I

1. Introduction to Hydrology

Introduction, Hydrologic cycle, Water budget equation, Precipitation: Forms and type of precipitation, Measurement of precipitation, Selection of rain gauge station. Adequacy of rain gauges, Methods of computing average rainfall, Interpolation of missing rainfall data, Consistency of rainfall data by double mass curve method. Hyetograph and Mass curve of rainfall. Difference between ground water and surface water. **06 hrs**

2. Losses from Precipitation

Evaporation: Factors affecting, Measurement by Class A pan, Estimation using empirical methods. Evapo-transpiration: Factors affecting and Measurement, Estimation using Blaney criddle method and Penman–Monteith equation. **05 hrs**

Infiltration: Factors affecting and measurement by double ring infiltrometer, Infiltration indices, Horton's equation of infiltration, Runoff and its estimation.

3. Hydrographs: Definition, Components of Hydrograph, Base flow separation, Ground water, Darcy's Law, Types of Aquifer, Unit hydrograph and its derivation, S – curve and its computation. **05 hrs**

Unit II

4. Introduction to Irrigation

Definition, Benefits and ill effects of irrigation, Sources of water for irrigation, Systems of irrigation: Surface, Flow irrigation, Lift irrigation, Bandhara irrigation, Micro irrigation, Sprinkler irrigation. Methods of applying water to crops in India. **04 hrs**

5. Water Requirements of Crops

Definition of Duty, Delta and Base period, Relationship between Duty, Delta and Base period, Factors affecting duty of water, Soil-water-plant relationship. Crops and crop seasons in India, Irrigation efficiency, Frequency of irrigation, Definition of gross command area, Culturable command area, Culturable cultivated area. **04 hrs**

6. Canals: Definition, Types of canals, Alignment of canals and canal regulators. Design of canals by Kennedy's and Lacey's methods.

Cross drainage works: Classifications, Diversion Works: definition, layout. Types of weirs and Barrages. Design of Impermeable floors – Bligh's and Lane's theories. **04 hrs**

7. Gravity Dams

Definition, Forces acting on a Gravity dam, Stability Analysis of Gravity Dam, **04 hrs**

Elementary and practical profile, Low and high gravity dams, Drainage Galleries.

Unit III

8. Earthen Dams

Introduction, Types of earthen dams, Failure of earthen dams, Drainage arrangements. Phreatic line, determination of phreatic line. **04 hrs**

9. Spillways

Definition, Types of Spillways, Design Principles for an Ogee Spillway. Energy dissipaters, Types of basins. **04 hrs**

Text Books

1. Jayarami Reddy, *Text Book of Hydrology*, 3ed., Laxmi Publications, New Delhi, 2016.
2. Modi P.N., *Irrigation, Water Resources, and Water Power Engineering*, Standard Book House, New Delhi, 2004.
3. Punmia B.C. and Pande L., *Irrigation and Water Power Engineering*, Laxmi Publications, New Delhi, 2000.
4. Raghunath H. M., *Hydrology*, New Age International Pvt. Ltd., Publication, New Delhi, 2006.
5. Subramanya K., *Engineering Hydrology*, 2ed., Tata McGraw Hill, New Delhi, 2005.

Reference Books

1. Garg S.K., *Irrigation Engineering and Hydraulic Structures*, Khanna Publications, New Delhi, 2005.
2. Linsley, Kohler and Paulhus, *Applied Hydrology*, Wiley Eastern Publication, New Delhi, 1988.
3. Michael A.M., *Irrigation Theory and Practices*, Vikas Publications, New Delhi, 2004.
4. Sharma R. K., *Hydrology and Water Resources Engineering*, Oxford and IBH, New Delhi, 2000.

Course Title: Survey Practice - II **Course Code: 15ECVP204**

L-T-P: 0-0-1 **Credits: 1** **Contact Hours: 2 hr / week**

ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**

Teaching Hours: 30 **Examination Duration: 3Hrs**

List of Experiments

Demonstrations

1. Measurement of horizontal angles with method of repetition and reiteration using theodolite and Total Station, Measurement of vertical angles using theodolite and Total Station.
2. Introduction of GPS.
3. Introduction to GIS, digitization of maps, geo-referencing of topo maps and generating contours.

