Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

Third Year B. Tech.
(Civil Engineering)
Sem - V to VI

AY 2020-21

Title of the Course: Soil Mechanics (4CV301)	L	T	P	Cr
	2	1	0	3

Desirable Courses: Fluid mechanics

Textbooks:

1. Das B. M., "Principles of Geotechnical Engineering", Cengage Learning, 7th Edition, 2002.
2. Murthy, V. N. S., "Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series", CBS publishing; 1st edition, 2007.
3. Ranjan Gopal and Rao A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers, 3rd Edition, 2016.

References:

1. Gulhati S. K. and Datta M., "Geotechnical Engineering", Tata McGraw-Hill, 1st Edition, 2005
2. Couduto, Donald P., "Geotechnical Engineering – Principles and Practices", Prentice-Hall.,2nd Edition, 2017.
3. Muni Budhu, "Soil Mechanics and Foundations", John Wiley & Sons, Inc, 3rd Edition, 2011.

Course Objectives :

1. To provide the knowledge of engineering properties of soil and soil classification.
2. To prepare students for competitive examinations and higher studies in the field of geotechnical engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** the index properties, engineering properties, concept of earth pressure and consolidation	II	Understanding
CO2	**Solve** problems associated with term 'compaction, shear strength of soil and earth pressure'.	III	Applying
CO3	**Analyse** soil properties based on shear strength, earth pressure, and degree of consolidation of soil.	IV	Analyzing

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**												**2**	**3**
CO2		**3**											**2**	**3**
CO3			**3**										**2**	**3**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Evolution, classification and properties of soils	**6 Hrs.**
a) **Introduction:** Origin, evolution of soils, Application areas of Soil Mechanics in Civil Engineering. Major soil deposits of India such as marine deposits, black cotton soils, lateritic soils, alluvial deposits and desert soils. b) **Soil Volume-Density Relationships and Structure:** Three and Two Phase soil system, void ratio, porosity, degree of saturation, specific gravity, various unit weights, Relative Density, Soil Structure. c) **Soil Classification:** Grain size and hydrometer analysis, Atterberg limits, Unified and IS soil classification system. d) **Effective Stress Concept:** Effective stress concept, total stress, pore water pressure and effective stress computations.	
Module 2: Permeability and Seepage	**4 Hrs.**
a) **Permeability:** Head, gradient and potential, Darcy's law and its validity. Factors affecting permeability, laboratory methods for determination of co-efficient of permeability. b) **Seepage:** Seepage forces, quick sand condition, Laplace equation. Flow net – properties, construction and applications, Uplift Pressure, Quick condition and Piping phenomenon.	
Module 3: Compaction of Soils	**4 Hrs.**
a) **Theory of Compaction:** Necessity of compaction, factors affecting compaction, Laboratory Standard and modified compaction test, field compaction on wet and dry side of OMC. Compaction behavior of sand. b) **Compaction at Site:** Equipment and measurement of field compaction, compaction specifications and control.	
Module 4: Shear Strength of Soils	**6 Hrs.**
a) **Shear Strength Concept:** Concept of shear and shear strength parameters, stress-strain curve, peak and residual strength, Mohr-Coulomb's theory and failure envelope, b) Principle stress, derivation of relationship between major and minor principal stresses in terms of shear strength parameters. c) **Laboratory Shear Tests:** Box shear test, triaxial compression test with pore pressure measurement, unconfined compression test, Lab. vane shear test, Classification of the tests according to drainage conditions and suitability of tests.	
Module 5: Earth pressure theory	**4 Hrs.**
a) **Lateral Earth Pressure:** Concept, Area of application, and Earth pressure in "at rest", "active and passive" conditions. b) **Earth Pressure Theories:** Rankine's theory for earth pressure, Earth pressure computations with level backfill, surcharge load on backfill, water table effect in backfill, stratified backfill. Critical depth of open cut in cohesive soil.	

Module 6: Compressibility and Consolidation of soils	**4 Hrs.**
a) **Compressibility:** Definition, compressibility of laterally confined soils. Compressibility of sand and clay. b) **Consolidation:** Terzaghi's theory of one dimensional consolidation, laboratory consolidation test, e-p and e-log p curves, determination of coefficient of volume compressibility, compression index, coefficient of consolidation, degree of consolidation, time factor, Computations of duration and magnitude for consolidation settlement.	
Module wise Outcomes At end of each module students will be able to: 1. Explain the nature and analyze the engineering behavior of soil mass. 2. Develop flow-net and analyze for quick condition, evaluate seepage quantity / seepage force / uplift pressure. 3. Explain the Soil compaction methods and apply the laboratory results to interpret field compaction. 4. Analyze and interpret the shear strength parameters for soil. 5. Analyse the earth pressure magnitudes and the depth of unsupported excavation in soils. 6. Analyse degree of consolidation.	
Tutorials: One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: Water Supply and Treatment Technology (4CV 302)	L	T	P	Cr
	3	0	0	3

Desirable Courses: Basic hydraulics and Engineering Chemistry

Textbooks:

1. Raju, B.S.N., "Water Supply and Wastewater Engineering" Tata McGraw Hill Private limited, New Delhi, 2nd Edition, 2000.
2. Garg, S. K. "Water Supply Engineering", Khanna Publishers, 33rd Edition, 2010.
3. Modi, P. N., "Water Supply Engineering (Environmental Engineering I)", Standard Book House, 6th Edition, 2018.

References:

1. "Manual on Water Supply and Treatment", CPHEEO, Ministry of Housing and Urban Affairs Development, Govt., of India, New Delhi, 1999.
2. Hammer M, J and Hammer M, J, "Water and Wastewater Technology", PHI learning private limited, 7th Edition, 2018.
3. Davis, M, L, and Cornwell, D, A, "Introduction to Environmental Engineering", Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.
4. Nathanson, J. A., "Basic Environmental Technology", PHI Learning private limited, 5th Edition, 2009.

Course Objectives :

1. To provide the pertinent knowledge on water supply and treatment systems.
2. To impart necessary skill for the design and operation of water treatment units.
3. To prepare students for higher studies and research in the field of water treatment technology.
4. To familiarize the students with latest trends in water treatment.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** water quality, water supply system and treatment technologies.	II	Understanding
CO2	**Solve** the problems on water related to quality, quantity, conveyance and treatment.	III	Applying
CO3	**Design** water treatment units, and pipeline system.	VI	Creating

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3												2	3
CO2		3											3	3
CO3			3										3	3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1: Assignment on real-life problem pertaining to modules 1 to 3 and evaluated by test/quiz/presentation/oral.
ISE 2: Field visit to water treatment plants and evaluated by test/quiz/presentation/oral.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Water demand and quality	**Hrs.**
Water supply system: Introduction, Components Water demand: Usage and rates, Governing factors, Variation, Estimation(Present, intermediate and ultimate) Water Quality: Physical, Chemical and biological parameters, IS 10500-2012 Sources: Quantitative and Qualitative study	**7**
Module 2 Conveyance of water	**Hrs.**
Source works: Intake (Types and location), Design of river intake, Jack well, Pumping system, Power and capacity of pump Conveyance system: Types (Gravity, gravity fed and pressure), Forces acting, Materials (Ductile Iron, Mild steel and Plastic), Jointing, Laying, Hydraulic testing, Break pressure tank, Design of gravity fed and pressure pipe, Economic design Appurtenances: Valves, Thrust block	**5**
Module 3 Water treatment (Aeration, Mixing and Settling)	**Hrs.**
Treatment: Philosophy, Unit processes and operations Aeration: Process, Types of aerator, Design of cascade aerator Coagulation: Physics and chemistry, Practice, Design of rapid mixer Flocculation: Theory, Design of slow mixer (hydraulic and mechanical) Settling: Theory, Types, Design of rectangular and circular clarifiers for type 1 settling, High rate	**8**
Module 4 Water treatment (Filtration and Disinfection)	**Hrs.**
Granular Filtration: Classification, Theory of deep mono and dual bed filter, Components of deep bed filter, Clean filter bed head loss, Filter operation, Design of mono and dual bed filter Disinfection: Types, Ideal and non-ideal disinfectant, Kinetics, Chlorination, Chemistry of chlorination, Chlorine demand, Chlorination practice, UV and Ozone disinfection	**6**
Module 5 Advanced water treatment	**Hrs.**
Membrane filtration: Types, Basic concepts, Applications Adsorption: Introduction, Basics of Carbon adsorption	**5**

Ion Exchange: Theory, Design of softener Point of use purifiers, Package drinking water plant, Water plant residual management	
Module 6 Water distribution system and Operation-Maintenance	**Hrs.**
Water distribution: Methods, System configurations, Hydraulic and functional requirements, Hydraulic analysis, Design, Computer applications (EPANET/WATERGEMS) Service reservoirs: Necessity, Components, Location, Head, and Capacity Leakage: Causes, Detection and Control Water quality in distribution: Causes of deterioration, Source trace, Water age, Nodal constituent concentration Operation and maintenance: Water supply system	**9**
Module wise Outcomes At end of each module students will be able to 1. Explain water supply system, Estimate water requirements and assess water quality. 2. Analyze and design conduits in water supply system. 3. Explain the process of aeration, coagulation, flocculation and settling, and Analyze and design aerator, rapid mixer, flocculator and clarifier. 4. Explain the process of filtration and disinfection; Analyze and design mono and dual media filters. 5. Explain advanced treatment systems; Design water softener. 6. Analyze and design water distribution system. Identify problems during operation and maintenance of water supply system.	

