D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

Accredited by NAAC with 'A' Grade

T. Y. B. Tech. Syllabus

Department of Civil Engineering

(with effect from academic year **2022-23**)

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR

Teaching and Evaluation Scheme from Year 2022-23

Third Year B. Tech. Civil Engineering

SEMESTER-V

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201CEL301	PCC	Theory of Structures	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201CEL302	PCC	Environmental Engineering	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201CEL303	PCC	Highway and Traffic Engineering	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201CEL304	PCC	Irrigation Engineering	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201CEL305-310	PEC	Professional Elective -I	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
6	201CEP311	PCC-LC	Environmental Engineering Lab	-	-	2	1	50	ISE	25	10	
									ESE(OE)	25	10	
7	201CEP312	PCC-LC	Highway and Traffic Engineering Lab	-	-	2	1	50	ISE	25	10	
									ESE(OE)	25	10	
8	201CEP313-318	PEC-LC	Professional Elective -I Lab	-	-	2	1	25	ISE	25	10	
9	201CEP319	PROJ	Mini Project	-	-	2	1	50	ISE	25	10	
									ESE(OE)	25	10	
10	201CEMC320	MC	Commercial Aspects in Civil Engineering Projects (Mandatory Course-IV)	2	-	-	-	50	ESE	50	20	
Summary		**Total**		**17**	**2**	**8**	**21**	**725**				
		Total Contact Hrs/week		**27**			**Total Credits**		**21**	**Total Marks**		**725**

ISE: *In Semester Evaluation* ***MSE:*** *Mid Semester Examination* ***ESE:*** *End Semester Examination*
OE *- Oral Examination* ***POE*** *- Practical Oral Examination*

Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.

Note 2 : ESE will be conducted for 100 marks and converted to 50 Marks

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D.Y.Patil College of Engg. & Tech.
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D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR

Teaching and Evaluation Scheme from Year 2022-23

Third Year B. Tech. Civil Engineering

SEMESTER-VI

Sr. No	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week			Credits	Total Marks	Evaluation scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201CEL321	PCC	Design of Steel Structures	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201CEL322	HSMC	Management for Civil Engineering	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201CEL323	PCC	Quantity Surveying and Valuation	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
4	201CEL324-329	PEC	Professional Elective -II	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201CEL330-331	OEC	Open Elective -I	3	1	-	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
6	201CEP332	ESC	Design of Steel Structures Lab	-	-	2	1	50	ISE	25	10	
									ESE(OE)	25	10	
7	201CEP333	HSMC-LC	Management for Civil Engineering Lab	-	-	2	1	50	ISE	25	10	
									ESE(OE)	25	10	
8	201CEP334	PCC-LC	Quantity Surveying and Valuation Lab	-	-	4	2	75	ISE	50	20	
									ESE(OE)	25	10	
9	201CEP335	ESC	Civil Engineering Software	-	-	2	1	50	ISE	50	20	
10	201CEMC336	MC	Ethics in Engineering (Mandatory Course-V)	2	-	-	-	50	ESE	50	20	
Summary		Total		17	1	10	21	775				
		Total Contact Hrs/week		28			Total Credits		21	Total Marks		775

ISE: *In Semester Evaluation* ***MSE:*** *Mid Semester Examination* ***ESE:*** *End Semester Examination*
OE *- Oral Examination* ***POE*** *- Practical Oral Examination*

Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.

Note 2 : ESE will be conducted for 100 marks and converted to 50 Marks

* Students have to undergo 4 to 6 weeks internship after IV or VI Semester during Summer vacation

D.Y.Patil College of Engineering Kolhapur Dept of Civil Engineering

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Internship Guidelines

*	The students are expected to undergo 4 to 6 week internship in the industry and work on the area as specified by the industry. The work should be assigned, monitored and evaluated by the concerned industry expert, based on the report by the students.
*	The department has to assign one faculty mentor who has to communicate with industry and monitor the internship related work, periodically.
*	The weightage of the evaluation will be as under.
	Industry Expert / Supervisor: 70%
	Department and faculty: 30%
	The evaluation should include presentations and submission of reports to the department at the beginning of the subsequent semester.
*	The internship can be availed by the students during the summer vacations after completion of Semester IV or Semester VI. The credits of internship will be considered in semester VII.
*	The industry expert / supervisor is expected to assign the work worth minimum of 100 to 120 hrs. for 4 to 6 weeks duration and should monitor and evaluate periodically.
*	At the completion of the internship work the student is expected to prepare a report on the work done and get certified from the industry expert.

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY, KOLHAPUR

Third Year B. Tech. Civil Engineering

SEMESTER-V

List of Professional Elective-I (Theory)

Course Code	Name of Subject	Track
201CEL305	Foundation Engineering	**Track-I** Structures and Geotechnical Engineering
201CEL306	Ground Improvement Techniques	
201CEL307	Municipal Solid Waste Management	**Track-II** Environment, Hydraulics and Water Resourse Engineering
201CEL308	Engineering Hydrology and Watershed Management	
201CEL309	Advance Surveying	**Track-III** Transportation and Construction Management
201CEL310	Rural Development Planning	

List of Professional Elective-I (Practical)

Course Code	Name of Subject	Track
201CEP313	Foundation Engineering Lab	**Track-I** Structures and Geotechnical Engineering
201CEP314	Ground Improvement Techniques Lab	
201CEP315	Municipal Solid Waste Management Lab	**Track-II** Environment, Hydraulics and Water Resourse Engineering
201CEP316	Engineering Hydrology and Watershed Management Lab	
201CEP317	Advance Surveying Lab	**Track-III** Transportation and Construction Management
201CEP318	Rural Development Planning Lab	

SEMESTER-VI

List of Professional Elective-II (Theory)

Course Code	Name of Subject	Track
201CEL324	Geotechnical Design	**Track-I** Structures and Geotechnical Engineering
201CEL325	Reinforced Earth & Geotextiles	
201CEL326	Environmental Impact Assessment	**Track-II** Environment, Hydraulics and Water Resourse Engineering
201CEL327	Water Power Engineering	
201CEL328	Intelligent Transportation Systems	**Track-III** Transportation and Construction Management
201CEL329	Offshore Structural Engineering	

Note: Students should select Professional Elective from any one track throughout…..

Open Elective:

Open elective courses are offered to gain the knowledge of multidisciplinary areas. Students must choose one open elective course from the list of courses offered by other departments (excluding open elective courses offered by their department). Following is the list of open elective courses. The detailed syllabus is available on to the college website under academic tab.

Sr. No.	Department	Course Code	Open Elective-I Course
1	Chemical	201CHL318	Industrial Safety and Act
		201CHL319	Energy Conservation and Audit
2	Mechanical	201MEL313	Human Resource Management
		201MEL314	Electric Vehicle
3	Architecture	201ARL318	Residential Gardening
		201ARL319	Role of Art & Technology in Interior Design
4	Electronics and Telecommunication	201ETL318	Sensor Technology
		201ETL319	Electronic Instrumentation
5	Computer Science & Engineering	201CSL319	E- Commerce & Digital Marketing
		201CSL320	Python Programming
6	Computer Science & Engineering (Artificial Intelligent & Machine Learning)	201AIML320	Applications of AI ML
		201AIML321	Augmented Reality and Virtual Reality
7	Computer Science & Engineering (Data Science)	201DSL319	Basics of Data Science
		201DSL320	Basics of Database

Course Plan

Course Title: Theory of Structures	
Course Code: 201CEL301	**Semester: V**
Teaching Scheme: L-T-P : 3-1-0	**Credits: 4**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: In this course, various techniques and their underlying mechanics for figuring out how indeterminate structures react to external agitation will be covered. The course is thorough on a fundamental level. Students experience in this course will help them lay the groundwork for more advanced structural engineering courses.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To teach the basics of elastic structural analysis and indeterminate structure behavior.
2. Using various approaches to investigate indeterminate structures.
3. To assess the suitability of various approaches
4. To raise awareness of the limitations of solution techniques and their outcomes.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C301.1	Evaluate static and kinematic indeterminacy of the structures
C301.2	Analyze the beams using consistent deformation and three moment method
C301.3	Analyze the beams and frames using displacement methods.
C301.4	Solve the beam and truss problems using energy methods

Prerequisite:	Analytical methods of determinate structures to find force and displacements

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C301.1	3	3	3	3	-	3	-	-	-	-	-	3	1	-	3
C301.2	3	3	3	2	-	2	-	-	-	-	-	3	1	-	4
C301.3	3	3	3	2	-	2	-	-	-	-	-	3	1	1	4
C301.4	3	3	3	2	-	2	-	-	-	-	-	3	1	-	3

Content	Hours
Unit 1. Introduction and Indeterminacy of Structure 1.1 Introduction to force and displacements methods. 1.2 Approaches to find static indeterminacy of frame, truss and beams with numerical problems 1.3 Approaches to find kinematic (Degree of freedom) indeterminacy of frame, truss and beams with numerical problems	6
Unit 2. Consistent Deformation Method 2.1 Application of Consistent deformation methods on propped cantilever beam. 2.2 Application of Consistent deformation methods on fixed beam. 2.3 Application of Consistent deformation methods on continuous beam, with Static indeterminacy less than or equal to two.	6
Unit 3. Clapeyron's Three Moment Theorem 3.1 Application of three moments on continuous beam with different end support conditions 3.2 Application of three moments on continuous beam with different moment of inertia. 3.3 Application of three moments on continuous beam with sinking of support.	6

Unit 4. Slope Deflection Method 4.1 Introduction to slope deflection equation, modified slope deflection equation with Static indeterminacy less than or equal to two. 4.2 Application of slope deflection equation, modified slope deflection equation on continuous beam , sinking of support , with Static indeterminacy less than or equal to two 4.3 Application of slope deflection equation, modified slope deflection equation on sway and non sway portal frames with Static indeterminacy less than or equal to two.	6
Unit 5. Moment Distribution Method 5.1 Application of moment distribution method on continuous beam, sinking of support , with Static indeterminacy less than or equal to two 5.2 Application of moment distribution method on sway and non sway portal frames with Static indeterminacy less than or equal to two	6
Unit 6. Energy Methods 6.1 Application of Castiglione's theorem and unit load method on continuous beams with Static indeterminacy less than or equal to two 6.2 Application of Castiglione's theorem and unit load method on knee bend and frame with Static indeterminacy less than or equal to two 6.3 Application of Castiglione's theorem and unit load method on truss, lack of fit, with Static indeterminacy less than or equal to two.	6

List of Tutorials

Tutorial No.	Tutorial Details	Hours
1	Tutorial based on finding of static indeterminacy of structure	1
2	Tutorial based on finding of kinematic indeterminacy of structure	1
3	Tutorial based on analytical problems on propped cantilever and fixed beam using Consistent deformation methods	1
4	Tutorial based on analytical problems on continuous beam using Consistent deformation methods	1
5	Tutorial based on analytical problems on continuous beam for different end support conditions , different M.I. using Clapeyrons three moment theorem	1
6	Tutorial based on analytical problems on continuous beam for different end support conditions , different M.I. and sinking of support using Clapeyrons three moment theorem	1

7	Tutorial based on analytical problems on continuous beam for different end support conditions , different M.I. using slope deflection method	1
8	Tutorial based on analytical problems on continuous beam, sway and non sway portal frame using slope deflection method	1
9	Tutorial based on analytical problems on continuous beam for different end support conditions , different M.I. using moment distribution method	1
10	Tutorial based on analytical problems on continuous beam, sway and non sway portal frame using moment distribution method	1
11	Tutorial based on analytical problems on continuous beam ,knee bent and frame using Castiglione's theorem	1
12	Tutorial based on analytical problems on unit load method, lack of fit for truss and frame	1

Text Books:

1	Bhavikatti, "Structural Analysis" Vikas Publishing House Pvt, ltd.
2	Vazirani and Ratwani, "Analysis of Structures" Vol. I & II, Khanna Publishers
3	S. B. Junnarkar, H.J. Shah, "Mechanics of Structures" - Vol-I & II, Charotar Publishers.
4	Pandit and Gupta, "Structural Analysis: Matrix approach
5	S. Ramamrutham, R. Narayanan, "Theory of structures" Dhanipat Rai Publishing Company

Reference Books:

1	Devdas Menon, "Structural Analysis", Narosa Publishing House
2	Hibbeler, R. C, "Structural Analysis", Pearson Education
3	Norris, C.H., Wilbur, J.B., and Utku, S., "Elementary Structural Analysis" McGraw Hill.
4	Wang, C.K., "Intermediate Structural Analysis", McGraw Hill,
5	C.S. Reddy, "Basic Structural Analysis", Tata McGraw Hill Publishing House, New Delhi
6	Gere & Weaver, "Matrix analysis of structures"

Course Plan

Course Title: Environmental Engineering	
Course Code: 201CEL302	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Environmental Engineering provides knowledge and skills in the field of water supply system and waste water disposal system. It also deals with the concepts of Noise Pollution, Municipal Solid Waste Management, building sanitation & Environmental Impact Assessment (EIA).

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To study different sources and characteristics of water and wastewater.
2. To know the various treatment processes for water and wastewater.
3. To understand the various components related to transmission and distribution of water.
4. To study various aspects of noise pollution, solid waste management, building sanitation & Environmental Impact Assessment (EIA).

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C302.1	Interpret different sources and characteristics of water and wastewater.
C302.2	Explain the various treatment processes for water and wastewater.
C302.3	Plan the various components related to transmission and distribution of water.
C302.4	Illustrate various aspects of noise pollution, solid waste management, building sanitation & Environmental Impact Assessment (EIA).