Experiments

1. To determine the elevation of an object using single plane and double plane method when base is accessible and inaccessible using theodolite and Total station.
2. To set out simple curves using linear methods perpendicular offsets from long chord.
3. To set out simple curves using linear methods by offsets from chords produced.
4. To set out simple curves using Rankine's deflection angles method.
5. To set out compound curve with angular methods.
6. To set out reverse curve between two parallel line with angular methods.

Structured Enquiry

- To set out the center line of columns for different buildings using Total Station.

Open Ended Experiment

- A developer wants to get a landscaping done for a particular area; you as a surveyor are required to develop the layout map of the same area.
- Fix an alignment between two points and produce a detailed report on earthwork.

Reference Books:

1. Bhavikatti S.S., *Surveying and Leveling Vol-I & II,* I.K. International Publishers, 2008.
2. Punmia B.C., Jain, Ashok K. J., and Arun.K. J., *Surveying Vol. 1 & 2*, 15ed., Laxmi Publications (P) ltd, New Delhi, 2005.
3. Duggal S. K., *Surveying Vol-II*, 4e, McGraw Hill Education Pvt. Ltd.,New Delhi, 2013.

IS Codes:

1. IS 11134:1984(R2000), *Code of practice for Setting out of Buildings.*
2. SP:7, *National Building Code of India, Bureau of Indian Standards*, 2016
3. IRC: 73-1980-*Geometric Design Standards for Rural (Non Urban) Highways,*

Indian Road Congress, New Delhi.

4. IRC: 86-1983-*Geometric Design Standards for Urban Roads in Plains, India Road Congress*, New Delhi.

Course Title: Material Testing Lab **Course Code: 15ECVP205**

L-T-P: 0-0-2 **Credits: 1** **Contact Hours: 4 Hrs/ Week**

ISA Marks: 80 **ESA Marks: 20** **Total Marks: 100**

Teaching Hours: 40 Hrs **Examination Duration: 3 Hrs**

PART A

I. Tests on Cement:

1. Standard consistency of cement
2. Setting time for cement, and Specific surface of cement by Blaine's air permeability apparatus.
3. Specific gravity of cement and Compressive strength of cement.

II. Tests on Fine and Coarse Aggregate:

4. Specific Gravity and water absorption of fine aggregate. Fineness modulus test for fine, Bulking of sand
5. Specific gravity and water absorption of coarse aggregate, Fineness modulus test for coarse aggregate.

III. Tests on Fresh Concrete and Hardened Concrete:

6. Workability of concrete - Slump, Vee-Bee Consistometer and Compaction factor test, with different water cement ratio without plasticizer.
7. Workability of concrete - Slump, Vee-Bee Consistometer and Compaction factor test with different water cement ratio with plasticizer.
8. Compressive Strength, Tensile strength, Flexural strength of concrete.
9. Self-Compacting Concrete.

IV. Prepare the Concrete Mix Design for different grade of concrete for different exposure condition.

V. Demonstration:

Soundness of cement, Durability and Permeability of concrete

VI. Open Ended Experiment:

- To prepare the **concrete** mix design apart from conventional concrete, propose the mix proportions, procure the materials, cast and tests

PART B

Mechanical properties of materials

1. Tension test on Mild steel and HYSD bars.
2. Compression test of Mild Steel, Cast Iron and HYSD Cylinders.
3. Test on Bricks, concrete blocks.
4. Impact tests on Mild Steel. (Charpy & Izode).
5. Flexural Test on wood
6. Shear Test on Mild steel.
7. Hardness tests on ferrous and non-ferrous metals – Brinell's and Rockwell.
8. Torsion test on Mild Steel circular sections.
9. Buckling of struts
10. Unsymmetrical Bending.
11. Non-Destructive Test on Concrete by Rebound hammer, UPV.

Reference:

For Concrete Lab:

1. Bhavikatti S. S., *Concrete technology,* I.K. International Publishing House, 2015.
2. Gambhir M. L., *Concrete Technology*, 3ed. Tata McGraw hill Publishers, New Delhi, 2009.
3. Gambhir M. L., *Concrete Technology*, 3ed., Tata McGraw hill Publishers, New Delhi, 2008.
4. Shetty M.S., *Concrete technology - Theory and practice*, 1ed., S.Chand and company, New Delhi, 2008.

