SEMESTER V

S. No.	Subject Code	Board of Study	SUBJECT	Periods per week			Scheme of Examination and Marks				Credit L+(T+P)/2
				L	T	P	PRE**		ESE*	Total Marks	(L+P+T)
							Mid Sem	TA			
1	SOE-B-CE501	CIVIL	Theory of Structures –II	3	0	0	30	20	50	100	3
2	SOE-B-CE502	CIVIL	Structural Engineering Design-I	3	0	0	30	20	50	100	3
3	SOE-B-CE503	CIVIL	Geotechnical Engineering-I	3	0	0	30	20	50	100	3
4	SOE-B-CE504	CIVIL	Transportation Engineering-II	3	0	0	30	20	50	100	3
5	SOE-B-CE505	CIVIL	Concrete Technology	3	0	0	30	20	50	100	3
6	SOE-B-CE506	CIVIL	Concrete Technology Lab	0	0	4	0	30	20	50	2
7	SOE-B-CE507	CIVIL	Structural Engineering Design-I Lab	0	0	4	0	30	20	50	2
8	SOE-B-CE508	CIVIL	Geotechnical Engineering-I Lab	0	0	4	0	30	20	50	2
9	SOE-B-CE509	CIVIL	Seminar On Industrial Training	0	0	1	0	25	25	50	1
10	SOE-B-CE510	CIVIL	***Design Thinking(online)	1	0	2	15	15	20	50	2
TOTAL				**16**	**0**	**15**	**165**	**230**	**355**	**750**	**24**

* End Semester Examination

** Progress Review Examination

***Certificate Coarse on MOOCs/NPTEL: Students required to enroll for the course Design Thinking (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC shall be required to appear for end sem examination of the course conducted by OPJU. For backlog students in this course examination will be conducted by OPJU.

Semester: V **Branch: Civil Engineering**
Subject: Theory of Structures -II **Code: SOE-B-CE501**

Course Description:
This course covers topics such as structural response with use of basic principles and more emphasis is placed on the methods of analyzing structures. This course develops further the structural principles introduced in Theory of Structures I. It deals with analysis of statically indeterminate elastic structures using slope-deflection methods, moment distribution and Kani's Method. The course also involves introduction to some structural design and analysis software packages.

Course Objective:

- Moment distribution method - Iterative method often used in analyzing indeterminate Structures.

- To learn the methods which are applied to analyze indeterminate structures.
- To gain the expertise in analysis of indeterminate beams and rigid frames.
- To develop professional skill in analyzing indeterminate pin jointed structures.

Syllabus:

UNIT I

Method of Moment distribution: Moment Distribution Method, Application to indeterminate beams and rigid frames without sway and with sway problem.

UNIT II

Force Method of Analysis using Strain Energy Concept: Strain Energy theorems of analysis of statically indeterminate structures-beams, frames and trusses, Lack of fit. Qualitative and Quantitative Influence lines of indeterminate beams by Muller Breslau Principle and its use.

UNIT III

Method of three moments: Indeterminate beams, Principle of superposition. Analysis by consistent deformation method,

UNIT IV

Method of Slope deflection and Column analogy: Slope deflection method, Application to indeterminate beams and rigid frames without sway and with sway problem. Basics of Column analogy method and application for fixed beams.

UNIT V

ILD: Qualitative and Quantitative Influence lines of indeterminate beams by Muller Breslau Principle and its use.

Text Books:

1. Intermediate Structural Analysis – Wang C.K. (Tata McGraw Hill)
2. Mechanics of Structures Vol 1 & Vol.2 - Junarkar. S. B and Shah H.J
3. Basic Structural Analysis – C.S. Reddy (Tata McGraw Hill)
4. Analysis of Structures Vol-II , Vazirani V N- Paperback

Reference Books:

1. Structural Analysis Vol-1&Vol-II, Bhavikatti .S.S., Vikas Publishing House Pvt
2. Fundamentals of Structural Analysis – Harry H. West and Louis F. Geschwindner
3. Theory of Structures (Vol. I & Vol. II) – G. Pandit, S. Gupta & R. Gupta (Tata McGraw Hill)
4. Structural Analysis – Hibbeler (Pearson Education)

Course outcome:

At the end of the course, students will be able to:

1. Capable of analyzing different kinds of structures such as determinate, indeterminate, rigid Jointed or pin-jointed plane frames.
2. Capable of understanding about the suitable method for a given structure.
3. Ready to proceed for designing of analyzes structure.