Prerequisite:	Engineering Chemistry, Fluid Mechanics, Environmental Studies.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C302.1	3	3	3	-	-	3	3	3	-	-	-	-	-	1	2
C302.2	3	3	3	-	-	3	3	3	-	-	-	-	1	1	2
C302.3	3	3	3	-	-	3	3	3	-	-	-	-	1	1	3
C302.4	3	3	3	-	-	3	3	3	-	-	-	-	1	1	2

Content	Hours
Unit 1. Introduction to Water Supply: **a. Introduction:** Necessity and brief description of water supply system. **b. Quantity of Water:** Water requirement, Types of demand, Per capita demand, design period, Population Forecasting, fluctuations in demand of water, factors affecting the water demand. **c. Quality of Water:** Impurities in water, Methods of analysis of water- Physical, Chemical and Biological tests and their significance, Standard of potable water as per Standard.	4
Unit 2. Water Treatment: **a. Water Treatment:** Principles of water treatment processes. Layout of Water Treatment Plant. **b. Aeration:** Principle and concept, Necessity, Methods, Design of cascade aerator. **c. Sedimentation:** Theory, Types of settling, Types of sedimentation tanks, Principles & design, Concept of tube & plate settler.	9

d. Coagulation & Flocculation: Theory, Factors affecting, Destabilization of colloidal particles, Types of dosing of coagulants, Selection of coagulants, Jar test, Design of rapid mixer & flocculator, Theory of clariflocculator. **e. Filtration:** Mechanism, Head loss development, Negative head loss, Types of filters- slow sand filter, rapid sand filter & pressure filter. Design, Operation & Maintenance of rapid sand filter. **f. Disinfection:** Theory, Factors affecting disinfection, Types of disinfectants, Types and methods of chlorination, break point chlorination. **g. Water Softening Processes**: Lime-soda process, Ion exchange. **h. Demineralization:** Reverse osmosis, Electro-dialysis.	
Unit 3. Conveyance of Water: **a. Different types of pipes and joints**: Cast iron, wrought iron, steel, concrete, cement lined cast iron, asbestos cement, concrete- their suitability and uses, types of pipe- joints. **b. Appurtenances:** Sluice, pressure relief, check valves, air relief, drain valves, stop cocks and water tap, fire hydrant and water meters their working and uses. **c. Distribution system:** Requirement of distribution, classification, layout of distribution system, pipe network analysis. **d. Methods of supplying water:** Intermittent and continuous service reservoirs- types and necessity, design of balancing reservoir. **e. Wastage of water:** Leakage detection, Factors affecting losses and wastes.	5
Unit 4. Sanitation: **a. Introduction:** Purpose of sanitation, Necessity of systematic collection, treatment and disposal of wastewater, Definition of different terms in sanitary engineering, Collection systems of sanitation- water-carriage system, Types of wastewater- Domestic, industrial, storm drainage. **b. Sewerage System:** Classification, merits and demerits; types of sewers based on- materials and shapes, design of sewers. **c. Sewage characteristics:** Characteristics of wastewater- Physical, Chemical and Biological parameters. **d**. Problem based on BOD	4

Unit 5. Sewage Treatment and Disposal: **a. Sewage Treatment Plant Process:** Screens, grit chambers, skimming tanks, primary clarifiers, Activated Sludge Process, secondary clarifiers, trickling filters, Chlorination. **b. Sludge Treatment:** Concept of anaerobic sludge digestion, Types of reactors, Moving and Sequential Batch reactor, dewatering and drying of sludge. **c. Low cost wastewater treatment methods:** Septic tank. **d. Wastewater Disposal:** Disposal by dilution, Self-purification of streams, Disposal by land treatment, CPCB standards for Sewage Discharge.	9
Unit 6. Noise Pollution, Solid Waste Management, Environmental Impact Assessment & Building Sanitation: **a. Noise Pollution:** Introduction and definition, Characteristics and measurements of Sound, Sources and Effects of noise, Noise levels and rating systems, Noise Abatement and Control. **b. Solid Waste Management:** Solid waste definition, Types, Sources, Characteristics, Functional outlines-storage, Collection, transfer and transport, Methods of disposal of solid waste- composting, Incineration, Pyrolysis and sanitary land filling. **c. Environmental Impact Assessment:** Concept, Outline and details of EIA, Report preparation. **d. Building Sanitation:** Definitions of the terms related to building sanitation- Water pipe, Rain water pipe, Soil pipe, Waste pipe, Vent pipe, anti-siphonage pipe, etc. Traps, Sanitary Fittings- Water closets, flushing cistern, bath tubs, wash basin, sinks, and urinals. Systems of plumbing- one pipe, two pipes, single-stack and single-stack partially ventilated system.	5

Text Books:

1	G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering"- Dhanpat Rai Publisher.
2	Warren Viessman and Mark J. Hammer, "Water Supply and Pollution Control"- Harper & Row Publishers.
3	B. C. Punmia, Ashok Kumar, A. K. Jain, "Water Supply Engineering" - Laxmi Publisher.
4	B. C. Punmia, Ashok Kumar, A. K. Jain, "Waste Water Engineering" - Laxmi Publisher.
5	Bhide A.D. and Sundersen B.B., "Solid Waste Management in Developing Countries" - Indian National Scientific Documentation Centre, New Delhi

Reference Books:

1	Metcalf & Eddy, "Waste Water Engineering Treatment & Disposal" –Tata McGraw Hill

Reference Manuals:

1	Manual on Water Supply and Treatment- Government of India Publication, 1993
2	"Manual on Sewerage &Sewage Treatment" Ministry of Urban Development Govt. of India Msy-2000.,Ministry of Urban development
3	"Manual on Municipal Solid Waste Management" - Ministry of Urban Development Govt. of India.

D.Y.PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
KASABA BAWADA KOLHAPUR-416006
(An Autonomous Institute) B. Tech. Curriculum
Third Year B. Tech. Civil Engineering
SEM-V (Academic Year-2022-23)

Course Plan

Course Title: Highway and Traffic Engineering	
Course Code: 201CEL303	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
This course will discuss the principles and practices of testing of highway materials. The major topics of this course cover highway geometric design, Design of flexible and rigid pavements, methods of flexible and pavement construction and Traffic Engineering

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To understand importance of highways, their alignment and geometric design.
2 To understand properties of various pavement materials and make use of the same in design of pavements.
3 To study various pavement construction methods.
4 To understand various techniques of Traffic Engineering.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C303.1	Design highway geometrics.
C303.2	Design flexible and rigid pavements.
C303.3	Describe methods of flexible and pavement construction.
C303.4	Describe various Traffic Engineering techniques.

Prerequisite:	Surveying, Fundamentals of Civil engineering, etc.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C303.1	3	3	1	1	-	2	1	1	-	-	-	1	1	-	3
C303.2	3	3	1	1	-	2	1	1	-	-	-	1	2	-	3
C303.3	3	-	-	-	-	2	1	1	-	-	-	-	-	-	2
C303.4	3	-	-	-	-	2	1	1	-	-	-	-	-	1	2

Content	**Hours**
Unit 1. Introduction: Importance of Transportation, Modes of Transportation, Characteristics of Road Transportation. Highway development and planning: Classification of roads, Current Road Development Programmes in India. Highway alignment and project preparation: Requirements of alignment, Factors controlling Alignment, Preparation of New Highway projects.	5
Unit 2. Geometric design of highways-: Introduction; highway cross section elements; sight distance, Design of horizontal alignment- design speed, radius of curves, superelevation, widening of pavements on curves; Design of vertical alignment- types of gradient, vertical curves, design of intersections, problems.	5
Unit 3. Pavement materials- Materials used in Highway Construction- Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems.	5

Unit 4. Design of pavements- Types of pavements; Flexible pavements: factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; Rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC, Construction of various types of joints.	8
Unit 5. Construction of pavements - Construction of Base, Sub base, Shoulders. Embankment Construction, Construction of Gravel Base, Cement Stabilised Sub Bases, WBM Bases, Wet Mix Construction; Crushed Cement Bases, Bituminous Construction and Maintenance: Preparation and Laying of Tack Coat; Bituminous Macadam, Penetration Macadam, Built up Spray Grout, Open Graded Premix, Mix Seal, Semi-Dense Asphalt Concrete-Interface Treatments and Overlay Construction, IRC Specifications, Specifications and method of cement concrete pavement construction (PQC Importance of providing DLC as sub-base and polythene thin layer between PQC and sub-base);	8
Unit 6. Traffic Engineering and control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting.	5

Text Books:

1	A. M. Joshi Transportation Engineering-I, 1st edition, Electrotech publication engineering series, Satara
2	L. R. Kadiyali, 'Traffic Engineering and Transport Planning', Khanna Publications, New Delhi.

Reference Books:

1	L. R. Kadiyali, 'Highway Engineering', 10th Edition, Khanna Publications, New Delhi.
2	S. K. Khanna, Justo, Veeraragavan, Highway Engineering, Nem Chand and Bros., Roorkee, 10th Edition

Codes:

1	IRC:37-2001, Guidelines for the design of flexible pavements
2	IRC:58-2002, Guidelines for the design of rigid pavements
3	MORT&H Specifications

Links:

1. https://onlinecourses.nptel.ac.in/noc22_ce94/preview
2. https://onlinecourses.nptel.ac.in/noc22_ce70/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce9473/preview

D.Y.PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
KASABA BAWADA KOLHAPUR-416006
(An Autonomous Institute) B. Tech. Curriculum
Third Year B. Tech. Civil Engineering
SEM-V (Academic Year-2022-23)

Course Plan

Course Title: Irrigation Engineering	
Course Code: 201CEL304	**Semester: V**
Teaching Scheme: L-T-P : 3-1-0	**Credits: 4**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: Agriculture Technology has a vital role in the growth of our country in which Irrigation Engineering plays an important role. This course focuses on various methods of Irrigation and their merits and demerits, Introduction to different hydraulic structures for storage and diversion of river water for irrigation is discussed in detail in this course.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 To understand the necessity of irrigation and efficacy of different irrigation methods.
2 To study the storage and distribution system of Irrigation and related hydraulic structures.
3 To understand the merits and demerits of irrigation for sustainable development.
4 To understand the water budgeting and water management

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C304.1	Explain and choose the suitable and sustainable irrigation system as per cropping pattern.
C304.2	Determine the storage capacity of reservoir and its planning of distribution.
C304.3	Design the storage structures and conveyance system.
C304.4	Asses the efficacy of irrigation water distribution and revenue generation by proper water management.

Prerequisite:	Fluid Mechanics

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C304.1	1	1	2	-	-	2	3	2	1	2	1	2	3	2	2
C304.2	3	2	2	-	1	-	-	-	-	-	-	1	2	-	3
C304.3	3	3	3	1	1	-	-	-	-	-	-	-	2	-	4
C304.4	2	1	2	-	-	2	2	3	1	2	3	2	3	1	3

Content	**Hours**
Unit 1. **Introduction to Irrigation:** Definition, Functions, Advantages and Necessity, Methods of Irrigation - Surface Irrigation, Subsurface Irrigation, Micro-Irrigation. Advantages of various techniques of irrigation – Free Flooding, Check Flooding, Basin Flooding, Furrow irrigation, Border strip irrigation, Sprinkler irrigation, Drip irrigation. **Water Requirements of Crops**: Soil moisture and Crop water relationship, Factors governing Consumptive use of water, Principal Indian crops, their season and water requirement, Crop planning, Agricultural practices, Calculations of canal and reservoir capacities – duty, delta, irrigation efficiency .	6

Unit 2. **Distribution works:** Modes of conveying irrigation water- Types of irrigation canals - contour canal, ridge canal, side sloping canals, Canal sections - filling, cutting, partial cutting and partial filling, Balanced depth, Canal FSL, Capacity factor and Time factor, L-section. **Unlined Canals** - Methods of design of unlined irrigation canals, Silt theories – Kennedy's theory, Lacey's theory, Comparison of Lacey's and kennedy's theories, Design examples **Lining of irrigation canals** -- Types of Lining, Selection of type of lining, Economics of lining, Maintenance of lined canals, Methods of providing drainage behind lining., Introduction to SCADA System of pipe network for irrigation.	6
Unit 3. **Water Management :** Distribution, Warabandi, Rotational water supply system, Participatory Irrigation Management, cooperative Water distribution systems, Introduction to auto weather stations **Assessment of Canal Revenue**: Introduction to Various methods of canal revenue assessment (Area basis or crop rate basis, volumetric basis, seasonal basis, composite rate basis, permanent basis or betterment levy basis) **Water Logging and Drainage:** The process of water logging, Causes of water logging, Effects of water logging, Preventive and curative measures, Land Drainage, Reclamation of water logged areas, Alkaline and saline lands	6
Unit 4. **Diversion Head Works :** Layout of a typical diversion headwork, Weir and barrages, Differences between a weir and a barrage, Various parts of a weir and their functions, Exit gradient, Principles of Design of weirs/barrages on permeable formations -Bligh's creep theory and Khosla's theory	4
Unit 5. **Storage Head works and Outlet works:** Introduction to different types of dams – Earth dams, Rock fill dams, Gravity dams, Arch Dams, Buttress Dams, Timber Dams, Steel dams etc. **Earth Dams** -- Types of earthen dams based on section, Methods of construction, Seepage in earth dams, Phreatic line, Causes of failure of earthen dams and preventive measures, Checking the slope stability of earth dam in different conditions.	8

Gravity dams -- Introduction, Forces acting on a gravity dam, Modes of failure of gravity dam, analysis of a gravity dams section, Construction details of gravity dams—joints, keys, Grouting etc. **Spillways --** Types of spillways, Spillways gates and energy dissipation works.	
Unit 6. **Reservoir Planning** Introduction – Types, site selection, Storage zones, Area-elevation capacity curve and its importance, Mass inflow curve, Demand curves, Fixation of reservoir capacity using mass inflow curve and demand curve, Reservoir sedimentation-Phenomenon, Measures to control reservoir sedimentation, Density currents, Significance of trap efficiency, Flood management.	6

List of Tutorials

Tutorial No.	Tutorial Details	Hours
1	Tutorial based on – Study of different methods of irrigation Free flooding, Check Flooding, Basin Flooding, Furrow irrigation etc.	1
2	Tutorial based on – Numerical examples based on estimation of Duty, Delta and base periods of different crops.	1
3	Tutorial based on –Types of canals, Canal sections, Balanced depth of canals, typical L-section of a canal	1
4	Tutorial based on –Design of Lined canals and Unlined canals, SCADA system of irrigation, Auto weather stations	1
5	Tutorial based on – Participatory irrigation management, Functioning of co-operative water distribution systems,	1
6	Tutorial based on – i) Water logging and Land drainage arrangements ii) Lining of canals and economics of canal linings	1
7	Tutorial based on -- Design of weirs/barrages on permeable formations using Bligh's theory and Khosla's theory.	1
8	Tutorial based on – Different types of dams and reservoirs.	1
9	Tutorial based on -- Earth dams, Gravity Dams, Rockfill dams	1
10	Tutorial based on – Arch dams, Spillways, Energy Dissipation measures	1
11	Tutorial based on – Preparation of Area-Elevation- Capacity curves, Fixing various control levels of reservoirs,	1
12	Tutorial based on – i) Determining reservoir capacity, ii) Reservoir sedimentation, iii) Flood Management	1

Text Books:

1	Dr. B. C. Punmia & B. B. Pande, , Irrigation & Water Power Engineering -Laxmi Publications (P) Ltd, NewDelhi
2	S.K.Garg, Khanna Publishers, Irrigation Engineering and Hydraulic Structures - Delhi
3	Dr. P.N.Modi, Irrigation, Water Resources & Water Power Engineering - Standard Book House, New Delhi
4	Dr. K.R.Arora, Irrigation, Water Power & Water Resources Engineering - standard PublishersDistributors, Delhi

Reference Books:

1	G. L. Asawa, Irrigation Engineering - New Age International Publishers, New Delhi
2	Raghunath, Irrigation Engineering - Wiley Eastern Ltd, New Delhi.
3	Michael, Irrigation Theory and practice - Vikas Publications House.
4	S. R. Sahastrabudhe, Irrigation Engineering - Katson Publishers.