Title of the Course: **Design of steel Structures (4CV303)**	L	T	P	Cr
	2	1	-	3

Desirable Courses: Solid Mechanics & Structural Mechanics

Textbooks:

1. Duggal S.K., "Limit state design of steel structures", Tata McGraw-Hill Publications, New Delhi, 2nd Edition, 2014.
2. Shiyekar, M.R., "Limit state design in structural steel", PHI learning Pvt.Ltd Publications 2nd Edition 2013.
3. Subramanian N., "Design of steel structures", Oxford University Press, 2010.

References:

1. Dayaratnam, P., "Design of steel structures", S. Chand Publication, New Delhi, 2008.
2. Englekirk, Robert, "Steel structures: controlling behavior through design", John Wiley and Sons, 2003.
3. Gaylord, Edwin and Gaylord, Charles, "Design of steel structures", Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rdEdition, 2010.
4. IS 800-2007 'Code of Practice for General Construction in steel', and IS 875-1987 part 1 to 5; Code of Practice for Design Loads (other than earthquake) for building structures, Bureau of Indian Standards, New Delhi.

Course Objectives:

1. To illustrate various design philosophies and concept of plastic analysis.
2. To impart the knowledge of design of various steel members and their connections.
3. To provide knowledge of design practical steel structures such as industrial sheds, steel buildings etc.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Apply** the concept of limit state for design of steel structures.	IV	**Applying**
CO2	**Calculate** the strength of steel structural members and connections.	V	**Evaluating**
CO3	**Design** steel structures such as industrial sheds, steel buildings etc.	VI	**Creating**

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**												**1**	**1**
CO2		**3**											**2**	**2**
CO3			**3**										**3**	**3**

Assessments: Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Introduction	**Hrs.**
Introduction to steel structures, standard rolled steel sections and their properties and designation, Design philosophies, Types of loads acting on structure, Introduction to IS Codes and specifications: IS 875, IS 800. Introduction to Plastic theory- Plastic hinge concept, Plastic collapse load, Plastic moment, Shape factor, Plastic section modulus.	**5**
Module 2: Connections	**Hrs.**
Types of bolts, bolted and welded connections. Concentric and eccentrically loaded connections, simple connection of bracket plates to columns.	**4**
Module 3: Tension and Compression Members	**Hrs.**
Various types of failures such as yielding of gross area,rupture at criticalsection and block shear. Design of single and double angle sections. Buckling classification of various sections, Buckling curves, Design of single and double angle struts in trusses,	**5**
Module 4: Beams and Girders	**Hrs.**
Laterally restrained and unrestrained simply supported beams. Design of compound beams and welded plate girder. Selection of section and positioning of stiffeners, Curtailment of flange plates.	**5**
Module 5: Columns and Column Bases	**Hrs.**
Column subjected to Axial load and biaxial bending, built up column sections, laced and battened columns. Column bases: Design of slab base, gusseted base, moment resisting base, Anchor bolts**.**	**5**
Module 6: Roofing System	**Hrs.**
Trusses, Purlins. Dead load, Live load and Wind load calculations. Analysis and design of truss. Connections of truss to column.	**5**
Module wise Outcomes At end of each module students will be able to: 1. Explain the concept of various design philosophies and solve problems on Plastic analysis. 2. Design of concentric and eccentric steel connections. 3. Design of tension and compression members. 4. Design of flooring system, beams and plate girders. 5. Design of columns and column bases. 6. Design of roofing system.	

Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: **Professional Elective-I Construction Equipment and Techniques (4CV311)**	L	T	P	Cr
	2	1	0	3

Desirable Courses: NIL

Textbooks:

1. Kumar NeerajZha, "Construction Project Management", Pearson India Education, 2nd edition,2015
2. Robert Peurifoy, Clifford J. Schexnayder, AviadShapira, Robert Schmitt, "Construction planning, equipment, and methods", McGraw-Hill, 8thedition, 2010.
3. Sharma S.C. "Construction Equipment and Management", Khanna Publishers New Delhi, 1988.

References:

1. Kumar Neeraj Zha, "Formwork for construction" McGraw-Hill, 3rd reprint, 2019.

Course Objectives :

1. This course aims at making civil engineering students who need to understand the breadth and depth of construction field for possible engagement.
2. To introduce various construction equipment and techniques,
3. To provide knowledge about efficient utilization of the equipment and techniques.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Describe different construction equipment and plants.	2	**Understanding**
CO2	Explain different construction techniques.	2	**Understanding**
CO3	Choose suitable equipment, formwork and technique based on project requirements.	3	**Applying**

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**										**1**	**1**	**1**	
CO2		**2**	**2**										**2**	**2**
CO3			**2**								**2**		**2**	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents: (Arrange Contents logically/process-wise/Conceptually/Theory followed by application)	
Module 1: Construction Equipment	**Hrs.**
• **Introduction** –Conceptual planning of new project, site access and services, mechanical v/s manual construction • **Earth moving Equipment**- Bulldozers, Power shovel, Hoes, Hauling units, Simple numerical problems based on cycle time and production rates. • Drag line, Clamshell, Trenchers, Compactors-types and performance, operating efficiencies.	**05**
Module 2: Drilling & Blasting	**Hrs.**
• Excavation in hard rock: Rippers, jack hammers, drills, compressors and pneumatic equipment, Blasting explosives, detonators, fuses.	**04**
Module 3: Formwork	**Hrs.**
• Material for formwork, introduction to design of formwork • Advanced formwork techniques	**05**
Module 4:Plants for construction works	**Hrs.**
• RMC plant layout and applications • Asphalt mixing and batching plant (Hot mix plant), Sensor Paver for rigid roads • Aggregate crushing plants.	**05**
Module 5: Construction Techniques	**Hrs.**
• Diaphragm Walls: Purpose and Construction methods • Introduction to trenchless technology • Prefabricated construction: Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measures during erection. • Steel Construction : Planning for field operations, selection of equipment and erection tools	**05**
Module 6: Pile Construction	**Hrs.**
• Pile driving equipment- Types, pile driving hammers, single acting and double acting, differential acting hammers, hydraulic and diesel hammers, vibratory drivers.	**05**
Module wise Outcomes At end of each module students will be able to 1. Assign appropriate equipment for earth moving works. 2. Choose suitable equipment and technique for drilling and blasting. 3. Use suitable formwork for concrete works. 4. Explain elements of different plants for construction work. 5. Apply construction techniques for diaphragm walls, trenchless laying of pipelines, prefabrication and steel structure. 6. Describe pile driving equipment and their use.	
Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz,	

surprise test, declared test, seminar, final orals etc.	

Title of the Course:	L	T	P	Cr
Professional Elective-I: Structural Geology 4CV312	2	1	-	3

Desirable Courses: Engineering Geology

Textbooks:

1. Gokhale N. W. , "Theory of Structural Geology", CBS Publishers, Delhi, 2019.
2. Marland P Billings,"Structural Geology", Pearson Education, Third edition,2016.
3. Philip Kearly, Keith A. Klepeis, Frederick J. Vine, "Global Tectonics", John Wiley & Sons Ltd,Third Edition,2009.

References:

1. Leo A. W. Wiegman, "Earth Structure : An Introduction To Structural Geology And Tectonics" , W. W. Norton & Company, Inc., 2nd ed. 2004.
2. Marshak Stephen and MitraGautum, "Basic Methods of Structural Geology",Pearson Education; 2017.
3. Gokhale N. W., "A Manual of Problems in Structural Geology", CBS Publishers, Delhi.2019.