Assessment:

Assessment can vary from course to course and can include a combination of class work, tutorials, assignments, laboratory work, quizzes, surprise test, online test, project work and exams.

Semester: V **Branch: Civil Engineering**

Subject: Structural Engineering Design I **Code: SOE-B-CE502**

Course Description

This course on Structural Engineering Design I aim at understanding Basic designing in the framed structure. Introduction to the Working stress method which is used from the last hundred's years. The new introduction is the Limit State Method which recently used in the designing and covers all overcomes and makes structure safe from all the loads. Based on the Limit State method there are list of designs like, singly reinforced beam, doubly reinforced beam, slab (one-way and two- way), staircase etc. this all designing is purely based on the Limit state Method which involves safety factors use of the various IS code the practice and the drawing detailing.

Course Objectives

1. To become acquainted with introduction to Reinforced Cement Concrete design.
2. To become familiar with R.C.C structures.
3. To become acquainted with designing of each component of the building.
4. To become familiar with actual design by taking site visits.
5. To become acquainted with designing at the field.
6. To become acquainted with beam, slab, staircase, column, footing.

Syllabus:

UNIT I

Working Stress Method: Introduction to various design philosophies R.C structures: Historical development Properties of Concrete and reinforcing steel, stress-strain curves, permissible stresses, modular ratio, loads on structure, Basis for design by working stress method. Analysis and design of singly reinforced and doubly rectangular reinforced sections by working stress method, conceptually the difference between Working stress method, Ultimate load method & Limit state method

UNIT II

Limit State Method – Flexural Member: Introduction to limit state method, characteristic loads, partial safety factor, limit state of flexure – assumptions, stress block parameters, neutral axis, analysis and design of singly and doubly reinforced section, shear in beams, bond and development length.

UNIT III

Limit State Method – T-Beam and Slabs: Properties of T-section, moment of resistance and design of singly reinforced T-beam. Design of one-way slab and two-way slabs.

UNIT IV

Limit State Method – Columns:
Axially loaded short columns, minimum eccentricity, longitudinal and transverse reinforcement. and effective length of column, safe load on columns, circular columns. Pu – Mu interaction curves, combined axial load and uni-axial bending, combined axial load and bi-axial bending.

UNIT V

Limit State Method – Staircases and Column Footings: Design of stairs – dog legged stair. General principle of design of reinforced concrete footing, proportioning of footings. edge thickness, depth of footing, design of isolated column footings – square and rectangular footings.

Text Books:

1. Reinforced Concrete Design, S. U. Pillai and D. Menon, 2017, Tata McGraw. Third Edition.
2. Limit State Theory and Design of Reinforced Concrete (IS:456-2000), V. L. Shah and S. R. Karve,2017, Structures Publications, Pune, Eight Edition.
3. Relevant IS codes IS: 456:2000, IS 875, Part 1, 2.
4. Design Aids for Reinforced Concrete to I.S.-456-1978 (SP-16). 1980. Bureau of Indian Standards, New Delhi.
5. Limit State Design of Reinforced concrete, P. C.Varghese, 2008. PHI Learning.

Reference Books:

1. Illustrated Reinforced Concrete Design, Dr. V.L.Shah and Dr. S.R. Karve .2018. Structures Publications Pune, Ninth Edition.
2. Reinforced Concrete Limit State Design, A. K. Jain, 2012, Nem Chand and Bros. Roorkee, Seventh Edition.
3. Fundamentals of Reinforced Concrete Design, M. L. Gambhir, 2008, PHI Learning.
4. Limit State Design of Reinforced Concrete, B. C. Punmia, A. K. Jain and A. K. Jain, 2016, Laxmi Publications.
5. Design of Reinforced Concrete, B. C. Punmia and A. K. Jain, Laxmi Publications.