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Course Plan

Course Title: Foundation Engineering	
Course Code: 201CEL305	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: This course deals with calculations of bearing capacity of soil and design of shallow foundation and pile foundation.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 Understand the basics of foundation engineering in the civil engineering projects.
2 Study the load bearing capacity of soil and to calculate foundation settlement.
3 To study the method of design the shallow foundation and pile foundation.
4 To know the techniques for foundation in the water.
5 To study the stability analysis of slopes.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C305.1	Explain aspects of soil investigation and estimate bearing capacity of soil.
C305.2	Illustrate design concept of shallow foundations and settlement.
C305.3	Explain design of pile foundation & foundations in water.
C305.4	Evaluate stability of slopes.

Prerequisite:	Geotechnical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C305.1	3	3	-	-	-	-	-	1	-	-	-	2	3	2	4
C305.2	3	3	3	-	-	-	-	1	-	-	-	-	3	2	4
C305.3	3	3	3	-	-	-	-	1	-	-	-	-	3	2	3
C305.4	3	3	-	-	-	-	-	-	-	-	-	-	3	-	3

Content	Hours
Unit 1. Soil Exploration, Site Investigations & Sampling Objectives and Importance of soil exploration & investigation, planning of exploration program, Number of bore holes, spacing of boring and significant depth of exploration, Methods of sub surface exploration: Direct methods & Indirect method of exploration. Sampling: Types of samples, types of sampler, requirement of good sampler, Bore log and sampling record. RQD	6
Unit 2. Bearing Capacity Evaluation Classification of Foundation, its suitability. Bearing capacity of soil & theories, Modes of failure of soil, Terzaghi's bearing capacity theory, I.S. Code method of bearing capacity evaluation & computation (IS 6403), Effect Factors affecting bearing capacity-water table effect, Bearing capacity evaluation from field tests, Plate load test, S.P.T. (By I.S. Code method) , Pressure meter Test.	6

Unit 3. Shallow Foundation and Settlement Criteria for selection and design of foundation, minimum depth of footing, Assumptions & limitations of rigid design analysis. Design of shallow foundations: Isolated, combined, strap footing (Rigid analysis), Raft foundation (Elastic method), Concept of floating foundations. (Structural Design is not expected) Types of Settlement: Estimation of Immediate & Consolidation settlement (as per IS 8009-1976 Part I), Differential settlement, Angular distortion.	6
Unit 4. Pile Foundation Classification and their uses, Selection of pile & design criteria of pile foundation, Estimation of single pile and group capacity in cohesive soil, cohesion less soil: Static method, Dynamic method, Pile load test, Negative skin friction, Group action piles, spacing of piles in group, Group efficiency. Under reamed piles: Suitability, Details of pile & bulb, Stages of construction.	6
Unit 5. Foundations in Water: Types of caissons, Components of wells foundation, types & choice of shapes, Forces acting on well foundation, Rectification tilt and shift, Sand island method, Pneumatic caissons, Safety precautions, Caisson disease. Types, materials and suitability of sheet piles, Common types of cofferdams, uses and requirements.	6
Unit 6. Slope Stability Analysis Slope classification, modes of slope failure, Infinite slope in cohesive and cohesion less soil, Methods & Analysis of stability of finite slope, Taylor's stability number, Improving slope stability and slope protection measures	6

Text Books:

1	B. C. Punmia, Ashok Kumar Jain, "Soil Mechanics and Foundation Engg", Laxmi Publications Pvt Limited, 16th Edition
2	K.R. Arora, "Soil Mechanics and Foundation Engg.", Standard Publishers Distributors, 2nd Edition

Reference Books:

1	Karl Terzaghi, Mesri, Ralph B. Peck, R. B. Peck, "Soil mechanics in engineering practice", Wiley, 3rd Edition
2	Joseph E. Bowles, "Foundation Analysis and Design", McGraw-Hill Education (India) Private Limited, 5th Edition
3	V. N. S. Murthy, "Soil Mechanics and Foundation Engg." CBS Publishers and Distributors, 2nd Edition
4	Braja M. Das, Nagaratnam Sivakugan, Siva Sivakugan, "Introduction to Geotechnical Engineering", Cengage Learning, 6th Edition
5	P. Purushottam Raj, "Geotechnical Engineering", Dorling Kindersley, 1st Edition

Course Plan

Course Title: Ground Improvement Techniques	
Course Code: 201CEL306	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
The soils at construction sites are not always totally suitable for supporting physical infrastructure such as buildings, bridges, highways, tunnels and dams. Under these conditions, soil needs to be treated using ground improvement techniques. Similarly specific types of soil improvement techniques are required in the case of expansive soils and collapsible soil and in the case of earthquake prone areas. T h e course addresses various ground improvement techniques along with principles, design issues and construction procedures.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. Demonstrate knowledge of understanding of soil behavior.
2. Apply various methods of soil improvement.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C306.1	Explain the ground improvement techniques.
C306.2	Explain the concepts of various soil stabilization techniques.
C306.3	Justify the use and application of various soil improvement techniques.

Prerequisite:	FCE, Geotechnical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C306.1	3	3	-	-	-	-	-	-	-	-	-	3	3	-	3
C306.2	3	3	-	-	-	-	-	-	-	-	-	3	3	-	2
C306.3	3	3	-	-	-	-	-	-	-	-	-	3	3	-	2

Content	Hours
Unit 1. Introduction to soil improvement Soil exploration, methods of soil exploration, stages in soil exploration. Need for Ground Improvement, Benefits/Advantages of Ground Improvement, Factors affecting the Strength of Stability of Soil, Ground Improvement Techniques for different type of soils, Types of problematic soils, Emerging trends in ground Improvement. Concept and methods of soil stabilization	6
Unit 2. Mechanical Soil stabilization Fundamental concept of Mechanically Stabilized Earth (MSE), Use of MSE, Design concepts of MSE, Soil Reinforcement.	6
Unit 3. Hydraulic modification Concept and purpose of hydraulic modification, Site Improvement by drainage, Dewatering methods, Design of dewatering systems, Sand Drains, Wick drains etc., Preloading, Vertical drains, Electro-kinetic dewatering.	6
Unit 4. Modification by admixtures Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes, recycled materials, Construction techniques and applications.	6

Unit 5. Site improvement by Grouting Different grouting techniques, Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.	6
Unit 6. In situ soil treatment methods Stabilization by geo-textile, geosynthetics, fabrics, Soil nailing, rock anchoring, micro-piles, design methods, construction techniques.	6

Text Books:

1	P. C. Varghese, "Foundation Engineering", PHI Ltd, 2012
2	B. C. Punmia, Ashok Kumar Jain, "Soil Mechanics and Foundation Engg", Laxmi Publications Pvt Limited, 16th Edition

Reference Books:

1	Manfired R. Hausmann, "Engineering Principles of Ground Modification", McGraw-Hill Pub, Co., 1990.
2	M C. R. Davies, F.Schlosser, "Ground improvement geosystems", Thomas Telford Publishing, 1997
3	Koerner, R. M., "Designing with geosynthetics", Prentice Hall Inc. 1998.
4	https://nptel.ac.in/courses/105108075

Course Plan

Course Title: Municipal Solid Waste Management	
Course Code: 201CEL307	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Rapidly growing populations, urbanisation and industrialization generate increasingly larger quantities of solid waste that are becoming difficult to manage effectively. Improper management of solid waste poses risks to the environment and public health. Solid waste management is essential to reduce the effect of waste on the environment & health. This course explains waste management and the disposal of municipal solid waste, biomedical and E waste along with its legal aspects.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To understand the components, generation & characteristics of municipal solid waste.
2. To understand the process of collection, transportation, treatment & disposal options for solid waste.
3. To know the aspect of biomedical & E waste management
4. To study solid waste management rules & legal aspects .

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C307.1	Interpret fundamentals of municipal solid waste management.
C307.2	Illustrate aspects of waste collection, transportation and processing.
C307.3	Explain various methods of solid waste management.
C307.4	Explain legal aspects of solid waste management.

Prerequisite:	Engineering Chemistry, Environment Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C307.1	2	1	1	1	-	1	2	-	-	-	-	-	1	1	2
C307.2	2	2	1	1	-	1	2	-	-	-	-	-	1	1	2
C307.3	2	2	1	1	-	1	2	-	-	-	1	-	2	2	3
C307.4	2	1	1	1	-	1	2	-	-	-	1	-	2	2	3

Content	Hours
Unit 1. Fundamental of solid waste management: Types and sources of solid waste, Classification of solid waste, Hazardous and non-hazardous solid waste, Factors affecting the solid waste generation. Physical and chemical characteristics of municipal solid waste. Impact of solid waste on Environment. Solid waste management hierarchy, Organization pattern of solid waste management system, waste prevention and waste reduction techniques.	6

Unit 2. Storage, collection and transportation of municipal solid waste: Storage of solid waste, Collection methods of solid waste, Transportation of municipal waste. Transportation vehicles with their capacity: Auto-vehicles, Tractors or Trailers, Trucks, Dumpers, Compactors, Transfer station, necessity, location, practices according to Population of the town or city. Role of rag pickers and their utility for society,	6
Unit 3. Treatment and disposal of municipal solid waste: a) Composting: Concept of composting, Principles of composting process. Factors affecting the composting process Methods - i) Manual Composting - Bangalore method, Indore Method ii) Mechanical Composting- Dano Process iii) Vermicomposting. b) Land filling: Concept, Factors to be considered for site selection, Methods - Area method, Trench method and Ramp method. Leachate and its control, Biogas from landfill, Advantages and disadvantages of landfill method, Recycling of municipal solid waste c) Incineration of waste: Introduction, Types of incinerators - Flash, Multiple chamber Incinerators, Products of incineration process, Advantages and disadvantages of incineration process. Pyrolysis of waste.	8
Unit 4. Biomedical waste management and public involvement in solid waste management: Sources, generation and Classification of Biomedical Waste Biomedical Waste Management technologies, Public involvement in solid waste management, Health aspects during handling, processing, at the time of segregation, recovery, recycling and reuse of solid waste.	4
Unit 5. Industrial and E-waste waste management: Variety of industrial waste, Collection and disposal industrial waste, Control measures and Recycling of industrial waste, E-waste Management, Varieties of E-wastes, Dangers of E-waste, Recycling of E-waste, Disposal of E- waste.	6
Unit 6. Legal aspects of solid waste management: Role of Central Pollution Control Board and Maharashtra Pollution Control Board in management of solid waste from various sources. Rules and regulations for Waste Management by Ministry of Environment & Forest • Municipal Solid Waste Management Rules, 2016 • Biomedical Waste Management Rules, 2016 • E-Waste Management Rules, 2016 • Plastic Waste Management Rules, 2016 • Construction and demolition Waste Management Rules, 2016 • Hazardous and other wastes Management Rules, 2016	6

Text Books:

1	A. D. Bhide and B. B. Sundaresan, Solid Waste Management in Developing Countries: By NEERI, India, Published by Indian National Scientific Documentations Centre, New Delhi
2	T. V. Ramachandra, Municipal Solid Waste Management, Published by Common Wealth of Learning, Canada; Centre for Ecological Sciences, I I Sc, Karnataka Environment Research Foundation
3	Dr. R. Saravanan, R. Dinesh Kumar, A. Suriya, Municipal Solid Waste Management, Published by Suchitra Publications
4	Sasikumar K., Sanoop Gopi Krishna, Solid Waste Management, Published by PHI Learning Pvt. Ltd

Reference Books:

1	Kreith, George Tchobanoglous, Handbook of Solid Waste Management, Published by McGraw Hill Professional
2	Hosetti, B.B., Prospects and Perspectives of Solid Waste Management, Published by New Age International (P) Ltd., Publishers, New Delhi,
3	C. S. Rao, Environmental Pollution Control Engineering, Published by New Age International, New Delhi

Other Sources:

http://www.hsagolden.com/
http://www.almitrapatel.com/
http://www.yousee.in/
http://www.skgsangha.org/
http://www.epa.gov/epaoswer/on-hw/muncipal/index.htm

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Course Plan

Course Title: Engineering Hydrology and Watershed Management	
Course Code: 201CEL308	**Semester: V**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: Hydrology plays vital role in Water resource Engineering. This course focuses on understanding different Hydro- meteorological parameters and its evaluation in the context of designing Hydraulic Structures. Further the course includes study of watershed management, water harvesting and forest and grassland management. Also erosion control measures are discussed**.**

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1. To impart the basic knowledge of importance of Hydrology & irrigation in water resources development.
2. To know various hydro meteorological parameters and their estimation.
3. To understand the principles of watershed management and water harvesting
4. To understand the importance of forest and grassland management.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C308.1	Apply the knowledge of estimation of hydro meteorological parameters.
C308.2	Estimate direct runoff and peak discharge using hydrograph technique
C308.3	Estimate of soil loss due to erosion by using Universal soil loss equation.
C308.4	Apply the knowledge of watershed management in preparation of action plan.