Course Objectives :

1. Introduce students the necessary knowledge and concepts of structural geology and geotectonics.
2. Make the student able in recognizing, classifying and describing various geological structures and structural phenomena.
3. Enable students to understand geological problem before undertaking any civil engineering project.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Describe** the geotectonic especially continental drift and plate tectonics.	II	Understanding
CO2	**Explain**the mechanism of geological structures in the field.	II	Understanding
CO3	**Apply**the knowledge of structural geology to **solve** the problems related with foundation or excavations.	III	Applying

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	1													1
CO2	1	2												2
CO3	2	2											1	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Module 1: Continental Drift	**Hrs.**
Introduction to geotectonics, origin of the Earth, interior of the Earth, isostasy, Pratt's and Airy's hypothesis, continental drift, evidances for Gondwana land and Laurasia	**04**
Module 2: Plate Tectonics	**Hrs.**
Plate tectonics, plate boundaries and their types, plate margins, Convection current hypothesis, opening and closing of oceans, Sea floor spreading, relevance of geotectonics with structural geology.	**05**
Module 3: Structural Geology-Folds	**Hrs.**
Primary and secondary geological structures, outcrop, bedding or stratification, dip and strike, extrusions and intrusions, flows and masses, causes for the development of structures, folds and folding, definition and parameters/morphology of folds, types of folds, mechanics of folding, recognition of folds in the field, civil engineering significance of folds.	**05**
Module 4:Structural Geology-Faults	**Hrs.**
Faults, definition and parameters of faults and fault terminology, classification of faults, mechanics of faulting, effect of faults on outcrops, field evidences of faulting, civil engineering significance of faults, Foliation and lineation, their origin and relation with structures, Shear zones and their development.	**05**
Module 5:Unconformity, Joints and Mountain building	**Hrs.**
Unconformities and joints, types of unconformity, recognition of unconformity in the field, concept of overlap, types of joints, common joints in different rocks, concept of stress and strain in developing joints, study of landforms, mountain building and types of mountain, roll of plate tectonics in mountain building, mountains of India, Structural geological aspects of physiographic divisions of India.	**05**
Module 6: Applications of Geology in Civil Engineering	**Hrs.**
Geological maps, description, outcrop patterns and geological structures, determination of strike and dip, problems with outcrops, borehole data and thickness of beds. Dip-strike three point problem, completion of outcrop.	**05**
Module wise Outcomes At end of modules student will be able to 1. Describe the concept of continental drift along with the global evidences. 2. Describe the events of continental drift, seismicity and volcanism collectively by the theory of plate tectonics. 3. Explain the folds in field and explain associated mechanics. 4. Explain the faults in field and explain associated mechanics. 5. Explain Unconformities, joints and landforms in field and explain associated mechanics. 6. Solve the structural geological problems related with foundation and excavations.	
Tutorial	

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: Professional Elective-I Computational Methods and Optimization Techniques (4CV313)	L	T	P	Cr
	2	1	0	3

Desirable Courses: All Courses in Mathematics for UG

Textbooks:

1. Chapra S.C. and Canale R.P., "Numerical Methods for Engineers", Tata McGraw Hill Publications, 4th Edition, 2002.
2. Babu Ram "Numerical Methods", Pearson, 1st Edition, 2010.
3. Taha Hamdy A., "Introduction to O.R.", 6th edition, (PHI)

References:

1. Balguruswamy, E. "Numerical Methods", Tata McGraw-Hill Publishing Co. Ltd., 2nd Edition, 2009.
2. Jain M.K., Iyengar S. R., Jain R. K., "Numerical Methods", New Age International (P) limited, 5th Edition, 2007.

Course Objectives :

1. To provide knowledge of numerical approach and significance of error analysis.
2. To provide necessary knowledge of numerical tools required for analyzing and solving problems in the field of engineering.
3. To provide pre-requisite statistical knowledge to the students for analyzing the data/results.
4. To deliver know-how of typical optimization techniques applicable to engineering problems.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Summarize elements of Computational Methods and Optimization Techniques	2	understanding
CO2	Solve linear, nonlinear, and differential equations by numerical methods and analyze data using various methods of regression.	3,4	applying and analyzing
CO3	Recommend optimal solution to linear programming problems	5	evaluating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**													**3**
CO2		**3**												**3**
CO3			3										**3**	**3**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1: Assignment pertaining to modules 1 to 3 and evaluated by test/quiz/presentation/oral.

ISE 2: Assignment on pertaining to modules 4 to 6 and evaluated by test/quiz/presentation/oral.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module1: Introduction to O. R.	**Hrs.**
Introduction, Background and necessity of O. R., Problem Formulation, Classification of optimization problems. Unconstrained optimization, Constrained optimization, Overview of various optimization techniques.	**4**
Module2: Linear Programming	**Hrs.**
General form, Standard form, Symmetric form, Canonical form, Types of solutions of L.P.P., Review of graphical method, Optimization of Linear P. P. using Simplex method, Introduction to Big-M and two phase simplex method, Conceptual introduction to duality and sensitivity analysis.	**5**
Module3: Typical optimization problems in civil engineering	**Hrs.**
Conventional optimization problems in civil engineering, Assignment Model, Hungarian method, minimization and maximization cases. Transportation Model, Initial feasible solution, NW corner rule, Least cost rule, Vogel's approximation method, Optimization using stepping stone method and MODI method, minimization and maximization cases.	**5**
Module 4: Introduction to computational methods	**Hrs.**
Introduction to Computational Methods, Pros and cons of analytical and numerical methods, Accuracy & Precision, Errors in Computational Methods, Total error, Round-off error, pre-specified error, Significance of error computation.	**4**
Module 5: Regression	**Hrs.**
Difference between regression and interpolation, Significance of numerical regression techniques. Error analysis, Linear Regression, Least Squares Method, Polynomial Regression, Nonlinear Regression: Power fit, Parabola of Best fit.	**4**
Module6: Solutions of equations	**Hrs.**
Revision of computational methods for solving linear and non-linear equations, Gauss Seidel Method, one point iteration method, Newton-Raphson method, Multiple Roots, Descartes' rule, Strum theorem. Solutions of Ordinary Differential Equations, Initial value and boundary value problems, Classification of methods of solution. Runge - Kutta Method, Solutions of B.V. Problems by Finite Difference methods. Classification of Partial Differential Equations, Formation of difference equations, Solution of Laplace's and Poisson's equations.	**6**
Module wise Outcomes **Module wise Measurable Students Learning Outcomes :** After the completion of the course the student should be able to 1. Explain elements of optimization techniques, and formulate problems 2. Explain elements of L. P. P. and Solve L. P. P. using Simplex Method 3. Formulate and optimize Assignment and Transportation problems	

4. Explain elements of computational methods and error analysis 5. Use computational methods for regression of data 6. Deploy computational methods for solutions of linear, nonlinear equations, ODEs and PDEs	

Title of the Course:	L	T	P	Cr
Professional Elective-I Structural Mechanics (4CV314)	2	1	-	3

Desirable Courses: Solid Mechanics, Structural Analysis

Textbooks:

1. Gere, J. M. & Weaver, W.,"Matrix Analysis of Framed Structures", CBS Publishers and Distributor, 2nd Edition, 2004.
2. Godbole, P. N., "Introduction to Finite Element Methods", I K International Publishing House Pvt. Ltd., 1stEdition, 2013.
3. Reddy, C. S., "Basic Structural Analysis", McGraw Hill Education, 3rd edition, 2017.

References:

1. Cook, Robert D., Malkus, David S., Plesha, Michael E., and Witt, Robert J., "Concepts and Applications of Finite Element Analysis", 2003.
2. McGuire, William, Gallaghar, Richard H. and Ziemian, Ronald D., "Matrix Structural Analysis", John Wiley, 2nd Edition, 2000.
3. Meghare A. S.&Deshmukh S. K.,"Matrix Methods of Structural Analysis" Charotar Publishing House, 2nd Edition, 2016.