Course Outcomes:
Students will be able to understand:

1. To understand conceptually the difference between Working stress method, Ultimate load theory method & Limit state Design method.
2. To design the structural elements like RCC beam, slab, column, and footings by limit state Design method as per I.S.456-2000.
3. To design two-way slab & one way continuous slabs
4. To design columns & footings for eccentric loads.

Assessment:
Assessment will be based on a combination of attendance, class work, tutorials, assignments and exams.

Semester: V **Branch: Civil Engineering**

Subject: Geotechnical Engineering - I **Code: SOE-B-CE503**

Course Description

Every Civil Engineering structure consists of main two components i.e. foundation and superstructure. The foundations of buildings, roads, dams etc. rest on soil whose behavior plays an important role to transfer their loads, therefore, the knowledge of the properties & behavior of the soil below foundations is essential for their safe design.

Course Objectives

1. To provide basic knowledge about Geotechnical Engineering, soil formation, index properties of soil, Principles and methods of compaction of soil
2. To provide basic knowledge about Evaluation of flow through soil medium, Permeability, capillary seepage force, flow net and characteristics.
3. To know about Determination of consolidation characteristics of fine grained soil, Compressibility of granular and fine grained soils, settlement.
4. To evaluation of shear strength parameters of soil,stress path, Measurement of shear strength.
5. To estimation of stress distribution.

Syllabus:

UNIT I

Physical Properties: Overview of soil formation, Soil structure and clay mineralogy, Soil phase relationships, Index properties of granular and fine grained soils, Soil classification systems. Soil structure and Clay mineralogy.

UNIT II

Permeability and Seepage: Permeability of soils, Darcy's law, Equivalent permeability in stratified soils, In-situ and laboratory permeability test, Types of heads and seepage forces, Total and effective stress, Two-dimensional Laplace's equation, Flow nets, Uplift pressure, Exit gradient and piping, Filter criteria.

UNIT III

Compaction: General principles, Factors affecting compaction, Standard and modified Proctor tests, Effect of compaction on engineering properties, Field compaction.

Compressibility and Consolidation: Components of total settlement, Compressibility of granular and fine grained soils, Terzaghi's 1-D consolidation theory, Consolidation test, Determination of preconsolidation stress, Overconsolidation ratio, Computation of settlement, Secondary consolidation.

UNIT IV

Shear Strength: Mechanism of shear resistance, Mohr-Coulomb failure criterion, Measurement of shear strength: Direct shear test, unconfined compression test, Vane shear test, Triaxial shear test (CD, CU, and UU), Pore-pressure parameters, Stress path, Shear strength of clays and sands.

UNIT V

Stress Distribution: Boussinesq's equation, Vertical stress due to line load, strip load, uniformly loaded circular area, Westergaard's approach, Pressure bulb concept, approximate methods.

Soil Exploration, Various Method of field Exploration, and Undisturbed Soil Sampling eequipments. a Field tests ,Static & Dynamic Penetration Test, Field Vane Shear Test, modern electronic test of site characterization.

Text Books:

1. Ranjan, G. and Rao, A.S.R. (2016). Basic and Applied Soil Mechanics, 3rd Edition, New Age International Publishers, India.
2. Arora, K.R. (2020) .Soil Mechanics And Foundation Engineering - Geotechnical Engineering. Standard publisher dist.
3. Murthy, V.N.S. (2006). Geotechnical Engineering, Marcel Dekker Inc, New York, USA.

Reference Books:

1. Lambe, T.W. and Whitman, R.V. (1991). Soil Mechanics, John Wiley & Sons.
2. Budhu, M. (2010). Soil Mechanics and Foundations, John Wiley & Sons.
3. Gulhati S.K. and Datta, M. (2005). Geotechnical Engineering,Tata McGraw-Hill Publishing Company Limited, New Delhi,

Course Outcomes:

Students will be able to understand:

1. Comprehend the soil as three-phase materials.
2. Understand various engineering parameters of soil.
3. Acquire a basic understanding of soil mechanics required for designing of geotechnical systems.