Prerequisite:	Water Resource Engineering I

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C308.1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
C308.2	3	3	2	-	-	-	-	-	-	-	-	1	-	-	2
C308.3	2	2	1	-	2	1	-	-	-	-	-	1	-	1	2
C309.4	2	1	1	-	2	1	-	-	-	-	-	1	1	1	3

Content	**Hours**
Unit 1. **Introduction**: Hydrologic cycle, water-budget equation, world water balance. **Precipitation**: forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area-arithmetic mean method, Thiessen's polygon, isohyetal method.	6
Unit 2. **Abstractions from precipitation**: evaporation process, evaporimeters, analytical methods of evaporation estimation, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, actual evapotranspiration, interception, depression storage. **Infiltration**: Introduction, Infiltration capacity, Infiltrometer, Horton's method and infiltration indices, infiltration indices.	6

Unit 3. **Runoff**: Runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph. **Stream Gauging:** Selection of site, various methods of discharge measurement (velocity-area method, dilution method, slope-area method), Advance techniques/equipment's used in gauge discharge measurements such as Radar, Current meter, ADCP (Acoustic Doppler Current Profiler)	6
Unit 4. **Introduction:** Concept of watershed development, objectives of watershed development, the need for watershed development in India, Integrated and multidisciplinary approach for watershed management. **Characteristics of the watershed:** size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socio-economic characteristics, basic data on watersheds, watershed delineation.	6
Unit 5. **Principles of erosion:** Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation. **Measures to control erosion**: Contour techniques, plowing, furrowing, trenching, bunding, terracing, gully control, rockfill dams, brushwood dam, Gabion.	6
Unit 6. **Water harvesting:** Rainwater Harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks. **Forest and grassland management:** Interpretation of Satellite Imageries- Land use and Land Cover. Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils. **Planning:** Watershed management activities, preparation of action plan, Reservoir Routing.	6

Text Books:

1	S. K. Garg , Irrigation Engineering — Khanna Publishers, Delhi.
2	Dr.Punmia and Dr. Pande , Irrigation and Water Power Engineering‖ — Laxmi Publications, Delhi
3	J.V.S Murty , Watershed Management, New Age International Publishers.
4	Ghanshyam Das, Hydrology and Soil Conservation Engineering: Including Watershed Management. 2008. Prentice-Hall of India Learning Pvt. Ltd., New Delhi.

Reference Books:

1	Michael, Irrigation Theory and practice - Vikas Publications House.
2	Raghunath, Irrigation Engineering - Wiley Eastern Ltd, New Delhi.
3	Jaspal Sing, M.S.Acharya, Arun Sharma, Water management- Himanshu Publications.
4	Mahnot, S.C., Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi. 2014.
5	Katyal, J.C., R.P. Singh, Shriniwas Sharma, S.K. Das, M.V. Padmanabhan and P.K. Mishra. 1995. Field Manual on Watershed Management. CRIDA, Hyderabad.

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Course Plan

Course Title: Advanced Surveying	
Course Code: 201CEL309	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:

The course includes introduction to various advanced techniques of surveying which is an important field of civil engineering. The course aims to give thorough knowledge to students about the use of various modern methods/techniques in surveying.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To understand tachometric surveying in distance and height measurements.
2. To get introduced to different geodetic methods of survey such as triangulation.
3. To study and analyze the aerial photographs.
4. To get introduced to modern advanced surveying techniques involved such as Remote sensing, GIS, GNSS, Photogrammetry etc.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C309.1	Explain tachometric surveying in distance and height measurements.
C309.2	Differentiate geodetic methods of survey such as triangulation.
C309.3	Analyze the aerial photographs.
C309.4	Compare modern advanced surveying techniques involved such as Remote sensing, GIS, GNSS, Photogrammetry etc.

Prerequisite:	Engineering surveying

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C309.1	2	2	-	2	2	-	-	-	1	-	-	-	-	-	2
C309.2	2	2	-	2	2	-	-	-	-	-	-	-	-	-	2
C309.3	2	2	-	2	2	-	-	-	-	-	-	-	-	-	4
C309.4	2	2	-	2	2	-	-	-	4	-	-	-	-	2	2

Content	**Hours**
Unit 1. Tachometry a) Basic principle, Tachometric equation for horizontal line of sight and inclined line of sight in fixed hair method. b)Analytic lens in external focusing telescopes, Reducing the constants in internal focusing telescope, Moving hair method and tangential method, Substance bar,	7
Unit 2. Geodetic Surveying: a) Triangulation Principle and Classification, system, Selection of station, Base line, b) Measurement, Correction and use of sub tense bar. c) Signals, satellite station, Reduction to centre, Trilateration.	6
Unit 3. Aerial Photogrammetry: Aerial photographs: types, scale, & resolution; Types of aerial cameras; Geometry of aerial photographs; Flight planning; Impact of season, time, & topography on aerial photographs; Parallax, relief displacement.	5

Unit 4. GIS a)Definition of GIS, History and development of GIS, Components of GIS, Hardwares and software, future of GIS. b)Representation of Geographic features in Raster and Vector data model: Advantages and Disadvantages, GIS Mapping.	7
Unit 5. Remote Sensing a) Definition, relevance, types, electromagnetic radiation and energy sources and its characteristics, applications to civil engineering.	5
Unit 6. Global Navigational Satellite System a)Introduction to GNSS; Types of GNSS; GNSS satellite; Differential GPS; Sources of GNSS errors; b) Application of GNSS in surveying, mapping and navigation.	6

Text Books:

1	B. C. Punmia, Surveying- Vol 2 and Vol 3 - Laxmi Publications
2	A. M. Chandra, Plane Surveying– New age international (P) Ltd
3	A.M. Chandra, Higher Surveying, New age international (P) Ltd

Reference Books:

1	S.K. Roy, Fundamentals of Surveying - – Prentice Hall of India
2	Milton O. Schimidt, Fundamentals of Surveying– Wong, Cengage Learning
3	Arther Bannister et al., Surveying, Pearson Education, India
4	Survey of India Publication on maps

Online References:

1. https://nptel.ac.in/courses/105/108/105108077/
2. https://nptel.ac.in/courses/105/101/105101206/
3. https://nptel.ac.in/courses/105/107/105107201/

Course Plan

Course Title: Rural Development Planning	
Course Code: 201CEL310	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Rural development is considered to be of noticeable importance in the country today than in the olden days in the process of the evolution and development of the nation. It is a strategy that tries to obtain an improved and productivity, higher socio-economic equality and ambition, and stability in social and economic development of the rural India.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 To understand the concept and significance of rural development
2 To understand resources for rural management and its management
3 To study economic aspects of rural management
4 To study government policies and plans for rural development

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C310.1	Describe the concept and significance of rural development
C310.2	Summarize the resources for rural management and its management
C310.3	Explain economic aspects of rural industry.
C310.4	Explain government policies and plans for rural development

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Prerequisite:	Environmental Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C310.1	2	1	1	-	-	-	1	-	-	-	-	-	1	1	2
C310.2	1	1	1	-	-	-	1	-	-	-	-	-	1	1	2
C310.3	2	2	1	-	-	-	1	-	-	-	-	-	1	1	3
C310.4	1	1	1	-	-	-	1	-	-	-	-	-	1	1	3

Content	Hours
Unit 1 Overview of Rural Development: Need, definition, objectives. Significance of Rural Development. Social significance: problems, social change utilization, infrastructure, etc. Economic significance- National income, employment, food and fodder, industrial development, internal trade and transport, capital formation, etc. Political significance- Political stability Rural Development Environment, Panchayat Raj Institution, CAPART (Council for Advancement of People's Action and Rural Technology) Organizational set up, purposes, objectives, activities. Role of Civil Engineer in Rural Development.	6
Unit 2. Water Resource Management and Sanitation: Watershed management Structures (K. T. weir, Gabian Structure, Cement Plug, Contour Bunding, Farm pond, Underground Bandhara) Uses, Importance, Advantages and Disadvantages. Rain Water Harvesting and Recharging of sources. Irrigation System- purpose and Type. Layout and component parts of Drip Irrigation, Sprinkler Irrigation and lift Irrigation. Design parameter for laying Drip, Sprinkler and Lift Irrigation System. Rural Water Supply- Sources, Low cost technique of treatment, Protection of Bore hole. Rural Sanitation- Low cost W.C., Readymade Toilet, Soak Pit, techniques for constructing W. C. requiring less quantity of water.	6

Unit 3. Rural housing, roads, and Energy: Indira Awas Yojana - Salient features, beneficiary people, Conversion of Unserviceable Houses into Pucca/Semi-Pucca houses. Credit-cum- Subsidy scheme of rural housing- Salient features share of Central and State government. Rural Building Centers-Purpose, technology transfer, skill development, training, eco-friendly materials. Pradhan Mantri Gram Sadak Yojna(PMGSY)- Key elements. concept of rural road connectivity. Low Cost Housing- Principles. purposes, use of Local Material for construction. Rural Roads- Type, Specifications, Construction Techniques and Road Drainage. Renewable energy at Integrated Rural Energy Programme - Objectives, key elements, implementation, financial provisions, sources of renewable energy. Working of Gobar gas and Biogas plant, National project on biogas development-technology, performance and implementation, financial assistance, involvement of Panchayat and local bodies. Bio mass-Types of fuel such as Firewood, agricultural residues, dung cakes.	6
Unit 4. Rural industry and finance: Cottage Industry- Brick Manufacturing, Concrete hollow Block, Artificial Sandstone crushing plant. Agro based Industry- Dairy, Animal Husbandry, Horticulture, Sericulture, and Fishery. Sources of funds for rural development Domestic (institutional and non -institutional) foreign institutional and non-institutional)	6
Unit 5. Government policies pertaining to rural development: Central & State GOPRO DE TECHNICAL Schemes, Prime Minister Riyal Development Fellows Scheme National Rural Employment. Guarantee Act, 2005, NREGA. Swarnjayanti Gram Swarozgar Yojana (SGSY). The Sampoorna Grameen Rozgar Yojna. Deen Dayal Upadhyaya. Grameen Kaushalya Yojana.	6
Unit 6. Rural planning development: Plan and planning for rural development. Levels and Functions of Planning. Micro-level Planning, Meso-level Planning, Macro-level Planning, Decentralization Policy of Planning, Block and District Level Planning.	6

Reference Books:

1	Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications India Pvt Ltd ISBN 978-81-7829-926-6 (PB)
2	Desai Vasant, Rural Development in India: Past,Present and Future: a Challenge in the Crisis, Himalaya Publishing House, Delhi ISBN 8183181929 ISBN 9788183181921
3	Rastogi, A.K., Rural Development Strategy, Wide Vision, Jaipur ISBN -81-8068-000-2
4	Gaur, Keshav Dev, Dynamics Of Rural Development, Mittal Publications, 1992, Delhi
5	Document Published by Ministry of Rural development, Govt. of India Ministry of Rural development.

Software/Learning Website:

a) http://rural.nic.in/
b. http://www.panchayat.gov.in/
c. https://www.india.gov.in/topics/rural

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Course Plan

Course Title : Environmental Engineering Lab	
Course Code : 201CEP311	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE (OE) Marks : 25**

Course Description:

Environmental Engineering Lab deals with the determination of quality parameters of water and waste water. It comprises of the design of water and wastewater treatment plants. Visit to Water Treatment Plant (WTP) and Sewage Treatment Plant (STP) followed by the brief visit report is to be carried out by every individual.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To know the quality parameters of water and waste water.
2. To understand practical procedure to determine parameters of water and waste water to develop laboratory skills.
3. To study the design aspects of water and wastewater treatment units.
4. To understand the practical and field aspects of water treatment and sewage treatment facilities through site visit.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C311.1	Examine the quality parameters of water and waste water as per the code and norms.
C311.2	Design Water Treatment Plant and Sewage Treatment Plant for various qualities as per mentioned design parameters using software.
C311.3	Correlate the Water Treatment and Sewage Treatment facilities in the practice with theoretical knowledge through site visit.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C311.1	2	2	2	2	-	2	2	2	-	-	-	-	1	-	4
C311.2	2	2	2	2	-	2	2	2	-	-	-	-	1	1	3
C311.3	2	2	2	2	-	2	2	2	-	-	-	-	1	1	3

LIST OF EXPERIMENTS:

Experiment No	Name of Experiment	Type	Hours
A.	**Characterization of Water and Wastewater (Minimum 6)**		
1	Solids (Total Suspended Solids, Total Dissolved Solids, Total Solids)	O	2
2	Turbidity	O	2
3	Optimum dose of alum by jar test.	O	2
4	Residual Chlorine	O	2
5	Dissolved Oxygen (DO)	O	2
6	Biochemical Oxygen Demand (BOD)	O	2
7	Chemical Oxygen Demand (COD)	O	2
8	Oil & Grease	O	2
9	Chloride content	O	2
B.	**Design of Water Treatment Plant and Sewage Treatment Plant using software.**	S	6
C.	**Visit to Water Treatment Plant and Sewage Treatment Plant.**	S	6

Type: S- Study**, O-** Operational

Text Books:

1	G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering"- Dhanpat Rai Publisher.
2	B. C. Punmia, Ashok Kumar, A. K. Jain, "Water Supply Engineering" - Laxmi Publisher.
3	B. C. Punmia, Ashok Kumar, A. K. Jain, "Waste Water Engineering" - Laxmi Publisher.

Reference Books:

1	Metcalf & Eddy, "Waste Water Engineering Treatment & Disposal" –Tata McGraw Hill

Reference Manuals:

1	Manual on Water Supply and Treatment- Government of India Publication, 1993
2	"Manual on Sewerage &Sewage Treatment" Ministry of Urban Development Govt. of India Msy-2000.,Ministry of Urban development

Codes:

1	**IS:10500**

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Course Plan

Course Title : Highway and Traffic Engineering Lab	
Course Code : 201CEP312	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE Marks : 25**

Course Description:

This course will discuss the practices of testing of highway materials viz. road aggregates and bitumen. It will also include design of bituminous mixes.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To check various properties of highway materials as per MORT&H.
2. To design a bituminous mix.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C312.1	Investigate engineering properties of given road aggregate samples.
C312.2	Investigate engineering properties of given bitumen samples.
C312.3	Design a bituminous mix.