Course Objectives:

1. To explain the concept of matrix methods of structural analysis.
2. To inculcate applications of flexibility and stiffness methods to solve indeterminate structures.
3. To illustrate the concept and applications of finite element method in structural engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	**Apply** the conceptsof matrix methods ofstructural analysis.	III	Applying
CO2	**Analyze**indeterminate structures by using structure oriented and element approach.	IV	Analyzing
CO3	**Calculate** thenodal displacements and member forces by using finite element method.	V	Evaluating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3													2
CO2		3												3
CO3		2			2									1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc. MSE: Assessment is based on 50% of course content (Normally first three modules) ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.	
Course Contents:	
Module 1: Flexibility Method- Beams & Frames	**Hrs.**
Flexibility coefficient matrix, Compatibility conditions, Development of flexibility matrix equations, Analysis of indeterminate beams and rigid jointed frames by using flexibility method.	**5**
Module 2: Flexibility Method- Trusses	**Hrs.**
Analysis of indeterminate trusses by using flexibility method, Stresses due to lack of fit or error in length, Temperature stresses.	**4**
Module 3: Stiffness Method- Structure Approach	**Hrs.**
Stiffness coefficient matrix, Relation between flexibility and stiffness coefficient matrix, Development of stiffness matrix equilibrium equations, Analysis of continuous beams and frames.	**5**
Module 4: Stiffness Method–Element Approach: Beams & Frames	**Hrs.**
Formulation for element stiffness matrix for beam element and plane frame element, Local and global coordinates, Transformation of matrices, Analysis of continuous beams and frames by using direct stiffness method.	**5**
Module 5: Stiffness Method–Element Approach: Trusses	**Hrs.**
Direct stiffness method- Element approach, Development of element stiffness matrix and nodal load vector for truss element, Analysis of trusses.	**5**
Module 6: Finite Element Method	**Hrs.**
Introduction finite element method, Basic concept, General procedure of finite element analysis, Discretization, nodes, element incidences, displacement model, shape function, selection of order of polynomials, Principle of minimum potential energy, variational principle, Development of element stiffness matrix and nodal load vector for bar element, Applications to bars with constant and variable cross sections subjected to axial forces.	**5**
Module wise Outcomes At end of each module students will be able to: 1. Analyse statically indeterminate structures such as beams and frames by using flexibility method. 2. Analyse statically indeterminate trusses by using flexibility method. 3. Apply physical concept of stiffness method for analysis of continuous beams and frames. 4. Derive element stiffness matrix for various types of elements and analyze trusses. 5. Analyse continuous beams and frames by using direct stiffness method. 6. Apply the concept of finite element method for solving problems in structural engineering.	
Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: Environmental Engineering Laboratory (4CV 351)	L	T	P	Cr
	0	0	2	1

Desirable Courses:

Engineering Chemistry Laboratory and Water supply and Treatment Technology

Textbooks:

1. Metcalf and Eddy, "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 5th Edition, 2014.
2. Sawyer. C.N. And McCarty. P.L., "Chemistry for Environmental Engineers", Tata McGraw-Hill Publishing Company Limited, 5th Edition, 2003.

References:

1. IS 3025 (Relevant parts), Bureau of Indian Standards.
2. Standard Methods for the Examination of Water and Wastewater, APHA, 23rd Revised Edition, 2017.
3. User manual of EPANET and WATERGEMS.

Course Objectives :

1. To provide the students hands-on practice for analyzingphysical, chemical and bacteriological quality of water.
2. To develop the skills required for applying knowledge to decide the chemical dose requirements.
3. To expose the students for computer applications in water network analysis.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply the analysis techniques to determine the physical, chemical and bacteriological water quality parameters.	III	Applying
CO2	Design experiment/s to address real-life cases pertinent to water quality.	VI	Creating
CO3	Apply modern engineering tool/software to analyse water distribution system.	III	Applying
CO4	Analyze and interpret the results to assess the quality of water for potability.	IV	Analyzing

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1				**2**									**2**	**2**
CO2				**2**										
CO3					**2**								**2**	
CO4				**2**									**2**	**2**

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments	**Hrs.**
1. Physical and chemical water quality analysis i. Electrical conductivity and Total Dissolved Solids ii. Turbidity and Total Suspended Solids iii. Calcium iv. Sulphate v. Residual chlorine vi. Fluoride vii. Iron and Manganese	**14**
2. Bacteriological water quality analysis Most Probable Number	**2**
3. Application of water quality analysis i. Optimal coagulant dose by jar test ii. Chlorine demand for surface/groundwater iii. Efficiency of water purifier (reverse osmosis/resin) for hardness removal. iv. Assessment of river/bore well water pollution through chloride content. v. Efficiency of cascade aerator for dissolved oxygen enhancement.	**10**
4. Analysis of water network using EPANET/WATERGEMS	**2**

Title of the Course: **Soil Mechanics Laboratory (4CV352)**	L	T	P	Cr
	0	0	2	1

Desirable Courses: Soil Mechanics.

Textbooks:

1. Lambe T.W., Soil Testing, Willey Eastern Ltd., New Delhi, 1978, 1st Edition.
2. Murthy, V. N. S., "Textbook of Soil Mechanics and Foundation Engineering Geotechnical Engineering Series", CBS publishing; 1st edition, 2018.

References:

1. Bowles J.E., Engineering Properties of Soil & Their Measurement, Tata - McGraw-Hill Publishing Co., 4th Edition, 1992.
2. Beauro of Indian Standards, I.S.2720 (Various sections / parts)

Course Objectives :

1. To develop the skills to find Index properties and engineering properties of soil and the classification of soil.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	**Demonstrate** the experimental data to assess index properties and engineering properties of soil.	III	Applying
CO2	**Analyze**and interpret the behaviour of soils based on the experimental data.	IV	Analyzing

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1				**3**									**3**	**3**
CO2				**3**									**3**	**3**

Assessments :

Lab Assessment: There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.

The experimental lab shall have typically 8-10 experiments

Course Contents:

List of Experiments		**Hrs.**
1.	Identification and classification of soils by field procedures	**2**
2.	Determination of specific gravity for coarse and fine grained soil	**2**
3.	Particle size distribution - Mechanical sieve analysis and sedimentation process using hydrometer	**2**
4.	Determination of consistency limits and indices	**2**
5.	Determination of coefficient of permeability by both constant and variable head method	**2**
6.	Determination of Field density / In-situ density for soil	**2**
7.	Determination of shear strength parameters by direct / box shear test	**2**
8.	Determination of MDD and OMC for soil by Standard Proctor compaction test	**2**
9.	Demonstration of Unconfined compression test	**2**
10.	Demonstrationof one dimensional consolidation test	**2**
11.	Demonstrationof triaxial compression/shear test	**2**

Title of the Course: **Estimating and Contracts (4CV321)**	L	T	P	Cr
	3	0	0	3

Desirable Courses: Building Materials and Construction, Building Planning and Design

Textbooks:

1. Dutta, B. N., "Estimating & Costing in Civil Engineering," UBS Publishers, 28th Revised Edition, 2016.
2. Birdi G.S., "Text book of Estimating & Costing", Dhanapat Rai Sons, 7th Edition, 2015.
3. Patil B. S., "Civil Engineering Contracts & Estimates", Orient Longman Ltd., 4th Edition, 2015.

References:

1. I.S. code 1200 (Part I to XXX) B.I.S., Delhi
2. "Standard Specification Vol. I & II", PWD Maharashtra.
3. "D.S.R.", PWD Maharashtra for the recent year.

Course Objectives :

1. To provide students with necessary knowledge and skills in specification writing, estimating, costing, methods of execution of works.
2. To make students aware of prevailing professional practices.
3. To acquaint the students with estimation software.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** elements of estimating as well as contracting.	2	understanding
CO2	**Construct** specifications and quantity sheets for various items of traditional as well as unconventional civil works.	3, 6	applying, creating
CO3	**Analyze** rates and estimate costs of different civil works; and identify an appropriate method for execution of a civil work.	4	analyzing

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**													
CO2		**3**											**3**	**2**
CO3			3								**2**		**3**	**2**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1: Assignment pertaining to modules 1 to 3 and evaluated by test/quiz/presentation/oral.