Assessment:

Assessment will be based on a combination of attendance, class work, tutorials, assignments and exams.

Semester:V Branch: CivilEngineering

Subject: Transportation Engineering–II Code: SOE-B-CE504

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Course Description:

This course gives Introduction to different modes of transportation .It is principally aimed to introduce the students about various elements of railway track, railway bridges, ports, harbor and airport. It makes student aware about the concepts of Geometric design of Railway Engineering, Tunnel, Bridges and Harbor. It also emphasized on the safe, efficient and economical design of some major elements of the infrastructure required for above mentioned mode of transportation.

Course Objectives:

- Toeducatethestudentsonthevariousmeansoftransportationi.e.,Railway Engineering, Harbor Engineering and AirportEngineering.
- To give exposure to the students to the concepts of Geometric design of Railway Engineering.
- To educate the students on to the concepts of Tunnel, Bridges and Harbor Engineering.

Syllabus:

UNIT I

Railway Engineering: Historical background of Railways in India. Railway track cross-section, coning of wheels, rail cross-section, weight of rail, length of rail, wear of rails, creep of rails, rail joints and welding ofrail.

Sleepers: Functions and requirements of sleepers, classification of sleepers, timber, metal and concrete sleeper, comparison of different types of sleepers, spacing of sleepers and sleeper density.

Ballast: Function and requirements of ballast, types, comparison of ballast materials.

UNIT II

Geometric Design of railway track: alignment, horizontal curves, super elevation, equilibrium, cant and cant deficiency, length of transition curve, gradients and grade compensation, Negative super elevation, transition curves, widening of gauges on curves. Point and crossing, design of turn outs various types of track junctions, signaling and interlocking, signals, and control on movements of trains.

UNIT III

Tunnel Engineering: Consideration in tunneling shape and size, methods of tunnel, constructions, tunneling in soft soil and rocks, lining of tunnels, ventilation, drainage of tunnels.

UNITIV

Bridge Engineering: Bridge site investigation and planning, selection of bridge site, alignment, collection of bridge design data, economic span, scour depth, depth of foundation afflux, clearance, and free board.

UNIT V

Harbor & Dock Engineering: Harbor layout, harbor works, break water, jetties, wharves, piers and berthing facilities, navigational aids, port facilities, docks; Dry and Wet docks, transit sheds and ware houses, general layout of a port.

Text Books:

1. Railway Engineering – S.C. Saxena and S.P. Arora, "A textbook of Railway Engineering", (Dhanpat RaiPublications)
2. Railway Engineering – S.C. Rangwala, "Railway Engineering", (Charotar Publishing House Pvt.Ltd.)
3. Bridge Engineering – S.P. Bindra, "Principles and practice of bridge engineering", (Dhanpat RaiPublications)
4. Tunnel Engineering – S.C. Saxena (Dhanpat RaiPublications)
5. Harbour Engineering – R. Srinivasan (Charotar Publishing House Pvt. Ltd)

Reference Books:

1. Tunnel and Harbour – Seetharaman S. (UmeshPublication)
2. Harbour Engineering – R. Srinivasan (Charotar Publishing House Pvt.Ltd.)

Course Outcomes:

- A person with broad vision and knowledge of different means of Transportation Engineering.
- The students will be able to make safe geometric design for railway track with high speed.
- The students will be able to understand methods of construction of Tunnel, Bridges and Harbor.

Assessment:

Assessment can vary from course to course and can include a combination of class work, tutorials, assignments, laboratory work, quizzes, surprise test, online test, project work and exams.

Semester: V **Branch: Civil Engineering**

Subject: Concrete Technology **Code: SOE-B-CE505**

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Course Description

This course covers the basics of concrete making materials with its properties. The concrete with its properties like workability, fresh concrete properties, etc. Concrete mix design with different methods. Also include the different special concrete and properties of same.

Course Objectives

1. To develop Fundamental knowledge of properties of concrete and its ingredients.
2. To acquire an interest in concrete technology and admixture and its filled requirements.
3. Developing a good skill of various methods of concrete making, placing and special formwork.
4. Developing a professional skill of concrete mix design by IS Code Method.