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Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Pos/ Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C312.1	3	-	-	2	-	2	-	1	-	-	-	1	2	3	3
C312.2	3	-	-	2	-	2	-	1	-	-	-	1	2	3	3
C312.3	3	3	-	3	-	2	-	1	-	-	-	1	2	3	3

LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Type	Hours
1	Aggregate Abrasion Test	O	2
2	Aggregate Crushing Strength Test	O	2
3	Aggregate Impact Test	O	2
4	CBR Test	S	2
5	Penetration Test on Bitumen	O	2
6	Softening Point Test	O	2
7	Ductility Test	O	2
8	Flash and Fire Point Test	O	2
9	Stripping Value Test	O	2
10	Marshall Stability Test	O	2
11	Mix Design of BM/ DBM/SDBC/BC	S	4

Type: S- Study**, O-** Operational

Text Books:

1	S. K. Khanna, Justo, Veeraragavan, Highway Engineering, Nem Chand and Bros., Roorkee, 10th Edition
2	G. Venkatappa Rao, 'Highway Material Testing and Quality Control', I. K. International Publishing House Pvt. Ltd., New Delhi

Codes:

1	IS: 73-1992 for paving bitumen
2	IS: 1201 to1209-1978 for testing of bituminous materials
3	IS: 2386 (Part I -1963) for testing aggregates
4	IS:2720 – 1990 for CBR test.

Course Plan

Course Title: Foundation Engineering Lab	
Course Code: 201CEL313	**Semester: V**
Teaching Scheme: L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks : 25	**ESE Marks: N.A.**

Course Description: Foundation engineering is a branch of geotechnical engineering which applies soil mechanics, structural engineering, and project serviceability requirements for design and construction of foundations for structures. The laboratory includes the hands on practice for estimation of foundation parameters and design of shallow and deep foundation.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 Apply knowledge of foundation engineering in the civil engineering projects.
2 Interpret the load bearing capacity of soil and to calculate foundation settlement.
3 Design the shallow and pile foundation.
4 To study the stability analysis of slopes.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C313.1	Demonstrate knowledge of soil investigation and estimate bearing capacity of soil.
C313.2	Design shallow foundations and estimate settlement of foundation
C313.3	Design of pile foundation
C313.4	Evaluate stability of slopes.

Prerequisite:	Geotechnical Engineering, FCE

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C313.1	3	3	-	-	-	-	-	1	-	-	-	2	3	2	4
C313.2	3	3	3	-	-	-	-	1	-	-	-	-	3	2	4
C313.3	3	3	3	-	-	-	-	1	-	-	-	-	3	2	3
C313.4	3	3	-	-	-	-	-	-	-	-	-	-	3	-	3

Activity No	Name of Activity	Type	Hours
1	Introduction to Activity Based Learning- Concept mapping, Jigsaw and five minute exam activity	S	2
2	Activities on Soil Exploration, Site Investigations & Sampling Bearing Capacity Evaluation, Shallow Foundation and Settlement	S	8
3	Activities on Pile Foundation, Foundations in Water and Slope Stability Analysis	S	8
4	Introduction to computer aided design of shallow/deep foundation	O	6

Type: S- Study**, O-** Operational

Text Books:

1	B. C. Punmia, Ashok Kumar Jain, "Soil Mechanics and Foundation Engg", Laxmi Publications Pvt Limited, 16th Edition
2	K.R.Arora, "Soil Mechanics and Foundation Engg.", Standard Publishers Distributors, 2nd Edition

Reference Books:

1	Karl Terzaghi, Mesri, Ralph B. Peck, R. B. Peck, "Soil mechanics in engineering practice", Wiley, 3rd Edition
2	Joseph E. Bowles, "Foundation Analysis and Design", McGraw-Hill Education (India) Private Limited, 5th Edition
3	V. N. S. Murthy, "Soil Mechanics and Foundation Engg." CBS Publishers and Distributors, 2nd Edition
4	Braja M. Das, Nagaratnam Sivakugan, Siva Sivakugan " Introduction to Geotechnical Engineering", Cengage Learning, 6th Edition
5	P. Purushottam Raj, "Geotechnical Engineering", Dorling Kindersley, 1st Edition

Course Plan

Course Title: Ground Improvement Techniques Lab	
Course Code: 201CEP314	**Semester: V**
Teaching Scheme: L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks: 25	**ESE Marks: N.A.**

Course Description:
The course explores the principles, design issues and construction procedures. Ground improvement techniques through the laboratory work. This lab course has wide scope in the real life engineering work. The ground improvement techniques directly deal with the economical aspect of any civil engineering project. This lab course also has potential for research and development.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. Demonstrate knowledge of understanding of soil behavior.
2. Apply various methods of soil improvement.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C314.1	Describe the ground improvement techniques.
C314.2	Interpret various soil stabilization techniques and its behavior.

Prerequisite:	FCE, Geotechnical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C314.1	3	3	-	-	-	-	-	-	-	-	-	3	3	-	3
C314.2	3	3	-	-	-	-	-	-	-	-	-	3	3	-	2

List of Assignments

Assignment No	Name of Assignment	Type	Hours
1	Introduction to Activity Based Learning- Concept mapping, Jigsaw and five minute exam activity	S	2
2	Activities on Soil exploration	S	4
3	Activities on Mechanical Soil stabilization, Hydraulic modification and Modification by admixtures.		6
4	Activities on Site improvement by Grouting, In situ soil treatment methods.	S	8
5	Case study- Soil improvement/ stabilization.	O	4

Type: S- Study**, O-** Operational

Text Books:

1	P. C. Varghese, “Foundation Engineering”, PHI Ltd, 2012
2	B. C. Punmia, Ashok Kumar Jain, “Soil Mechanics and Foundation Engg”, Laxmi Publications Pvt Limited, 16th Edition

Reference Books:

1	Manfired R. Hausmann, “Engineering Principles of Ground Modification”, McGraw-Hill Pub, Co., 1990.
2	M C. R. Davies, F.Schlosser, “Ground improvement geosystems”, Thomas Telford Publishing, 1997
3	Koerner, R. M., “Designing with geosynthetics”, Prentice Hall Inc. 1998.

Course Plan

Course Title : Municipal Solid Waste Management Lab	
Course Code : 201CEP315	**Semester: V**
Teaching Scheme : L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme : ISE Marks : 25	**ESE Marks: N.A.**

Course Description:

The course imparts the knowledge pertaining to solid waste characterisation. The course helps to develop the laboratory and analytical skills required for determination of important characteristics of solid waste.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To study characteristics of municipal solid waste and its composition.
2. To determine various parameters and its values of the solid waste sample.
3. To understand disposal methods for solid waste.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C315.1	Determine the characteristics of municipal solid waste.
C315.2	Explain disposal methods of municipal solid waste.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C315.1	2	2	1	1			1						1	1	3
C315.2	2	2	1	1			1						1	1	3

LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Type	Hours
1	Study of Composition of solid waste	S	2
2	Determination of bulk density of solid waste	O	2
3	Determination of moisture content.	O	2
4	Determination of pH	O	2
5	Determination of calorific value	O	2
6	Determination of proximate analysis	O	2
7	Determination of ultimate analysis	O	2
8	Visit to solid waste disposal site/ plant & preparation of report / case studies	S	10

Type: S- Study**, O-** Operational

Text Books:

1	A. D. Bhide &B. B. Sundaresan, Solid Waste Management in Developing Countries: NEERI, India, Published by Indian National Scientific Documentations Centre, New Delhi
2	T. V. Ramachandra, Municipal Solid Waste Management, Published by Common Wealth of Learning, Canada; Centre for Ecological Sciences, I I Sc, Karnataka Environment Research Foundation
3	Dr. R. Saravanan, R. Dinesh Kumar, A. Suriya, Municipal Solid Waste Management, Suchitra Publications
4	Sasikumar K., Sanoop Gopi Krishna, Solid Waste Management, PHI Learning Pvt. Ltd

Reference Books/ Handbook:

1	Frank Kreith, George Tchobanoglous, Handbook of Solid Waste Management, McGraw Hill Professional
2	Hosetti, B.B., Prospects and Perspectives of Solid Waste Management, Published by New Age International (P) Ltd., Publishers, New Delhi,
3	C. S. Rao, Environmental Pollution Control Engineering, New Age International, New Delhi

Course Plan

Course Title: Engineering Hydrology & Watershed Management Lab	
Course Code: 201CEP316	**Semester: V**
Teaching Scheme : L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme : ISE+ MSE Marks : 25	**ESE Marks: N.A.**

Course Description:

The course explains the components of hydrologic cycle and estimation of rainfall and runoff by various methods. Provides understanding of watershed management.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. Understand the fundamental principles related to hydrologic cycle.
2. Determination of quantitative analysis of watershed characteristics and parameters.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C316.1	Apply the knowledge of various methods to estimate rainfall and runoff.
C316.2	Estimate the hydrologic data for planning watershed management.
C316.3	Analyze the hydrologic parameters of watershed by use of related softwares.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C316.1	2	2	-	-	-	1	-	-	-	1	-	1	1	-	2
C316.2	1	2	-	-	-	1	-	-	-	1	-	2	-	-	3
C316.3	1	2	-	-	-	1	-	-	-	1	-	2	1	1	3

LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Type	Hours
1	Determination of average rainfall using Thiessen's polygon and Isohytel map method.	O	4
2	Determination of evaporation losses, infiltration losses-Phi index calculation, Horton's infiltration curve.	O	4
3	To develop a unit hydrograph from a total runoff hydrograph resulting from isolated storms.	S	2
4	Exercises on delineation of watersheds using toposheets	S	4
5	Quantitative analysis of watershed characteristics and parameters	S	2
6	Analysis of hydrologic data for planning watershed management.	S	2
7	Study of watershed management technologies.	S	2
8	Practice on software for analysis of hydrologic parameters of watershed.	O	4

Type: S- Study**, O-** Operational

Text Books:

1	S. K. Garg, Irrigation Engineering, Khanna Publishers, Delhi.
2	Dr. Punmia and Dr. Pande, Irrigation and Water Power Engineering, Laxmi Publications

Reference Books:

1	Michael, Irrigation Theory and practice - Vikas Publications House.
2	Raghunath, Irrigation Engineering - Wiley Eastern Ltd, New Delhi.
3	Jaspal Sing, M.S.Acharya, Arun Sharma, Water management Himanshu Publications.
4	Mahnot, S.C. 2014. Soil and Water Conservation and Watershed Management. International Books and Periodicals Supply Service. New Delhi.

Course Plan

Course Title : Advanced Surveying Lab	
Course Code : 201CEP317	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks: 25	**ESE Marks: N.A.**

Course Description:

The course includes introduction to various advanced techniques of surveying which is an important field of civil engineering. The course aims to give thorough knowledge to students about the use of various modern methods/techniques in surveying.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. Describe the functions of surveying in civil engineering field.
2. Apply the traditional methods of surveying such as chain compass survey, simple and differential levelling, theodolite traversing, tachometry and contouring
3. Apply the modern techniques of surveying such as use of Total station.
4. Understand and apply different methods of plane survey, geodetic survey, and hydrographic survey.
5. Calculate design and establish curves, understand, interpret and prepare plan, profile and cross-sectional drawing.
6. Work as team member on surveying party to achieve common goal of accurate and timely project completion.

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Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C317.1	To evaluate tachometric constants, RL's, Gradients by tachometer.
C317.2	To analyse the aerial photographs by Mirror Stereoscope.
C317.3	Apply principles of Remote sensing and GIS to collect map and retrieve spatial information.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C317.1	2	2	-	2	2		-	-	1		-	-	-	-	2
C317.2	2	2	-	2	2		-	-	-		-	-	-	-	2
C317.3	2	2	-	2	2		-	-	2		-	-	-	1	3

LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Type	Hours
1	To determine tachometric constants.	O	2
2	To find out reduced levels by tacheometer.	O	2
3	To find out gradient by tacheometer.	O	2
4	To find out area of polygon by tacheometer.	O	2
5	To study the aerial photographs by Mirror Stereoscope.	O	2
6	Importing maps and layers from various sources.	O	2
7	Generation of Vector Maps, Raster Maps and Layout using QGIS	O	2
8	Georeferencing of Toposheets	O	2
9	Prepare the different geospatial layers	O	2
10	Creation of spectral signature curves of various features mapping of Land use and land cover	O	2
11	**Field Projects:** Radial Contouring (100 M diameter)	O	4

Type: S- Study**, O-** Operational

Text Books:

1	B. C. Punmia, Surveying, Vol 2 and Vol 3 - Laxmi Publications
2	A. M. Chandra, Plane Surveying, New age international (P) Ltd
3	A.M. Chandra, Higher Surveying, New age international (P) Ltd

Reference Books:

1	S.K. Roy, Fundamentals of Surveying – Prentice Hall of India
2	Milton O. Schimidt, Fundamentals of Surveying, Wong, Cengage Learning
3	Arther Bannister et al., Surveying, Pearson Education, India
4	Survey of India Publication on maps

Learning Resources:

1. ArcGIS user manuals

2. QGIS User Manuals

Course Plan

Course Title: Rural Development Planning Lab	
Course Code : 201CEP318	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE Marks : N.A.**

Course Description:

The course deals with the study and interpretations of requirements of rural area in terms of resources, infrastructure, economic aspects as well as government policies and plans.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To know various resources needed for rural development.
2. To study significance of rural, develop in nation building
3. To understand government policies plans for rural development.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C318.1	List various resources needed for rural development.
C318.2	Explain significance of rural, develop in nation building
C318.3	Explain government policies plans for rural development.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C318.1	1	1	-	1	-	1	1	-	-	-	-	-	2	1	1
C318.2	2	1	-	1	-	1	1	-	-	-	-	-	2	1	2
C318.3	2	1	-	1	-	1	1	-	-	-	-	-	2	2	2

LIST OF EXPERIMENTS

Activity No	Name of Activity	Type	Hours
1	Objective of Rural Development	S	2
2	Rural Water Resources, Management and Sanitation	S	2
3	Rural Housing Schemes	O	4
4	Rural Roads and Renewable Energy	S	2
5	Rural Industries and Finance	S	2
6	Government Policies pertaining to Rural Development	S	2
7	Rural Development Planning	O	4
8	Site Visit to Rural area where Development plan is implemented and its report preparation	O	6

Type: S- Study**, O-** Operational

Text Books:

1	Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications India Pvt Ltd ISBN 978-81-7829-926-6 (PB)
2	Desai Vasant, Rural Development in India: Past,Present and Future: a Challenge in the Crisis, Himalaya Publishing House, Delhi ISBN 8183181929 ISBN 9788183181921
3	Rastogi, A.K., Rural Development Strategy, Wide Vision, Jaipur ISBN -81-8068-000-2
4	Gaur, Keshav dev, Dynamics Of Rural Development, Mittal Publications, 1992, Delhi
5	Document Published by Ministry of Rural development, Govt. of India Ministry of Rural development.