For MT Lab:

1. Bhavikatti S.S., *Strength of materials*, 4ed., Vikas Publishing House, 2018.
2. Gambhir M L and Neha Jamwal, *Building and construction materials-Testing and Quality control* McGraw Education India Pvt. Ltd., 2017
3. Kukreja C B, Kishore K., and Ravi Chawla *Material Testing Laboratory Manual for quality control*, Standard Publishers & Distributors, 2016.
4. Suryanarayana A K, *Testing of Metallic Materials*", Vedams ebooks Pvt. Ltd. New Delhi, 2007.

IS Code:(For Concrete)

1. IS 10262:2019 : Indian Standard Concrete mix proportioning – guidelines
2. IS 456:2000 Code of practice for plain and reinforced concrete
3. IS 383 : 2016 Specification for coarse and fine aggregates
4. IS 4031 (Part 1 to 6) 1996 (Reaffirmed 2005): Method of physical tests for hydraulic cement

5. IS : 2386 (Part 1 to 5) - 1963 (Reaffirmed 2005): Methods of test for aggregates for concrete
6. IS: 516:1959 (Reaffirmed 2004): Methods of testing for strength of concrete
7. IS 455:1989 (Reaffirmed 1995): Specification for portland slag cement
8. IS 1199 :1999 (Reaffirmed 2004): Methods of sampling and analysis of concrete
9. IS 9103 : 1999 (Reaffirmed 2004): Concrete admixtures - specification
10. IS 10510:1983 Specification for vee-bee consistometer
11. IS 5515:1983 Specification for compaction factor apparatus
12. IS 14858:2000 Compression testing machine used for testing of concrete and mortar requirements

IS Codes for steel

1. IS: 1608-2005, *Metallic materials - Tensile testing at ambient temperature,* Third revision
2. IS: 1768-2008, *High strength deformed steel bars and wires for concrete reinforcement-specification,* Fourth revision
3. IS: 1499-1979, *Method for Charpy Impact test (u-notch) for metals,* First revision
4. IS: 1598-19777, *Method for Izode Impact test for metals,* First revision
5. IS: 1500-2005, *Method for Brinell hardness test for metallic materials, Third Revision*
6. IS: 5652 – 1993, *(Part -1), Hard metals - Rockwell test (scale A), Second Revision*
7. IS: 1917-2012, *Metallic materials - wire - Simple Torsion test,(Third revision)*
8. IS: 1708 -1986, *Methods of testing of small clear specimens of timber*

Course Title: Engineering Computation Laboratory		**Course Code:** 17ECVP203
L-T-P: 0-0-1	**Credits: 1**	**Contact Hours: 2 Hrs/ week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks: 100**
Teaching Hours: 30	**Examination Duration: 3 Hrs**	

Students must be able to write coding in python, compile it and run as applied to the elemental numerical on engineering mathematics and civil engineering subjects like Mechanics of materials, Surveying, transportation, Fluid Mechanics, Structural Dynamics, etc. They should be able to document the lab work in the form of Flow-charts, Algorithms, coding output of results in tabular/graphical formats.

Following is the list of experiments:

1. Introduction to Python programming language: Data types, Operators, Program flow control, User defined functions
2. Working with Arrays, Array operators, Array indexing and slicing, and Plotting graphs
3. Developing and testing a Python function to find the roots of polynomial equations using Newton Gregory forward and backward interpolation.
4. Developing and testing a Python function to solve systems of linear equations using Gauss Elimination method.
5. Developing and testing a Python function to solve linear system of equations using Gauss Seidel iterative method.
6. Developing and testing a Python function to implement Power method for the computation of the largest eigenvalue and corresponding eigenvector.
7. Developing the equations for reactions, shear force and bending moment for a simply supported beam.
8. Developing and testing python function for finding area under the curve by Simpson's method and Trapezoidal method.
9. Developing and testing python function for curve fitting of two polynomial function.
10. Estimating the population for a given year by extrapolation using first, second, third and fourth order interpolating polynomials and comparing the prediction with actual results.

Open ended:

- Developing and testing python function related to Civil Engineering problem

Text Book

1. Mark Lutz, *Programming python*, O'Reilly Media, 2010.
2. Alex Martelli, *Python in a nutshell*, O'Reilly Media, 2003.
3. M.K.Jain, S.R.K.Iyengar, R.K.Jain, *'Numerical Methods for scientific and engineering computation'*, New Age International Publishers, 2003.