Syllabus:

UNIT I

Concrete Making Materials: Hydration of cement, Structure of hydrated cement, General Purpose cements, Special purpose cements, Blended cements, Classification of Aggregates, Properties, Grading requirements, Methods of combining aggregates, Surface index, specified grading, Alkali aggregate reaction, manufactured aggregates, Quality of mixing and curing water. Tests on fine aggregate.

UNIT II

Admixtures and Fresh Concrete: Chemical admixtures – Functions of Admixtures, Classification of Admixtures, Mineral Additives, effects on concrete properties. Workability, Factors affecting workability, Measurement of Workability, Requirements of Workability, Segregation, Bleeding.

UNIT III

Hardened Concrete and Durability: Compressive strength and parameters affecting it, Gain of strength with age, Maturity Concept, Elasticity, Creep and shrinkage, Permeability of Concrete, Durability of Concrete, relation between durability and permeability, corrosion of steel rebars.

UNIT IV

Concrete Mix Design and tests: Principles of concrete mix design, Concrete mix design steps as per Indian, American & British methods, destructive and non-destructive tests on concrete.

UNIT V

Special Concrete & Concreting Methods: Need of special concrete, properties, ingredients, method of development and applications of Light weight concrete, Fiber reinforced concrete, Polymer Concrete, self-compacted concrete, High performance concrete, Ready mix concrete, Extreme weather concreting, special concreting methods, Vacuum dewatering - underwater concrete, special from work.

Text Books:

1. Concrete Technology Theory and Practice, M. S. Shetty, 2018, S. Chand and Company Ltd. Delhi, Eighth Edition.
2. Concrete Technology, M.L. Gambhir, 2017, Tata McGraw Hill, Fifth Edition.

Reference Books:

1. Concrete Technology, A. M. Neville and J. J. Brooks, 2019, Pearson Education India: Second edition.
2. Design of concrete Mixes, N. K. Raju, 2018, CBS, Fifth edition
3. Light Weight Concrete Academic Kiado, Rudhani G., Publishing Home of Hungarian Academy of Sciences.
4. Concrete Technology, R.S. Varshney, Oxford, IBH Publishers.

Course Outcomes:

Students will be able to understand:

1. Ability to measure quality of concrete making materials.
2. Ability to design concrete mixes according to IS, ACI, BS Code methods.
3. Capable of understanding field requirements of various types of concrete.
4. Understanding the process of selection of materials and testing, uses of admixtures, professional practices in ready mix concrete

Assessment:

Assessment will be based on a combination of attendance, class work, tutorials, assignments and exams.

Semester: V **Branch: Civil Engineering**

Subject: Concrete Technology Lab **Code: SOE-B-CE506**

Course Description

This course covers the basics of fresh concreate, their test, and applications in the field. Workability of fresh concrete, strength of the hard concrete, sieve analysis of sand, mix design by IS code method of concrete.

Course Objectives

1. To know properties of various ingredients of concrete and concept of mix design.
2. To learn the behavior of concrete at its fresh and hardened state.
3. To understand special concrete and their application.
4. To explain deterioration of concrete and study methods of repair

List of Experiments

(At least ten experiments are to be performed by every student)

1. Determine the Fineness modulus by sieve analysis of fine aggregate.
2. Determine the Fineness modulus by sieve analysis of sand.
3. Determination of Soundness test on aggregate
4. Determine water absorption test of aggregate.
5. Determine the Mix Design by I.S. Code method (with OPC /PPC Cement)
6. Determine the Workability of concrete by slump test.
7. Determine the Workability of concrete compaction factor.
8. Determine the Workability of concrete Vee Bee test.
9. Determine the Workability of concrete Flow table test
10. Determine the Compressive strength test of concrete by crushing
11. Determine the Flexural strength of hardened concrete
12. Determine the soundness of fly ash.
13. Determine the Compressive strength test of concrete by non-destructive test - Rebound hammer.
14. Study Mix Design by I.S. Code method (with Slag Cement)

Recommended Books:

1. Concrete Technology Theory and Practice, M. S. Shetty, 2018, S. Chand and Company Ltd. Delhi, Eighth Edition.
2. Concrete Technology, M.L. Gambhir, 2017, Tata McGraw Hill, Fifth Edition.
3. Concrete Technology, A. M. Neville, and J. J. Brooks, 2019, Pearson Education India: Second edition.
4. Design of concrete Mixes, N. K. Raju, 2018, CBS, Fifth edition
5. Light Weight Concrete Academic Kiado, Rudhani G., Publishing Home of Hungarian Academy of Sciences.
6. Concrete Technology, R.S. Varshney, Oxford, IBH Publishers.