Software/Learning Website:

1	http://rural.nic.in/
2	http://www.panchayat.gov.in/
3	https://www.india.gov.in/topics/rural

Course Plan

Course Title : Mini Project	
Course Code : 201CEP 319	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE (OE) Marks : 25**

Course Description:

In this course, students work in groups of 3 to 4 students. The students are encouraged to plan, manage and complete a task/ project/ activity related to Civil Engineering branch. Mini project demonstrates the power of student projects to develop college, community connections, applied research skills and higher levels of student thinking. The aim of this course is to develop the important attributes like communication, presentation, organization, time management, research, inquiry, self-assessment, group participation, leadership and critical thinking. Performance is assessed on an individual basis and takes into account the quality of task/project/activity completed and the depth of content understanding demonstrated.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To develop critical thinking in students and solving civil engineering problems by exploring and proposing sustainable solutions.
2. To integrate knowledge and skills from civil and other engineering areas.
3. To help the students to develop their own innovative prototype of ideas.
4. To train the students in preparing mini project reports for various activities.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C319.1	Identify the community/ practical/ societal needs and convert the idea into a product/ process/ service.
C319.2	Analyse and design a process or develop a physical/ mathematical model in order to solve identified problem/project.
C319.3	Create, work in team and apply the solution in practical way to a specific problem.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C319.1	3	3	3	1	-	2	-	2	1	2	1	2	1	1	2
C319.2	3	3	3	1	2	1	-	1	1	1	1	2	1	1	4
C319.3	-	-	-	-	1	-	-	1	3	3	1	2	1	1	4

Term Work:

- The students in a group of 3 to 4 work on a topic approved by the Head of the DRC committee in department and prepare a mini project report after completing the work to the satisfaction.
- The progress of the project is evaluated based on a minimum of two reviews. A mini project report is required at the end of the semester.
- The mini project work is evaluated based on oral presentation and the mini project report by the review committee constituted by the Head of the Department.

Text Books:

1	Standard Text books on the subject appropriate to project topic

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(An Autonomous Institute) B. Tech. Curriculum
Third Year B. Tech. Civil Engineering
SEM-V (Academic Year-2022-23)

Course Plan

Course Title: Commercial Aspects in Civil Engineering Projects	
Course Code: 201CEMC320	**Semester: V**
Teaching Scheme: L-T-P : 2-0-0	**Credits: N.A.**
Evaluation Scheme: ISE Marks : N.A.	**ESE Marks: 50**

Course Description:
The course includes various types of properties and knowledge of procedure for project development. It also includes various permissions, special permissions for development of projects, features of RERA.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To study various types of properties and get knowledge of procedure for project development
2 To know special permissions for development of projects, RERA.
3 To get knowledge of project finance

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C320.1	Describe various types of properties and get knowledge of procedure for project development
C320.2	Explain special permissions for development of projects, RERA.
C320.3	Explain project finance.

Prerequisite:	Building Planning and Design

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C320.1	3	-	-	-	-	2	-	2	-	-	2	1	-	2	2
C320.2	3	-	-	-	-	2	1	2	-	-	2	1	-	3	2
C320.3	3	-	-	-	-	2	-	2	-	-	2	1	-	2	2

Content	Hours
Unit 1. Types of Properties – Different zones, types of ownership (Lease and Freehold), Documents required – 7/12 extract, property card, zone maps, procedure for N.A., Land sub-division and Amalgamation, Re-development Projects.	4
Unit 2. Procedure of Project Development: Development agreement, Power of Attorney, Building Permissions, Agreement to Sale, Completion Certificate, Sale deed. Co-operative Housing Society Act, Apartment Act.	5
Unit 3. Special Permissions for Development: Environment Clearance, Environment Impact Analysis (EIA), Fire NOC.	5
Unit 4. RERA – Applicability, Provisions, Regulations, Regulatory Authorities, Functioning, Penalty.	5
Unit 5. Project Finance- Stamp duty and Registration, Types of loans – cash-credit, project loan. Joint Ventures, Types of taxes- income tax, TDS, GST. Types of Royalty. Insurance – Labour welfare, labour insurance, material insurance.	5

Reference Books:

1	Sandip Mantri, 'The A to Z of Practical Building Construction and Its Management', Satya Publications, New Delhi
2	Ramesh S. Prabhu, Kaushik Sampat, 'Maharashtra RERA Law & Practice and Taxation of Real Estate Developers & Joint Development Arrangements with Accounting Aspects', Taxmann Publication.

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Third Year B. Tech. Civil Engineering
SEM-VI (Academic Year-2022-23)

Course Plan

Course Title : Design of Steel Structures	
Course Code : 201CEL321	**Semester : VI**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20 + 30	**ESE Marks : 50**

Course Description:
This course contains the design of structural steel members and relates design specifications to the basic behavior of structures which show students how specifications and codes are used in the solution of design problems. Topics include design philosophies, loads, analysis and design of bolted and welded connections, design of tension and compression members, columns and column bases, design of beams and composite beams.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To understand the behavior of elements of steel structure.
2 To understand the design concept of steel structure.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C321.1	Describe the design philosophy and behavior of steel structure.
C321.2	Analyze and design axially loaded bolted & welded connections.
C321.3	Design members subjected to tension and compression.
C321.4	Analyze and design flexural members.

Prerequisite:	Mechanics of Structures, Structural Analysis

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C321.1	2	2	-	-	-	-	-	2	-	-	-	-	1	-	2
C321.2	2	3	-	-	-	-	-	2	-	-	-	-	2	1	4
C321.3	2	2	-	-	-	-	-	2	-	-	-	-	2	1	4
C321.4	2	2	-	-	-	-	-	2	-	-	-	-	2	1	4

Content	Hours
Unit 1. Introduction: Advantages and disadvantages of steel structures, types of steel structures, Design Philosophy, grades of structural steel, loads and load combinations, partial safety factors for load and materials for steel structures.	4
Unit 2. Connections: Types, advantages & disadvantages, Analysis and Design of axially loaded bolted and welded connections.	6
Unit 3. Tension Members: Common sections, Net area, modes of failure, load carrying capacity, Design of tension members.	6
Unit 4. Compression Members: As Struts - Common sections, economical sections, effective length, slenderness ratio, modes of failure, classification of cross section, behavior of compression member, load carrying capacity, Design of compression members (only single and double angle.)	6
Unit 5. Column and Column Bases: Design of column subjected to axial loading, design of lacing, battening system, column splices. **Column bases:** Design of slab base & gusseted base subjected to axial loading, Design of concrete pedestal (dimensions only)	8
Unit 6. Beam in flexure: Types of sections, behavior, design of laterally supported Beams, rolled sections, built up beams, Design for strength and serviceability. Web buckling & web crippling.	6

Text Books:

1	Duggal S.K., Limit State Design of Steel Structures - Tata McGraw-Hill Education private Ltd., New Delhi, 2nd Edition 2014
2	Bhavikatti S. S., Design of Steel Structures: By Limit State Method as Per IS: 800 – 2007 - I K International Publishing House.
3	Shiyekar M. R, Limit State Design in Structural Steel - 2nd Edition, PHI Publisher
4	Dayaratnam, Design of Steel Structures - Wheeler Publications, New Delhi.
5	B. C. Punmia, A. K. Jain and Arun Kumar Jain, Design of Steel Structures –Laxmi Publication

Reference Books:

1	William T. Segui, LRFD Steel Design - PWS Publishing
2	Edwin H. Gaylord, Charles N. Gaylord James, Stallmeyer,Design of Steel Structures - Mc-Graw Hill
3	Mac. Ginely T., Design of Steel Structures -
4	Kazimi S. M. and Jindal R. S., Design of Steel Structures - Prentice Hall India.
5	Breslar, Lin Scalzi, John Willey, Design of Steel Structures - New York.
6	Englekirk, Steel Structure - Controlling Behaviour Through Design, WILEY.

I.S. Codes:

1. IS: 800 – 2007
2. IS: 875 (part I, II and III)
3. SP6 (1) & SP 6 (6)
4. IS: 816
5. IS: 808.

Course Plan

Course Title: Management for Civil Engineering	
Course Code: 201CEL322	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Civil Engineering Management is the implementation of relevant skills, knowledge and tools to achieve the goal set for a project. Project management is divided into 5 main phases, namely- Initiating, Planning, Executing, Performance monitoring and Closing of the project. With an increase in the number of industries, multinational and national projects, project management is gaining increasing importance and demand. The course help aspirants inculcate a strong leadership quality, set goals and targets, and take step-by-step action to achieve those goals.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To understand the concept of project management and to analyze the economics of alternatives and evaluate benefits and profits of construction projects.
2. To get knowledge of tendering and contracting process and how to prepare a tender.
3. To understand planning and scheduling by using techniques like Bar Charts, CPM, PERT.
4. To understand importance of safety and risk management, selection of construction equipment and materials management.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C322.1	Apply the concept of project management and analyze the economics of alternatives and evaluate benefits and profits of a construction activity based on monetary value and time value.
C322.2	Prepare tender notice, tender documents, tenders by using concepts of Contracts Management
C322.3	Prepare plan and schedule of a project by understanding the activities and their sequence.
C322.4	Illustrate importance of safety and risk management, materials management and construction equipment required for the project.

Prerequisite:	Numerical Methods

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C322.1	3	3	3	-	-	2	-	1	-	-	3	1	-	3	3
C322.2	3	-	-	-	-	2	-	1	-	-	3	1	-	3	3
C322.3	3	-	2	-	-	2	-	1	-	-	3	1	-	3	3
C322.4	3	-	2	-	-	2	-	1	-	-	3	1	-	3	2

Content	Hours
Unit 1. Introduction –Construction projects- Unique Features, Phases of a Construction Project, Participants/Stakeholders of a Construction Project – Architect, Owner, Constructor, Consultant, Sub contractors. Project Organization: Forms of Business organization – Sole Proprietorship, Partnership, Corporation, Private Ltd. Company, Public Ltd. Company, Govt. Enterprises, Joint Ventures. Structure of construction organization – Military/Line Organization, Line and Staff Organization, Departmental/Functional Organization, Matrix Organization Management levels – Director Level, President level, Construction Management Level, Project Management Level, Functional Management Level.	6
Unit 2. Construction Economics: Time value of money, Cash flow diagrams, Evaluation Alternatives by Equivalence – Present Worth comparison, EUAC method, Payback Period method, Benefit-cost ratio, Break even analysis.	6
Unit 3. Construction Contracts: Types of Contracts, Joint Ventures, Non-Conventional Contracts; Contract Documents, Tenders – types of tenders, Prequalification of contractors, Pre-tender conference, Liquidated Damages, Submission of Tenders, opening of Tenders, e Tendering,	6
Unit 4. : **Project planning and scheduling** - Work break-down structure. Techniques of planning- Bar charts. Networks: basic terminology, preparation of CPM networks: computation of float values, critical path. PERT- Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.	6
Unit 5. Construction Safety and Risk Management- Causes of accidents, Principles of safety, Safety Policy, Safety Budget, Safety Organization, Education and training, Safety Plan, Safety Manual. Risk Management – Risks, Risk Identification, Process Risk Analysis and evaluation Process, Risk avoidance, Risk Transfer, Insurance.	6
Unit 6. Construction Equipment: classification of construction equipment, estimation of productivity for: excavator, dozer, compactors, graders and dumpers. Selection of construction equipment and basic concept on equipment maintenance **Materials Management**: Inventory related costs, Selective Inventory Control – ABC Analysis, VED Analysis, FSN Analysis, EOQ.	6

Text Books:

1	Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India,2015
2	Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016

Reference Books:

1	Chitkara, K.K, 'Construction Project Management: Planning Scheduling and Control', Tata McGraw-Hill Publishing Company, New Delhi.
2	Paneerselvam, 'Engineering Economics', PHI Publications.
3	S. V. Deodhar, 'Construction Equipment and Job Planning', Khanna Publishers.
4	Robert L Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, 'Construction Planning, Equipment, and Methods (Civil Engineering)', McGraw-Hill Education

Course Plan

Course Title: Quantity Surveying and Valuation	
Course Code: 201CEL323	**Semester: VI**
Teaching Scheme: L-T-P: 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: This course introduces students to the process of estimating in a construction management environment. Students learn how to cost estimate materials, labour, and other costs for construction projects. Also learn about valuation of land and building.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To know the importance of estimation in Civil engineering works.
2 To study about the specification writing & prepare rate analysis of various items.
3 To carry out the estimation for various Civil engineering structures.
4 To understand the valuation of Civil Engineering Structures.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C323.1	Explain the importance of estimation in Civil Engineering works.
C323.2	Prepare specification of items of works and analyse the rates for different items of works.
C323.3	Illustrate a detailed estimation for various construction projects.
C323.4	Interpret fundamental concepts of valuation.