ISE 2: Assignment on pertaining to modules 4 to 6 and evaluated by test/quiz/presentation/oral.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module1: Elements of Estimating	**Hrs.**
Definition of Estimate, Objectives, Types, Approximate estimate, Detailed estimate, Revised estimate, Supplementary estimate, Sub estimate, Annual maintenance estimate, Repair estimate. Concept of item of work, Units and modes of measurement, IS 1200.	**5**
Module2: Specifications	**Hrs.**
Necessity and significance, Types of specifications, Essential requirements of specifications, Contents of detailed specifications, Specifications for various items of works, Writing typical specifications for traditional items of civil work, Pros and cons of standard specifications, Typical deviations w.r.t. standard specifications, Steps involved in writing specifications for non-conventional items of civil work.	**6**
Module3: Preparation of Quantity Sheets	**Hrs.**
Taking out quantities, PWD method, MES method, measurement and abstract sheets, prime cost, provisional sum, provisional quantities items. Appropriate assumptions for certain quantities e.g. dimensions of R. C. C. elements and steel quantities in absence of detailed designs, Bar bending schedule, Preparing quantity sheets for buildings and other civil works, Computation of earth work volumes, Use of excel spread sheets and other software for estimating.	**7**
Module 4: Rate Analysis	**Hrs.**
Rate for an item of work, Factors affecting rate, materials required, Labor required, Plant and equipment cost, Sundry costs, water charges, contractor's profit, overhead charges, Rates for various items of work, Effect of lead and lift, Price escalation, DSR, Steps involved in rate analysis for non-conventional items of civil work.	**6**
Module 5: Detailed & Approximate Estimates	**Hrs.**
Detailed Estimates of Buildings, Bridges, Roads, Water supply and drainage schemes, Irrigation works etc. benefits of detailed estimates. Purpose and various methods for different types of Approximate Estimates of civil works namely Building, Bridges, Roads, Water supply and drainage schemes, Irrigation works etc. Basis for approximate estimates: Plinth area, Cubic contents, Service unit, Bay method, Elemental bill etc.	**6**
Module6: Methods for execution of Civil Works	**Hrs.**
Contracts Act: Definition of contract, Essentials of legally valid contract, Contract documents, Conditions of contract. Competitive Bidding Contracts: various types, Pros and cons of each type, tender notice, tender documents, submission, scrutiny and acceptance of tender, process and advantages of e-tendering. Negotiated contracts: various types, Pros and cons of each type. PWD practices, Introduction to BOT and other methods.	**8**
Module wise Outcomes At end of each module students will be able to 1. Describe elements of estimating 2. Construct specifications for various items of civil works	

3. Demonstrate preparation of quantity sheets 4. Analyze rates for different items of civil works 5. Estimate costs of different civil works 6. Describe elements of contracts and decide methods for execution of civil works	

Title of the Course: Foundation Engineering (4CV322)	L	T	P	Cr
	2	1	0	3

Desirable Courses: Soil Mechanics, Soil Mechanics Lab

Textbooks:

1. Dr. Arora K. R. ," Soil Mechanics and Foundation Engineering", Standard Publishers and distributors, 2nd edition, 1989.
2. Gulhati S. K., Datta Manoj, "Geotechnical Engineering", Tata McGraw Hill Delhi, 1st edition, 2005.
3. Punmia B. C., Jain Ashok Kumar, Jain Arun Kumar, "Soil Mechanics and Foundations", Laxmi Publications Pvt Ltd, 16th Edition, March 2005.

References:

1. Bowles J.E.,"Foundation Analysis and Design", McGraw Hill International Edition, 4th edition, 1988.
2. Kaniraj S. R., "Design Aids in Soil Mechanics and Foundation Engineering", TMH New Delhi, 2004.
3. Nayak N. V., "Foundation Design Manual", DhanpatRai and Sons, N Delhi.
4. Tomlinson M. J., "Foundation Design and Construction", ELBS, 6th edition, 1995.
5. Murthy V. N. S., "Soil Mechanics and Foundation Engineering", Saikripa Technical Consultants, Bangalore, 2007.

Course Objectives :

1) To provide the basic knowledge of the Foundation and interaction with soil.
2) To impart the designing of foundation.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** the concept of bearing capacity, foundation types and their suitability	II	**Understanding**
CO2	**Analyse** Shallow and deep foundations and evaluate stability of given soil slope configuration	IV	**Analyzing**
CO3	**Design** the Shallow and deep foundations on the basis of soil parameters.	VI	**Creating**

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3												3	3
CO2		3											3	3
CO3			3										3	3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one

End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion. [One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 : Shallow Foundation design for stability criteria	**6 Hrs.**
Introduction: General requirements for satisfactory performance of foundations (depth, stability and deformation criteria) **Bearing Capacity:** Modes of failure: general, local and punching. Definitions of ultimate, gross, net and safe bearing capacity, allowable bearing pressure. Derivation of Terzaghi's bearing capacity equation. IS code approach of bearing capacity evaluation with water table variation and for inclined/eccentric loads, ultimate bearing capacity in local shear condition. **Plate load test and Standard Penetration Test**: Brief test procedures and bearing capacity evaluation based on them.	
Module 2: Shallow Foundation design for deformation criteria	**4 Hrs.**
Stress distribution in soil: Boussinesq and Westergaard's theory, pressure bulb. Causes of foundation settlement, total, differential settlement, angular distortion, limiting values. **Immediate settlement computation**: IS 8009-1976 approach **Consolidation settlement**: Pre-consolidation pressure, under normally and over consolidated soils, Computation of consolidation settlement with derivation of equations.	
Module 3: Shallow Foundations	**4 Hrs.**
Contact pressure distribution in cohesive and cohesion less soils, Assumptions in rigid analysis, Isolated, combined, strap footing designs. Concept of elastic analysis, raft foundation. **Floating foundation**: concept and construction difficulties. **Foundations on Expansive soils**	
Module 4: Deep Foundations	**6 Hrs.**
Pile Foundation: Classification, static method of axially loaded single pile capacity estimation- structural capacity, capacity in cohesive, cohesion less and mixed soils, Down-drag, Under-reamed piles. **Pile groups:** Evaluation of group efficiency factor, group capacity evaluation. **Caisson Foundations**: Brief construction review of open, box and pneumatic caissons	
Module 5: Flexible Retaining Structures	**4 Hrs.**
Sheet piles: Projects in which sheet piles are used, Classification, Design of cantilever sheet pile in cohesive and cohesion less soils. Design of anchored sheet pile by free earth support	

method.	
Module 6 : Slope Stability	**4 Hrs.**
Causes and types of slope failures, Different factors of safety, Slope stability analysis by Swedish circle method (method of slices), Use of N and T curves, Friction circle method, Use of stability number.	

Module wise Outcomes

At end of each module students will be able to

1. Compute and Interpret bearing capacity, Design foundations for stability criteria
2. Explain Stress distribution in soils, Compute foundation settlement and Examine deformation criteria for foundations.
3. Differentiate between various shallow foundations, Assess their suitability and Produce foundation design calculations
4. Compute capacity of single pile and group of piles, Describe caisson construction
5. Recognize projects for sheet pile use, Compute embedded depth of sheet piles
   Explain the causes of earth slope instability, Analyze the factor of safety of given slope by various methods.

Tutorials:

One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.

Title of the Course: **Waste Management and Pollution Control (4CV323)**	L	T	P	Cr
	2	1	0	3

Desirable Courses: Water Supply and Treatment Technology, Environmental Science

Textbooks:

1. Nathanson, J. A., "Basic Environmental Technology", PHI Learning private limited, 5th Edition, 2009.
2. Modi, P. N., "Wastewater Engineering" Standard Book House, 6th Edition, 2018.
3. Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian Edition, 2017.

References:

1. Hammer M, J and Hammer M, J, "Water and Wastewater Technology", PHI learning private limited, 7th Edition, 2018.
2. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Housing and Urban Affairs Development, Govt., of India, New Delhi, 2013.
3. "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Housing and Urban Affairs Development, Govt., of India, New Delhi, 2016.