Course Outcomes:

Students will be able to understand:

1. Chemistry, properties, and classification of cement, fly ash, aggregates and admixtures, and hydration of cement in concrete.
2. Prepare and test the fresh concrete.
3. Test hardened concrete with destructive and non-destructive testing instruments.
4. Get acquainted to concrete handling equipment's and different special concrete types.
5. Design concrete mix of desired grade.
6. Predict deteriorations in concrete and repair it with appropriate methods and techniques.

Assessment:

Assessment will be based on a combination of attendance, class work, tutorials, assignments and exams.

Semester: V **Branch: Civil Engineering**
Subject: Structural Engineering Design I Lab **Code: SOE-B-CE507**

Course Description

This course covers the basics of design by limit states methods. The structural elements design based on the IS 456:2000. Details of the beam, slabs, footings, staircase etc

Course Objective:

1. To educate the student about concept of RCC by different methods of designing.
2. To educate students about concept in RCC design by IS 456 and SP 16.
3. To educate students about framed structure and its element.
4. To educate students about design and analysis of each member of framed structure with detailed design like concept of bars, stirrups, schedule of bar bending etc,
5. To educate students about detailed drawing of RCC component according to Solutions.

List of Experiments

(At least ten experiments are to be performed and detailed drawing at small sheet by every student and solved by Limit state method only).

1. Details of reinforcement in a simply supported RCC beam (singly reinforced) with the given design data regarding the size and number of bars, stirrups their size and spacing.
2. Details of reinforcement in a simply supported RCC beam (doubly reinforced) with the given design data regarding the size and number of bars, stirrups their size and spacing.
3. Details of reinforcement in a simply supported RCC beam (T section) with the given design data regarding the size and number of bars, stirrups their size and spacing.
4. Details of reinforcement in a one-way slab with the given design data regarding the size and number of bars, their size and spacing.
5. Details of reinforcement in a two-way slab with the given design data regarding the size and number of bars, their size and spacing.
6. Details of reinforcement in a stair case with the given design data regarding the size and number of bars, their size and spacing.
7. Details of reinforcement for a RCC rectangular column with isolated footing.
8. Details of reinforcement for a RCC square column with isolated square footing.
9. Study of detailed drawing of Isolated footings.
10. Bar bending schedules for few of the above items.
11. Study of detailing of Retaining walls.
12. Theory for Pre-stressed Concrete
13. Report of site visit. (Building under construction)

Text Books:

1. Reinforced Concrete Design, S. U. Pillai and D. Menon,2017, Tata McGraw, Third Edition.
2. Limit State Theory and Design of Reinforced Concrete (IS:456-2000), V. L. Shah and S. R. Karve,2017, Structures Publications, Pune, Eight Edition.
3. Relevant IS codes IS: 456:2000, IS 875, Part 1, 2.
4. Design Aids for Reinforced Concrete to I.S.-456-1978 (SP-16), 1980, Bureau of Indian Standards, New Delhi.
5. Limit State Design of Reinforced concrete, P. C. Varghese, 2008, PHI Learning.

Reference Books:

1. Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S.R. Karve ,2018, Structures Publications Pune, Ninth Edition.
2. Reinforced Concrete Limit State Design, A. K. Jain, 2012, Nem Chand and Bros. Roorkee, Seventh Edition.
3. Fundamentals of Reinforced Concrete Design, M. L. Gambhir, 2008, PHI Learning.
4. Limit State Design of Reinforced Concrete, B. C. Punmia, A. K. Jain and A. K. Jain, 2016, Laxmi Publications.
5. Design of Reinforced Concrete, B. C. Punmia and A. K. Jain, Laxmi Publications.