Prerequisite:	The students must have more knowledge about basic fundamentals of mathematics, building construction materials and building structure components with designing.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C323.1	3	3	1	-	-	-	-	-	-	-	-	1	-	2	2
C323.2	3	3	2	-	-	-	-	-	-	-	-	1	-	2	3
C323.3	3	3	3	-	-	1	1	-	1	-	1	2	1	2	3
C323.4	2	2	-	-	-	-	-	-	1	1	-	2	1	2	3

Content	Hours
Unit 1. a) Introduction to quantity surveying and its importance: Definition of Estimation, Purpose of estimates, Types of estimates - Detailed estimates & approximate estimates, Various items to be included in estimates. b) Approximate estimation: methods for building & other civil engineering projects like roads, irrigation/ water supply, sanitary engineering, industrial sheds etc. c) Principles in selecting units of measurement for items, Units of measurement for various items of work and Rules for measurements as per BIS: 1200, administrative approval & technical sanction of estimates, introduction to D.S.R. d) Prime cost, provisional sum & provisional quantities.	6

Unit 2. a) Specifications: Definition & purpose, basic principle of general and detailed specifications (writing the detailed specification for various Constructions should be covered in term work such as materials, quality, workmanship, method of execution, mode of measurement and payment for major items like excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work etc.) b) Rate Analysis: Definition, materials, sundries, labour, tools & plant, overheads & profit. Task work or out turn, factors affecting the cost of materials, price escalation.	6
Unit 3. Measurement and abstract sheets and recordings, taking out quantity methods – Long wall- short wall method (PWD Method) & Centre line method. Calculation of quantities for Load bearing and R.C.C framed structures.	6
Unit 4. a) Detailed estimate of building, R.C.C. Works, culverts, earthwork for canals, Roads including hill roads and other civil engineering works. b) Preparation of schedule for steel as reinforcement (Bar Bending Schedules) c) Introduction of the various software used in quantity surveying.	6
Unit 5. a) Valuation- Definition and Principles of valuation, Purposes. Definition of value, price & cost, Attributes of value, Different types of values. b) Values and his duties, factors affecting the valuation of properties, Tangible and Intangible properties, Concept of Landed properties – freehold and leasehold properties, Different types of leases. c) Valuation from yield and from life, Gross income and Net income, Outgoings, Capitalized value, Year's purchase – single rate and dual rate, reversion value of land	6
Unit 6. a) Methods of valuation - Rental method of valuation, direct comparison with capital value, valuation based on profit, valuation based on cost, Development method of valuation. b) Depreciation – Methods of depreciation: Straight line method, Constant percentage method, Sinking fund method and Quantity survey method. c) Obsolescence.	6

Text Books:

1	M. Chakraborty, "Estimating, Costing Specifications & valuation in Civil Engineering"
2	Dutta B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003.
3	S. C. Rangwala,, "Estimating and Costing", Charotar Publ. House, Anand.
4	B. S. Patil, "Civil Engineering, Contracts and Estimates", Universities Press Private Ltd., Hyderabad.
5	S. C. Rangwala, "Valuation of Real properties", Charotar Publ. House, Anand.
6	G. S. Birdie, "A text book of Estimating & Costing", Dhanpat Rai & Sons.

Reference Books:

1	Roshan Nanavati, "Professional Practice (Estimating and Valuation)", (1984 Edition) U.B.S. Publishers, Distributers PVT. Ltd.5 Ansari Road, New Delhi.
2	Standard specifications Volumes I & II (P. W. D. Maharashtra) Govt. of Maharashtra.
3	C.P.W.D. specifications.
4	C.P.W.D. schedules of rates.

Codes:

1	IS 1200 (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works.
2	IS 3861-1966: Method of Measurement of Areas and Cubical Contents of buildings.
3	S. S. R. (State Schedule of Rates) & D. S. R. (District Schedule of Rates) for current year.
4	PWD Redbooks, Vol 1 & 2.
	e – Resources: nptel.iitm.ac.in

Course Plan

Course Title: Geotechnical Design	
Course Code: 201CEL324	**Semester: VI**
Teaching Scheme: L-T-P :3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:

The course is dealing with design application of geotechnical engineering. Geotechnical Design comprises the soil investigation for properties of soil, the analysis and design of a functional structure(s) to accomplish the stability. The course includes the basic design requirement for foundation, design process of shallow and deep foundation as well as the stability analysis of slope and retaining structures.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 Design of structures subjected to soil pressure in vertical or lateral direction
2 Stability analysis of structure considering earth pressure

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C324.1	Interpret parameters required for geotechnical design of foundations.
C324.2	Demonstrate knowledge of design concept of different types of foundations
C324.3	Evaluate earth pressure for earth retaining structures.

Prerequisite:	FCE, Geotechnical engineering, Foundation engineering course

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C324.1	3	3	2	-	-	-	-	-	-	-	-	2	3	-	4
C324.2	3	3	3	-	-	-	-	-	-	-	-	2	3	1	3
C324.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	3

Content	Hours
Unit 1. Concepts and Criteria for Geotechnical Design Soil exploration: Necessity, objectives, stages & methods of exploration. Geotechnical parameters for design of foundations, Types of foundation, their suitability, requirements of good foundation, foundation location and minimum depth, Load calculation for design of foundations.	4
Unit 2. Geotechnical parameters and design of shallow foundations Estimation of bearing capacity of soil by Terzaghi's theory and IS code method, Field methods for estimation of bearing capacity, Types and Estimation of settlement values (as per IS 8009-1976 Part I), Design of shallow foundations: Design of isolated footing, combined footing, Types of raft, design criteria for raft foundation by rigid & elastic method, Proportioning footing for equal settlement.	8
Unit 3. Deep Foundation: Pile Foundation Classification of piles, Estimation of pile capacity: Single pile and group capacity in cohesive soil, cohesion less soil by Static method, Dynamic method, Pile load test, Negative skin friction, Piles in group, Spacing of piles in group, Group efficiency. Under reamed piles: Suitability, Details of pile & bulb, Stages of construction.	8

Unit 4. Deep Foundation: Caisson Foundations, Coffer dams & Sheet Piles Types of caissons, Elements of wells foundation, Characteristic of shapes, Difficulties in well sinking & remedial measures, Sand island method, Pneumatic caissons, Safety precautions, Caisson disease. Common types of cofferdams, uses and requirements, Types, materials and suitability of sheet piles,	6
Unit 5. Earth Retaining Structures Active and passive condition, Variation of earth pressure, Rankine's earth pressure and Coulomb's theory of earth pressure Retaining Wall-Analysis of retaining walls for dry and saturated back fills with surcharge loads, Sheet pile – analysis of cantilever type sheet pile wall, anchored sheet pile	6
Unit 6. Machine Foundation Types, Spring mass system (free vibration), natural frequency of foundation soil, Barken's method	4

Text Books:

1	B. C. Punmia, Ashok Kumar Jain, "Soil Mechanics and Foundation Engg", Laxmi Publications Pvt Limited, 16th Edition
2	K.R. Arora, "Soil Mechanics and Foundation Engg.", Standard Publishers Distributors, 2nd Edition

Reference Books:

1	Karl Terzaghi, Mesri, Ralph B. Peck, R. B. Peck, "Soil mechanics in engineering practice", Wiley, 3rd Edition
2	Joseph E. Bowles, "Foundation Analysis and Design", McGraw-Hill Education (India) Private Limited, 5th Edition
3	V. N. S. Murthy, "Soil Mechanics and Foundation Engg." CBS Publishers and Distributors, 2nd Edition
4	Braja M. Das, Nagaratnam Sivakugan, Siva Sivakugan " Introduction to Geotechnical Engineering", Cengage Learning, 6th Edition
5	P. Purushottam Raj, "Geotechnical Engineering", Dorling Kindersley, 1st Edition

Course Plan

Course Title: Reinforced Earth and Geo-textiles	
Course Code: 201CEL325	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: This course deals with ground improvement with geo-textile reinforcement as a technique applied for more than 30 years. Design RE retaining structures and Soil Nailing concepts also finding the load carrying capacity of Foundations resting on RE soil bed

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 To identify, formulate reinforced earth techniques that are suitable for different soils and in different structures and understand the laboratory testing concepts of Geo-textiles
2 To design RE retaining structures and Soil Nailing concepts
3 To determine the load carrying capacity of Foundations resting on RE soil bed.
4 To assess the use of Geo-textiles in drainage requirements and landfill designs

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C325.1	apply reinforced earth techniques that are suitable for different soils and in different structures
C325.2	Design RE retaining structures and Soil Nailing concepts
C325.3	Determine the load carrying capacity of Foundations resting on RE soil bed.
C325.4	Asses the use of Geo-textiles in drainage requirements and landfill designs

Prerequisite:	Geotechnical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C325.1	3	3	-	-	-	-	-	-	-	-	-	2	3	2	4
C325.2	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
C325.3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	3
C325.4	3	3	-	-	-	-	-	-	-	-	-	-	3	-	5

Content	Hours
Unit 1. Introduction: Significance and concept of earth reinforcement , Advantages and Disadvantage of reinforced earth construction, Sandwich technique for clayey soil, Recent developments, Types and configurations of geotextiles, Raw materials, Manufacturing process– Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Properties and tests on geotextiles: Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Evaluation of properties	6
Unit 2. Reinforced Earth Retaining Walls: Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problems	6
Unit 3. Soil Nailing Techniques: Concept, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken	6
Unit 4. Reinforced Earth Foundations: Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines.	6

Unit 5. Geo-textiles for Roads and Slopes: Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of sub grade, Design requirements, Slopes – Causes for slope failure, Improvement of slope stability with Geosynthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes	6
Unit 6. Geo-textiles- Filter, Drain and Landfills: Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soil retention, Geosynthetic permeability, anti-clogging, survivability and durability (No Numerical Problems) Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps (No Numerical Problems)	6

Text Books:

1	Koerner. R.M, "Design with Geosynthetics", Prince Hall Publications
2	Koerner. R.M. & Wesh, J.P, "Construction and Geotechnical Engineering using synthetic fabrics", Wiley Inter Science, New York.
3	Sivakumar Babu G. L., "An introduction to Soil Reinforcement and Geosynthetics", Universities Press, Hyderabad
4	Swami Saran, "Reinforced Soil and its Engineering Applications", I. K. International Pvt. Ltd, New Delhi
5	Venkattappa Rao, G., & Suryanarayana Raju., G. V.S, "Engineering with Geosynthetics", Tata McGraw Hill publishing Company Limited., New Delhi.

Reference Books:

1	Jones, "Earth reinforcement and Soil structure", CJEP Butterworths, London
2	Ingold, T.S. & Millar, K.S, "Geotextile Hand Book", Thomas, Telford, London.
3	Hidetoshi Octial, Shigenori Hayshi & Jen Otani, "Earth Reinforcement Practices", Vol. I, A.A. Balkema, Rotterdam
4	Bell F.G, "Ground Engineer's reference Book", Butterworths, London
5	Ingold, T.S, "Reinforced Earth", Thomas, Telford, London.
6	Sarsby R W- Editor, "Geosynthetics in Civil Engineering", Woodhead Publishing Ltd & CRC Press, 2007

Course Plan

Course Title: Environmental Impact Assessment	
Course Code: 201CEL326	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:

One of the basic tools for Environmental Management System is Environmental Impact Assessment (EIA) report. It is mandatory for all developmental projects to go for Environmental clearance. The course focuses on need for EIA, history, legal aspects, process of EIA, Post Project Monitoring and Environmental Management Plan for various sectors of Civil Engineering.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To explain the concept of Environmental Impact Assessment (EIA) as an Environmental Management tool.
2. To describe legal aspects of EIA.
3. To prepare EIA report.
4. To prepare Environmental Management System (EMS) for particular industry related with Civil Engineering

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C326.1	Explain the concept of EIA and elements of EIA
C326.2	Describe legal aspects of EIA and notifications.
C326.3	Prepare EIA report
C326.4	Prepare Environmental Management System (EMS) for particular industry related with Civil Engineering

Prerequisite:	Public Health Engineering, Irrigation Engineering.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C326.1	-	-	-	-	-	1	3	2	-	-	-	-	1	1	2
C326.2	-	-	-	-	-	2	3	3	-	-	-	-	-	-	2
C326.3	-	1	-	-	1	1	2	1	1	-	1	1	3	3	3
C326.4	-	-	-	-	1	2	2	-	1	-	1	1	2	2	3

Content	Hours
Unit 1. Introduction EIA a. Introduction b. Necessity and brief description of EIA. c. Steps in EIA process d. Categories for EIA study **e.** Environmental Impact Statement (EIS)	7
Unit 2. Legal aspects of EIA- Notifications a. Evolution of EIA in India b. Notification 1994 c. Notification 2006 d. Draft notification 2020 e. Amendments f. Environmental Clearance	7

Unit 3. Environmental Management Process a. EIA report- Steps b. Post project monitoring (PPM) c. Life Cycle Assessment	6
Unit 4. Environmental Management System (EMS) a. Environmental Management Plan b. Steps in EMS c. Environmental Audit d. CER(Corporate Environmental Responsibility) and CSR(Corporate Social Responsibility)	6
Unit 5. Case studies- Civil Engineering oriented a. Township planning b. Road construction c. Dam, Airport d. Irrigation Scheme	5
Unit 6. Case studies- General Engineering projects a. Industrial estates b. Chemical industries c. Power plant- Coal, Thermal, Gaseous, Hydro d. Mining- Coal mining	5

Text Books:

1	Larry W. Canter, Environmental Impact Assessment, McGraw-Hill International Editions.
2	S. K. Garg, Ecology and Environmental Studies, Khanna Publishers.