Course Objectives :

1. To introduce concepts of wastewater engineering, solid waste processing, air and noise pollution control.
2. To provide pertinent knowledge for the design and operation of waste management facilities.
3. To prepare students for higher studies and research in the field of waste management and pollution control.
1. To make students aware of recent advances in waste management.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** collection and characteristics of wastewater and solid waste; monitoring air quality and meteorological impact; treatment/processing/control technologies for prevention of pollution associated with wastewater, solid waste, air and noise.	II	Understanding
CO2	**Solve** the problems on wastewater and solid waste associated with generation, characteristics, collection and treatment/processing; air and noise pollution.	III	Applying
CO3	**Design** sewerage and wastewater treatment system.	VI	Creating

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	3												2	3
CO2		3											3	3
CO3			3										3	3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1: Assignment on real-life problem pertaining to modules 1 to 3 and evaluated by test/quiz/presentation/oral.
ISE 2: Field visit to waste processing facility OR assignment on pollution problem in society and evaluated by test/quiz/presentation/oral.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Wastewater and Collection	**Hrs.**
Wastewater: Sources, Flow rate and variations, Quantitative estimation, Characteristics Gravity sewer collection system: Nomenclature, Manhole, Inverted siphon, Pumping station Design of sanitary and storm sewer, Computer application SEWERCAD	**5**
Module 2 Introduction to Wastewater treatment	**Hrs.**
Wastewater treatment: Philosophy, Unit operations and unit processes Primary treatment: Screening, Grit removal, Settling Biological/Secondary treatment: Fundamentals of aerobic and anaerobic treatment, Classification	**4**
Module 3 Aerobic Wastewater treatment	**Hrs.**
Aerobic suspended growth: Conventional Activated Sludge Process (ASP) and modifications, Process design and operating parameters (ASP), Operational problems (ASP), Process design of oxidation ditch and Waste stabilization pond Biological filtration, Biological nitrogen and phosphorous removal	**5**
Module 4 Decentralized treatment and Disposal	**Hrs.**
Decentralized treatment: Concept, Septic tank and soakage pit, Anaerobic baffled reactor (ABR), Anaerobic filter (AF), Constructed wetland (CW), Typical system Advances in wastewater treatment : Moving bed bioreactor (MBBR), Membrane bioreactor (MBR), Cyclic ASP Disposal of wastewater: Methods, Effluent standards Stream pollution: Self-purification (Stream rejuvenation), DO sag curve, Streeter Phelp's equation for point source, Stream classification	**5**
Module 5 Solid waste	**Hrs.**
Sludge: Characteristics, thickening, dewatering, digestion, disposal Solid Waste: Characteristics, Generation, Collection and transportation Engineered systems for solid waste processing: Mechanical, Thermal, Biological Sanitary land fill: Location, Components, Design	**5**
Module 6 Air and Noise pollution	**Hrs.**
Air Pollution: Meteorological parameters, Ambient air quality monitoring, Air quality standards Air pollution control: Approaches and equipment for particulate and gaseous pollutants Noise pollution: Permissible limits of noise pollution, measurement of noise, Control of noise pollution.	**4**
Module wise Outcomes At end of each module students will be able to 1. Explain wastewater characteristics and collection system. Estimate wastewater flow rate and design flows for sewer. Design sewer. 2. Explain unit operations and processes for wastewater treatment. Analyze and design preliminary and primary treatment units. 3. Explain the activated sludge process (ASP) and biological filtration. Design of ASP, oxidation ditch, and waste stabilization pond.	

4. Explain decentralized treatment system, self-purification of stream and advances in wastewater treatment. Design septic tank. Estimate DO and deficit using Streeter-Phelp's equation. 5. Explain functional elements of solid waste management and processing techniques. Design sanitary land fill for area requirements. 6. Explain meteorological elements and its relation to air pollution; air and noise pollution control equipment.	
Tutorial:	
Module 1: [Tutorial 1: Examples on BOD and BOD test; Tutorial 2: Design of sanitary sewer; Tutorial 3: Design of storm sewer and pumping system; Tutorial 4: COD test]	**4**
Module 2: [Tutorial 1: Examples on bar screen; Tutorial 2: Design of grit chamber]	**2**
Module 3: [Tutorial 1: Examples on ASP; Tutorial 2: Design of oxidation ditch; Tutorial 3: Design of oxidation pond and bio-filter]	**3**
Module 4: [Tutorial 1: Examples on septic tank and area requirement for ABR, AF, and CW; Tutorial 2: Examples on stream purification]	**2**
Module 5: [Tutorial 1: Examples on solid waste generation and collection;Examples on landfill]	**1**
Module 6: [Tutorial 1: Examples on meteorological parameters and air quality ; Tutorial 2: Examples on noise and Demonstration of HVS and Noise level meter]	**2**

Title of the Course: Design of Concrete Structures (4CV324)	L	T	P	Cr
	2	1	-	3

Desirable Courses: Solid Mechanics, Structural Analysis

Textbooks:

1. Punmia, B. C. and Jain, A. K. "Limit state design of reinforced concrete", Laxmi Publication, 1st Edition, 2013.
2. Shah, V. and Karve, S. "Limit state theory and design of reinforced concrete", Structures Publications, 4th Edition, 2003.
3. Varghese, P. C. "Limit State Design of Reinforced Concrete Structures", Prentice Hall, 4th Edition, 2010.

References:

1. IS 456:2000– Code of Practice for Plain and Reinforced Concrete, BIS and SP 34-1987 – Handbook on concrete reinforcement and detailing.
2. Pillai, S. V. and Menon. D, "Reinforced concrete design", Tata McGraw Hill Book Co., 5th Edition, 2006.
3. Ramamruthm, S. "Design of reinforced concrete structures", Dhanpat Rai Publishing, 17th Edition, 2010.

Course Objectives:

1. To introduce the fundamental concepts of limit state method for the design of reinforced concrete components.
2. To impart knowledge for strength determination of different kinds of RC components using IS code.
3. To provide knowledge for design of the various structural members in the building system as per IS code.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Apply** the concept of limit state for design of reinforced concrete components.	III	Applying
CO2	**Calculate** the strength of reinforced concrete members.	V	Evaluating
CO3	**Design** various components of reinforced concrete structures	VI	Creating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**												**1**	**1**
CO2		**3**											**2**	**2**
CO3			**3**										**3**	**3**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Introduction	**5 Hrs.**
a) Design Philosophies- Working Stress Method, Ultimate Load Method, Limit State Method, Limit state of collapse, Characteristic strength, Characteristic load, Partial safety factors, Stress-strain curves for concrete and steel, Limit state of serviceability, Provisions in IS code. b) Singly reinforced rectangular beam, Balanced section, Under-reinforced section and over-reinforced section, Moment of resistance, Design of rectangular, T and L sections.	
Module 2: Doubly Reinforced Beams	**5 Hrs.**
a) Moment of resistance for doubly reinforced rectangular, T and L beams. b) Design of doubly reinforced rectangular, T and L beams.	
Module 3: Shear, Bond, and Torsion	**5 Hrs.**
a) Shear: Truss analogy, Design of beam for shear according to IS code. b) Bond: Bond and development length, Bond stress, Standard hooks, Anchorages. c) Torsion: Design of beam subjected to torsion according to IS code.	
Module 4: One Way and Two Way Slab	**5 Hrs.**
a) Design of single span, continuous and cantilever one way slab. b) Design of two way slab by IS code method. c) Design of staircases.	
Module 5: Columns	**4 Hrs.**
Load carrying capacity of axially loaded column, Short and long columns, Rectangular and circular columns, Design according to IS, Column subjected to combined axial load and uniaxial bending, P-M interaction diagram.	
Module 6: Isolated Footing	**5 Hrs.**
Design of square/rectangular and circular isolated footing.	
Module wise Outcomes At end of each module students will be able to: 1. Apply the concept of limit state method for design of singly reinforced beams in flexure and explain different design philosophies. 2. Design doubly reinforced beams. 3. Design the beam for shear, bond, and torsion. 4. Design one way, two way slab, and dog-legged staircase. 5. Design axially and eccentrically loaded columns. 6. Design square, rectangular, and circular isolated footings.	
Tutorial: One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, seminar, final oral, etc.	

Title of the Course: **PE-II: Design of Hydraulic Structures (4CV331)**	L	T	P	Cr
	2	1	0	3

Desirable Courses: Water Resources Engineering

Textbooks:

1. Garg, S.K., "Irrigation Engineering*",* Khanna publisher, Delhi, 11th Edition, 2014.
2. Modi, P.N.,"Water Recourses Engineering and Water Power Engineering*",* Standard Book House, 10th Edition, 2008.
3. Punmia,B.C. andPande, B.B., *"*Irrigation Water Power Engineering*"*,Laxmi Publication Private Limited, 4th Edition, 2009.