Course outcomes:

The student will be able to

1. At the end of the course, the student will be able to
2. Design the Reinforced Concrete beams using limit state and working stress methods
3. Design Reinforced Concrete slabs
4. Design the Reinforced Concrete Columns and footings
5. Design structures for serviceability
6. Design stair cases, canopy, retaining wall and water tanks

Assessment:

Assessment includes attendance, performance, record work, and exams.

Semester: V **Branch: Civil Engineering**

Subject: Geotechnical Engineering Lab - I **Code: SOE-B-CE508**

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Course Description

Geotechnical laboratory is to determine engineering properties of soil which are required for suitable design of foundations for any structure. The engineering properties include consolidation, compressibility, shear strength and bearing capacity of soil. By evaluating the properties of soil in the laboratory, students will be able to relate the concepts studied in the relevant theory course. Also students can utilize the knowledge of both theory and practical in the field application to real problems. In this laboratory both laboratory and in-situ experiments can be conducted. This laboratory course will help the students to understand the theoretical concepts learned in the course Geotechnical Engineering.

Course Objectives

To provide Civil Engineering students with the basic knowledge to carry out field

investigations and to identify soil & its properties in geotechnical engineering practice.

List of Experiments:

1. Determination of Water Content of Soil oven drying method and pycnometer bottle method.
2. Determination of specific gravity of soil by pychnometer /or density bottle
3. Grain size Analysis of soil by sieve analysis
4. Grain size Analysis of soil by hydrometer analysis
5. Determination of Field Density by Core Cutter method.
6. Determination of Field Density by Sand Replacement method
7. Determination of Liquid Limit and Plastic Limit of Soil.
8. Determination of shrinkage limit of soil.
9. Indian Standard Light Compaction Test or Standard Proctor Test.
10. Indian Standard Heavy Compaction Test or Modified Proctor Test.
11. Falling head Permeability Test.
12. Constant head Permeability test

Recommended Books:

1. Respective Bureau of Indian Standard/ International Standard Codes of Practices.
2. Bowles, J.E. (2012). Engineering Properties of Soil and their Measurement, 4th Edition, McGraw Hill (India) Publishers.
3. Mandal, J.N. and Divshikar, D.G. (1994). Soil Testing in Civil Engineering. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi, India.
4. Sivakugan, N., Arulrajah, A. and Bo, M.W. (2011). Laboratory Testing of Soils, Rocks and Aggregates,

Course Outcomes:

1. Knowledge of site specific field investigations including collection of soil samples for testing and observation of soil behaviour & Properties of the soil.
2. Be able to identify and classify soil based on standard geotechnical engineering practice.
3. Be able to perform laboratory compaction and in-place density tests for fill quality Control.

Assessment:

Assessment includes attendance, performance, record work and exams.

B. Tech Semester: V **Branch: Civil Engineering**

Subject: Seminar On Industrial Training **Code: SOE-B-CE509**

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Course Outcomes: At the end of the course, the student will be able to:

1. learn about best civil engineering practice.
2.gain real site experience.
3. Demonstrate professional work culture.

Syllabus Contents:

Student has to undergo minimum 4 weeks onsite training on civil construction sites after completion of 4th semester and prepare report and give presentation about learning during the training.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data. etc. After the approval the student has to submit the detail report.

B. Tech Semester: V **Branch: Civil Engineering**
Subject: Design Thinking (online) **Code: SOE-B-CE510**

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Course Outcomes: At the end of the course, the student will be able to:
1. explore online platform like MOOCs/NPTEL to learn advance courses.
2.Gain additional knowledge in their area of interests.

Syllabus Contents: as per course floated by MOOCs/NPTEL
Certificate Coarse on MOOCs/NPTEL: Students required to enrol for the course Design Thinking (Minimum 4 weeks) approved by department of civil engineering and submit the certificate of completion. The students who failed to score the desired marks as per minimum passing criteria of MOOC shall be required to appear for end sem examination of the course conducted by OPJU. For backlog students in this course examination will be conducted by OPJU.