References:

1. Sharma, R.K,"Hydrology and Water Resources", Dhanpatrai and sons Delhi,8th Edition,2007
2. Sahasrabudhe, S.R.,"Irrigation and Hydraulic structures", S.K Kataria and Sons Dehhi,3rd Edition,2011
3. Varshney and Gupta "Theory Design of Irrigation Structures", Vol. I, II, III, Nemechand and Brothers,6th Edition,2008

Course Objectives :

1. To introduce students the concepts of reservoir planning and irrigation engineering
2. To provide students with necessary skill for the design of various hydraulic structures.
3. To prepare the students for higher studies and research in the field of water resources and irrigation engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain**basics of reservoir, gravity dam, earth dam, spillway, weirs, canal,river training work and water power.	II	Understanding
CO2	**Apply** theknowledge of hydraulic structures to solve/analyze the problems associated with.	III, IV	Applying Analyzing
CO3	**Design** hydraulic structures inirrigation engineering.	VI	Creating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**3**													
CO2		**3**											**3**	**3**
CO3			3										**3**	**3**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1: Assignment on problem pertaining to modules 1 to 3 and evaluated by test/quiz/presentation/oral.

ISE 2: Assignment on design of various hydraulics structure problem and evaluated by test/quiz/presentation/oral.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three

modules) covered after MSE.	
Course Contents:	
Module 1 Planning of reservoir and classification of dams	**Hrs.**
Planning of reservoirs: storage calculations, control levels of reservoir, silting of reservoir, losses in reservoirs and calculation of life of reservoir. Dams: necessity and types, selection of suitable site for construction, selection of type .	**5**
Module 2 Gravity dam and arch dam	**Hrs.**
Gravity Dam: forces acting on gravity dam, failure criteria of gravity dam, theoretical and practical profile of gravity, methods of stability analysis and construction of gravity dam. Arch dams: types, layout of constant angle and constant radius arch dam, forces acting on arch dam.	**5**
Module 3 Earthen dam	**Hrs.**
Earthen dams: components and their functions, stability and design criteria; seepage through the body of the earth dam and below earth dam, application of slip circle method, different type of filters, upstream and downstream drainage arrangement, construction of earthen dam.	**5**
Module 4 Spillway	**Hrs.**
Spillway: necessity and different types, factors affecting choice and type of spillway, elementary hydraulic design, energy dissipation devices, jump height and tail water rating curve, energy dissipation below spillway, type of gates provided at the crest of the spillway	**4**
Module 5 Weir on permeable foundation and canal	**Hrs.**
Weirs on permeable foundation: theories of seepage, Bligh's creep theory, Khosla's theory Canal: types, alignment, Kennedy's and Lacey's silt theories, canal losses, typical canal sections, necessity and types of canal lining Canal structures: cross drainage works and canal regulatory works, aqueduct, culvert, super passage, level crossing, cross and head regulator, canal Siphon, canal escape, canal fall and canal outlets	**5**
Module 6 River training work and hydro power engineering	**Hrs.**
River training works: types of rivers, meandering phenomenon, types of river training works. Hydropower engineering: types of water power plants, layout and components of each type, intakes, conveyance system, surge tanks, power house types, components and layout.	**5**
Module wise Outcomes At end of each module students will be able to 1. Explain storage capacity of the reservoir and type of dam, estimate of life of the reservoir. 2. Analyze and design gravity dam. 3. Analyze and design earthen dam. 4. Analyze and design spillway with energy dissipating devices. 5. Analyze and design the weir on permeable foundation and canal. 6. Explain the river training methods and hydro power engineering.	
Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course:	L	T	P	Cr
PE-II: Advanced Surveying (4CV332)	2	1	-	3

Pre-Requisite Courses: Engineering Surveying

Textbooks:

1. Chandra A.M., Higher Surveying, New Age International Private Limited, 2015
2. K. R. Arora "Surveying", Vol. 1 & 2, Standard Book House, 16th edition, 2018, Kota.
3. Agrawal N.K., "Essentials of GPS" Spatial Network Pvt. Ltd., Hydrabad.

References:

1. James Anderson and Edward Mikhail, Surveying: Theory and Practice, McGraw Hill Education; 7th edition, 2017
2. Lillesand T. M. and Kiefer. R.W., "Remote Sensing and Image Interpretation", 4th Edition, John Wiley and Sons, New York, (2002).
3. R. E. Davis, F. Foote and J. Kelly, "Surveying; Theory and Practice", McGraw Hill Book Company, New York.

Course Objectives :

1. To understand advanced surveying techniques and geospatial techniques.
2. To develop an ability to analyze land profiles in logical manner and will be able to apply well understood principles in planning and design of engineering structures on the Earth's surface.
3. To adopt suitable survey technique and select equipment based on the required level of accuracy and prevailing field conditions.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Study** modern surveying equipment effectively to improve quality of surveys.	IV	Analyzing
CO2	**Analyze** and synthesize data from the aerial photographs and remote sensing images to prepare thematic maps.	IV	Analyzing
CO3	**Analyze and Solve** surveying problems by using remote sensing, GIS and GPS.	III IV	Applying, Analyzing

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**1**	**1**			**3**								**1**	
CO2	**1**	**1**			**3**								**1**	
CO3	**3**	**1**			**3**								**1**	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Module 1: Geodetic Surveying	**Hrs.**
Introduction & objective of Geodetic Surveying, Principal & classification of triangulation system, Selection of base line and stations, Orders of triangulation-triangulation figures, Station marks and signals-marking signals, Examples on Phase error, Extension of base, reduction of center, selection and marking of stations	**5**
Module 2: Total Station Survey	**Hrs.**
Principle, Data observations, Data extraction and conversion using software Concept of traversing, profile survey and contouring using Total Station	**4**
Module 3: Aerial Photogrammetry	**Hrs.**
Aerial Photogrammetry, Basic concepts, Geometry of vertical photographs, Scale and Flying height, Relief displacement, Flight planning computations, Stereoscopy and Parallax, Photo mosaic, Elements of photo interpretation.	**5**
Module 4:Remote Sensing	**Hrs.**
Definition and scope of remote sensing; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Atmospheric window and spectral reflectance curve; Resolutions in remote sensing; Types of remote sensing; Principles and applications of optical, thermal & microwave remote sensing; Introduction to hyperspectral remote sensing; Characteristics and types of Remote sensing satellites and sensors	**6**
Module 5: Introduction to Geographical Information System (GIS)	**Hrs.**
Definition of GIS, Components of GIS, Hardware and Software, GIS operations. Types of Geographic data; Raster and Vector data model: Advantages and Disadvantages; Fundamental of data storage: block code, run length code, chain code, quad tree; Spatial data input: Digitization and Conversion; Point, line and polygon; Concept of Arc, node and vertices; Digitization errors; Topological relationship; Topology: Error and editing.	**5**
Module 6: Introduction to Geographical Positioning System (GPS)	**Hrs.**
Introduction to GPS; Types of GPS; GPS satellite; data receiver and control points; Differential GPS; Sources of GPS errors; Application of GPS in surveying, mapping and navigation.	**4**
Module-wise Outcomes: At end of each module students will be able to 1. Classify triangulation systems and analyze baseline data. 2. Use Total Station and analyze Total Station survey data. 3. Explain basic concepts of aerial photogrammetry. 4. Explain basic concepts of Remote Sensing. 5. Use GIS and analyze GIS data. 6. Explain working of GPS and apply GPS measurement and mapping techniques for GPS surveying.	
Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: **Professional Elective II- Advanced Concrete Technology (4CV333)**	L	T	P	Cr
	2	1	-	3

Desirable Courses: Civil Engineering Materials

Textbooks:

1. Gambhir, M. L., "Concrete Technology", Tata Mc Graw Hill Publishers, 2012.
2. Nevelli, A.M., "Properties of Concrete", Prentice Hall Publishers, 5th Edition, 2012.
3. Shetty, M. S., "Concrete Technology", S. Chand and Company Ltd, New Delhi, 2014.

References:

1. Indian codes- IS: 456-2000, IS: 2250-1981, IS: 516-1959, IS: 5816 -1999, IS: 4031(Part 6) - 1988.
2. Kumar Neeraj Jha, " Formwork for Concrete Structures", https://www.amazon.in/Formwork-Concrete-Structures-Kumar-Neeraj/dp/1259007332
3. Perkins P.H., "Repair, Protection and Waterproofing of Concrete Structures" Elsevier Applied Science Publishers, 1986.
4. Krishna Raju. N, "Design of Concrete Mixes", 2nd Edition, CBS Publishers and Distributors, 2009.

Course Objectives:

1. To provide knowledge of advanced technique of making of concrete, application of concrete to roads and industrial floors, precast concrete, formwork.
2. To impart the knowledge of quality control and statistics
3. To illustrate various techniques for testing and repair of concrete structures.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Explain** advanced technique of making of concrete, application of concrete to roads and industrial floors, precast concrete, formwork.	II	Understanding
CO2	**Assess** quality of concrete through quality assessment techniques.	V	Evaluate
CO3	**Design** the formwork for concrete structures	VI	Creating

CO-PO Mapping :

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1	**2**													**2**
CO2			**3**											**3**
CO3			**3**											**3**

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1: Concrete Plant and Ready-mixed concrete	**5 Hrs.**
Batching plant and ancillary equipment for improving accuracy; mixers; distributing plant; vibrators. Site for RMC plant, need of RMC plant, types of plant; truck-mixer efficiency; effects of prolonged agitation; quality control: acceptance and compliance.	
Module 2: Special processes and technology for particular types of structure	**5 Hrs.**
Sprayed concrete, underwater concrete, grouts, grouting and grouted concrete, form construction, concrete for liquid retaining structures, pumped concrete, mass concrete, vacuum process; concrete coatings and surface treatments, Exposed concrete finishes; types of surface finish; methods of production; weathering.	
Module 3: Precast Concrete and Concrete for Roads and Industrial Floors	**5 Hrs.**
A) **Precast concrete-** Review of types of small and large products; methods of compaction other than vibration; mix design and curing; special formwork requirements; masonry. B) **Concrete roads-** Methods and materials for pavements; equipments, cement-bound materials; testing materials, joints, methods of curing. C) **Industrial floors-** Materials and construction procedures; screeds and toppings; testing.	
Module 4: Quality concepts, Quality control and Statistics	**5 Hrs.**
A) **Quality concepts-** Definitions; principles and Standards; quality schemes; third party capability assessment; QA schemes for materials, ready-mixed concrete and precast concrete; QA in concrete construction; product conformity. B) **Quality control-** Quality of mixed concrete: outline of problems involved; control techniques; selection of control procedures. Quality of finished product. C) **Statistics-** Measures of dispersion, probability and sampling theory, tests of significance, curve fitting and regression, repeatability and reproducibility, control charts. The role and limitations of statistics in concrete technology.	
Module 5: Formwork	**5 Hrs.**
Principles of design; concrete pressures; linings; release agents; formwork for exposed concrete finishes; tolerances. Formwork materials, structural requests, formwork systems, connections, slip formwork, specifications, removal for forms, failure of formwork.	
Module 6: Non-destructive Testing and Repairing of Concrete	**4 Hrs.**
Causes for repairing, types of concrete failures, distress in structure – causes and precautions, damage assessment of structural elements. Non-destructive testing- rebound hammer, ultrasonic pulse velocity apparatus and rebar locator etc. Repairing techniques and repairing materials-jacketing, FRP wrapping, shotcrete and grouting, chemical adhesives etc.	
Module wise Outcomes At end of each module students will be able to:	

1. Explain concrete plants and RMC 2. Demonstrate special processes and techniques of concreting like for particular types of structure like underwater, water retaining etc. 3. Explain advanced techniques of concreting for roads, industrial floors and precast units. 4. Assess the quality of concrete through quality control and quality assessment procedure. 5. Design the formwork for concrete structures. 6. Assesses existing strength of concrete using non-destructive testing methods and select proper strengthening method.	
Tutorial One hour per week per batch tutorial is to be utilized for problem solving to ensure that students have properly learnt the topics covered in the lectures. This shall include assignment, tutorials, quiz, surprise test, declared test, seminar, final orals etc.	

Title of the Course: **Mini Project 2 -Estimating and Costing (4CV 371)**	L	T	P	Cr
	0	0	2	1

Desirable Courses: Building Materials and Construction, Building Planning and Design

Textbooks:

1. Dutta, B. N., "Estimating & Costing in Civil Engineering," UBS Publishers, 28th Revised Edition, 2016.
2. Birdi G.S., "Text book of Estimating & Costing", Dhanapat Rai Sons, 7th Edition, 2015.
3. Patil B. S., "Civil Engineering Contracts & Estimates", Orient Longman Ltd., 4th Edition, 2015.

References:

1. I.S. code 1200 (Part I to XXX) B.I.S., Delhi
2. "Standard Specification Vol. I & II", PWD Maharashtra.
3. "D.S.R.", PWD Maharashtra for the recent year.

Course Objectives :

1. To develop the skills required for formulating specifications and carrying out rate analysis.
2. To provide students hands-on practice for estimating cost of civil works.
3. To impart training to use computer for estimating and costing.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Formulate specifications and analyze rates for different items of work	4,6	Analyzing, creating
CO2	Estimate costs of the different civil works	4	Analyzing
CO3	Demonstrate application of computer for estimating and costing	3	Applying

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1			**3**										**2**	**2**
CO2			**3**								**2**		**1**	**2**
CO3					**2**								**2**	

Assessments :

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Assignments	**Hrs.**
The mini-project to be completed for the course shall comprise of two parts as specified below	
Part 1. Estimate for Residential Building Preparation of a report incorporating i. General description of the work, Drawings, data and assumptions ii. Detailed Estimate of Two storeyed residential building iii. Detailed Specifications: Minimum 3 traditional items of work and Minimum 1 nontraditional items of work pertaining to the estimate in ii iv. Preparation of bar bending schedule for a part of the above work v. Rate analysis for the items covered in iii vi. Tender notice for the above work vii. Listing all conditions of contract for the above work and detailed drafting of any three conditions of contract for the above work viii. Concluding Remarks ix. References	**18**
Part 2. Estimate for any One Civil Work other than building (such as Road, Canal, C.D. works, Structural steel work, Water supply or treatment work, S.T.P., E. T. P. etc.) Preparation of a report incorporating i. General description of the work, Drawings, data and assumptions ii. Detailed Estimate of the work iii. Detailed Specifications: Minimum 1 item of work pertaining to the estimate in other than those common in buildings. iv. Rate analysis for the items covered in iii	**8**

v. Concluding Remarks vi. References	

Title of the Course: **Mini Project 3- Structural Steel Design & Drawing (4CV372)**	L	T	P	Cr
	-	-	2	1

Desirable Courses: Engineering Mechanics, Solid mechanics, Design of steel structures

Textbooks:

1. Duggal S. K., "Limit state design of steel structures", Tata McGraw-Hill Publications, New Delhi, 2nd Edition, 2014.
2. Shiyekar, M. R., "Limit state design in structural steel", PHI learning Pvt. Ltd Publications 2nd Edition 2013.
3. Subramanian N., "Design of steel structures", Oxford University Press, 2010.

References:

1. Dayaratnam, P., "Design of steel structures", S. Chand Publication, New Delhi, 2008.
2. Gaylord, Edwin and Gaylord, Charles, "Design of steel structures", Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2010.
3. IS 800-2007 'Code of Practice for General Construction in steel', and IS 875-1987 part 1 to 5; Code of Practice for Design Loads (other than earthquake) for building structures, Bureau of Indian Standards, New Delhi.
4. SP: 6(1)- 1998, Hand Book for Structural Steel Sections.

Course Objectives :

1. To impart the knowledge of analysis and design of various steel members and their connections.
2. To demonstrate the design of practical steel structures such as industrial sheds, steel buildings etc.
3. To provide the knowledge of detailing of steel structural drawings.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	**Estimate** various types of loads such as Dl, LL, WL etc acting on steel structures.	IV	Analyzing
CO2	**Calculate** design forces in members of steel structures for various combinations of loads using modern tools.	V	Evaluating
CO3	**Design** various types of practical steel structures and develop detailed structural drawings.	VI	Creating

CO-PO Mapping : (Use 1, 2, 3 as Correlation Strengths)

PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
CO1														**2**
CO2		**3**			**2**									**2**
CO3		**3**	**3**										**3**	**3**

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course.
The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiments The lab work shall consist of structural analysis, design and detailing of the following structures along with necessary drawings.	**Hrs.**
1. Industrial Shed: **a)** Roof truss, purlin, connections. **b)** Gantry girder. **c)** Columns and column bases	**06**
2. Building Frames: **a)** Secondary and main beams. **b**) Column and column bases. **c)** Beam- to- beam connection. **d**) Column- beam connection.	**09**
3. Foot Bridge: **a)**Influence lines. **b**) Cross beam. **c**) Main truss. **d**) Raker. **e**) Joint details. **f**) Support details. **OR** **3.Welded Plate Girder:** a) Stiffeners b) Curtailment of Flange plates	**09**
4. Analysis results of the first problem of industrial shed shall be compared with the results by any standard software package.	**04**