Reference Books:

1	R K Trivedi, Handbook of Environmental Laws, Acts, Guidelines, Compliances and Standards, Volume-I&II, B S Publications.
2	David Tyldesley and Associates, A Handbook on Environmental Impact Assessment, Prepared for SNH by Edinburgh

Course Plan

Course Title: Water Power Engineering	
Course Code: 201CEL327	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: The course includes hydal projects in India and their importance, information related to conveyance system, power house, component of hydal projects and types of hydal projects and modern types of turbines**.**

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To study fundamental knowledge of sources of energy , estimation of hydro power available , types of hydro power plants and water conveyance systems
2. To study types and classification of different components of hydro power plants and general arrangements of power stations
3. To know basic components functions and types of turbine , choice of turbine , turbine setting and cavitation
4. To understand the concepts of hydraulic design and economic diameter of pipe , pumped storage power plant and tidal power plant with their basic and general description , mini and micro hydal projects

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C327.1	Student will able to identify water power potential and components of water power plant
C327.2	Illustrate the types , classification and function of different components of hydro power plants
C327.3	To understand concept of hydraulic design and economic diameter of penstock, pumped storage power plants and tidal power plants with their general description

Prerequisite:	Hydraulics , Hydraulic machines , Water Resources Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and
Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C327.1	3	3	3	-	-	1	1	-	-	-	-	-	1	-	1
C327.2	3	3	3	-	-	1	1	-	-	-	-	-	1	-	2
C327.3	3	3	3	-	-	1	1	-	-	-	-	-	1	-	3

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Content	Hours
Unit 1. Water Power: Introduction to Sources of Energy, Role of Hydropower in overall power generation, Estimation of water power potential. Electrical Load on Hydro Turbines : Load Curve, load Factor, Capacity Factor, Utilization factor, Diversity Factor, Load Duration Curve, Firm Power , Secondary Power, Prediction of load.	6
Unit 2. Types of Hydro Power Plant: Classification of hydropower plants, General arrangements of Run of River Plants, Valley Dam Plants, Diversion Canal plants, High Head diversion plants, Storage and poundage, Pumped storage power plants, Advantages of Pumped storage power plants, types of Pumped storage power plants.	6
Unit 3. Intake: Types, losses, Air entertainment, Inlet aeration, Canals, Forebay, Tunnel. **Surge Tanks**: function and behaviour of surge tank, types, basic design criteria	6
Unit 4. Penstock: General classification, design criteria. Economical diameter. Anchor blocks, Conduit valves, Bends and manifolds, Thrust blocks. **Turbines:** Introduction, main types of turbines, Basic flow equations, Draft tubes, Cavitation in turbines, Turbine model testing , characteristics of turbines, Selection of types of turbine , Different types of modern turbine	6
Unit 5. Water Hammer and Surges: Introduction, Water Hammer, Transients caused by turbine, Load acceptance and rejection, Resonance in Penstocks, Channel Surges, water hammer devices.	6
Unit 6. Hydal projects: Introduction to hydal projects in India, case study of any mini and micro hydal project in India **Tidal power stations**: classification, types. Depression power plants	6

Text Books:

1	Dandekar M. M. & Sharma K. N.; Water Power Engineering: Vikas Publishing House Pvt.Ltd., New Delhi, 2003
2	Sharma R K & Sharma T K , text book of water power Engineering , S chand publication , 2003

Reference Books:

1	E Mosoni, Water power development –Vol. I &II
2	Streeter V. L. & Wylie E. B.: Hydraulic Transient; McGraw Hill Book Company, New York.20
3	Chaudhary Hanif, Applied Hydraulic Transients; Van Nostrand Rein Hold Company, New York 1992

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Course Plan

Course Title: Intelligent Transportation Systems	
Course Code: 201CEL328	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Intelligent Transportation Systems (ITS) is the application of computer, electronics, and communication technologies and management strategies in an integrated manner to provide traveler information to increase the safety and efficiency of the surface transportation systems. These systems involve vehicles, drivers, passengers, road operators, and managers all interacting with each other and the environment, and linking with the complex infrastructure systems to improve the safety and capacity of road systems.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To study types of ITS; ITS User Needs and Services- Advanced Traffic Management systems
2. To study ITS Data collection techniques and ITS Architecture
3. To understand ITS Applications; City ITS; Highway ITS
4. To know the human factors in ITS and ITS safety and security

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Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C328.1	Illustrate the appropriate system/s in various functional areas of transportation.
C328.2	Illustrate the applications of ITS
C328.3	Describe the application of information technology and telecommunication to control traffic
C328.4	Explain advance information to the travellers, automatic handling of emergencies and to improve safety

Prerequisite:	Transportation Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C328.1	3	-	-	-	-	2	1	-	-	-	-	3	1	2	3
C328.2	3	-	-	-	-	2	1	-	-	-	-	2	1	3	3
C328.3	3	-	-	-	-	2	1	-	-	-	-	2	1	2	2
C328.4	3	-	-	-	-	2	1	-	-	-	-	2	1	2	2

Content	Hours
Unit 1. ITS Definition; Types of ITS; Basic elements of ITS, ITS User Needs and Services- Advanced Traffic Management systems (ATMS), Advanced Public Transportation Systems (APTS), Benefits of ITS	6
Unit 2. ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection. Advanced traveller information systems (ATIS); transportation network operations; commercial vehicle operations (CVO) Advanced Vehicle Control systems (AVCS).	6
Unit 3. Public transportation applications, ITS and regional strategic transportation planning, including regional architectures, City ITS, Highway ITS	6
Unit 4. : ITS and changing transportation institutions, ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS and sustainable mobility.	6
Unit 5. Travel demand management, electronic toll collection, and ITS and road-pricing. Automated Highway Systems	6
Unit 6. Human factors in ITS; ITS and safety*;* ITS and security; ITS case studies in developed and developing world traffic. Introduction to Autonomous Navigation.	6

Text Books:

1	P. K. Sarkar, A. K. Jain, 'Intelligent Transport System', PHI Learning.
2	Dhanagare D. N., 'Intelligent Transportation Systems', Orient Blackswan Pvt. Ltd.
3	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House.

Reference Book:

1	Sussman, J. M., 'Perspective on ITS', Artech House Publishers, 2005.

Course Plan

Course Title: Offshore Structural Engineering	
Course Code: 201CEL329	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: This course gives basic information related to offshore structures. The offshore structures are associated with the development of hydrocarbon extraction off the world's continents. Offshore structures have been focal points for controversies concerning pollution and hazard to navigation, yet serve as a basis for many coastal economies.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. Thorough understanding of end-to-end offshore oil and gas operations in oil and gas industry
2. Addressing Offshore engineering from perspectives of design of offshore structures for the exploitation of energy resources
3. Understanding environmental issues in the exploitation of offshore resources
4. To explore students for future Renewable Energy sector, exploitation of off-shore renewable energies requires specialized design of structures, systems and technologies in a continuously evolving framework.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C329.1	Better understand the field of offshore engineering
C329.2	Understand the complexities of Offshore Engineering activities
C329.3	Understand special fabrication requirement needed for specialised job
C329.4	Explore their knowledge for upcoming market of offshore Renewable energy

Prerequisite:	-

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C329.1	2	1	-	-	-	1	2	-	-	-	-	1	2	1	2
C329.2	2	1	-	-	-	1	2	-	-	-	-	1	-	2	2
C329.3	2	-	-	1	-	1	1	-	-	-	-	1	2	-	3
C329.4	2	-	-	1	-	1	1	-	-	-	-	1	-	-	3

Content	Hours
Unit 1. General introduction of Offshore structure 1. Introduction 2. Jacket Pile foundation 3. Topside 4. Deepwater Challenges	6

Unit 2. Loads on Offshore Structures 1. Permanent Loads and Variable Loads 2. Environmental Loads – 2a.Wind 2b. Wave 2c. Current 3. Calculation of environmental forces	6
Unit 3. Analysis Of Offshore Structures – Operational Analysis 1. Inplace Analysis 2. Fatigue Analysis 3. Pushover Analysis 4. Dynamic Analysis	6
Unit 4. Analysis Of Offshore Structures – Non Operational Analysis 1. Lifting Analysis 2. Transportation Analysis 3. Loadout Analysis 4. On-Bottom Stability Analysis	6
Unit 5. Tubular Joint Design and Introduction to Pile foundation 1. Tubular Joints a. Classification b. Construction Practice c. Design of Joint d. SCF Calculations 2. Pile foundation a. Pile Design b. Pile installation and handling	6
Unit 6. Fabrication and Miscellaneous Connections 1. Jacket Fabrication and Assembling 2. Transportation – Structural Support arrangement 3. Lifting Pad eye 4. Deck joints design 5. VIV Check	6

Text Books:

1	Subrata K. Chakrabarti, Handbook Of Offshore Engineering -

Reference Books:

1	856235, "Code of Practice for Fixed Offshore Structures" British Standard Institution London, 1982
2	API-RP2A," Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms", American Petroleum Institute, Washington D.C
3	"Rules for the Design Construction and Inspection of Offshore Structures "Det Norske VERITAS @ DNV)
4	NORSOK Standard N-001 - Integrity of offshore structures
5	BS-EN-ISO 19900 – 2002 - General Requirements for Offshore Structures
6	DoE, Offshore Installations: Guidance on Design and Construction/London, April 1984
7	Young, Warren C, Roark's Formulae for Stress and Strain. Sixth Edition, McGraw-Hill.
8	Noble-Denton, Mathew Daniel and Other MWS Guidelines

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Course Plan

Course Title : Design of Steel Structures Lab	
Course Code : 201CEP332	**Semester : VI**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE + MSE Marks : 25	**ESE (OE) Marks : 25**

Course Description:

This course is the application of design of steel structures. It covers analysis and design of different types of bolted & welded connections. Course explores the design of structural members of industrial building including column and column bases.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To analyze and design steel structures.
2. To prepare the working drawing for various structural elements

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C332.1	Analyze and design different types of bolted & welded connections
C332.2	Prepare the working drawing as per requirement of project
C332.3	Aware usefulness of software in structural analysis and design

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C332.1	2	2	2	-	1	-	-	2	1	-	-	-	1	-	4
C332.2	1	-	-	-	1	2	-	-	2	-	-	-	-	1	3
C332.3	2	1	1	-	3	-	-	1	-	-	-	-	-	2	2

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LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Hours
Detailed structural design and drawing of the following steel structures along with necessary drawings by limit state method of analysis. (Max group size should not exceed 4 students)		
Project No-1	Design of industrial building including roof truss and its connections, purlin, bracings, column and column base. Preparation of all working drawings	14
Project No-2	Analysis and Design of building frame. Preparation of all working drawings.	10

*** Note:** Analysis of Structural Steel Element by using any **application software.**

Text Books:

1	Duggal S.K., "Limit State Design of Steel Structures" Tata McGraw-Hill Education private Ltd., 2nd Edition.
2	Dr. V.L. Shah, Veena Gore, "Limit State Design of Steel Structures: IS:800 – 2007" Structures Publication, 3rd Edition.
3	"Design of Steel Structures" Dr. N.R. Chandak, S.K. Kataria and Sons, 1st Edition

Reference Books:

1	William T. Segui, "LRFD Steel Design", PWS Publishing
2	Edwin H. Gaylord, Charles N. Gaylord James, Stallmeyer, "Design of Steel Structures" Mc-Graw Hill
3	Kazimi S. M., Jindal R. S., "Design of Steel Structures" Prentice Hall India.

Codes:

1	IS: 800 – 2007
2	IS: 875 (Part I, II and III)
3	SP6 (1) & SP 6 (6),

Course Plan

Course Title : Management for Civil Engineering Lab	
Course Code : 201CEP 333	**Semester : VI**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE (OE) Marks : 25**

Course Description:

Civil Engineering Management is the implementation of relevant skills, knowledge and tools to achieve the goal set for a project. Project management is divided into 5 main phases, namely- Initiating, Planning, Executing, Performance monitoring and Closing of the project. With an increase in the number of industries, multinational and national projects, project management is gaining increasing importance and demand.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1. To understand the concept of project management and to analyze the economics of alternatives and evaluate benefits and profits of construction projects.
2. To get knowledge of tendering and contracting process and how to prepare a tender.
3. To understand planning and scheduling by using techniques like Bar Charts, CPM, PERT.
4. To understand importance of safety and risk management, selection of construction equipment and materials management.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C333.1	Apply the concept of project management and analyze the economics of alternatives and evaluate benefits and profits of a construction activity based on monetary value and time value.
C333.2	Prepare tender notice, tender documents, tenders by using concepts of Contracts Management
C333.3	Prepare plan and schedule of a project based on requirements by understanding the activities and their sequence and taking help of a project management software for the same.
C333.4	Describe importance of safety and risk management, materials management and construction equipment required for the project.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C333.1	3	3	3	-	-	2	-	1	-	-	3	1	-	3	3
C333.2	3	-	-	-	3	2	-	1	2	2	3	1	-	3	3
C333.3	3	-	2	-	-	2	-	1	-	-	3	1	-	3	3
C333.4	3	-	2	-	-	2	-	1	-	-	3	1	-	3	2

LIST OF EXPERIMENTS

Experiment No	Name of Experiment	Type	Hours
1	Concept of construction project and various project organizations.	S	2
2	Use of economic comparison methods for problem solving.	S	2
3	Preparation of tender documents.	S	2
4	Preparation of contract documents	S	2
5	Application of project planning and scheduling.	S	4
6	Importance of construction safety.	S	2
7	Introduction to the risk management process.	S	2
8	Study of construction equipment.	S	2
9	Modern material management technology.	S	2
10	Visit to any public body like Z.P., P.W.D, W.R.E., etc. to study the tendering process used over there and prepare a report on the same.	S	4

Type: S- Study**, O-** Operational

Text Books:

1	Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson
2	Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016

Reference Books:

1	Chitkara, K.K, 'Construction Project Management: Planning Scheduling and Control', Tata McGraw-Hill Publishing Company, New Delhi.
2	Paneerselvam, 'Engineering Economics', PHI Publications.
3	S. V. Deodhar, 'Construction Equipment and Job Planning', Khanna Publishers.
4	Robert L Peurifoy, Clifford J. Schexnayder, Aviad Shapira, Robert Schmitt, 'Construction Planning, Equipment, and Methods (Civil Engineering)', McGraw-Hill Education

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Course Plan

Course Title: Quantity Surveying and Valuation Lab	
Course Code: 201CEP334	**Semester: VI**
Teaching Scheme: L-T-P: 0-0-4	**Credits: 2**
Evaluation Scheme: ISE Marks: 50	**ESE (OE) Marks: 25**

Course Description: This course introduces students to the process of estimating in a construction management environment. Students learn how to cost estimate materials, labour, and other costs for construction projects. Also learn about valuation of land and building.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To know the importance of estimation in Civil engineering works.
2 To study about the specification writing & prepare rate analysis of various items.
3 To carry out the estimation for various Civil engineering structures.
4 To understand the valuation of Civil Engineering Structures.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
C334.1	Explain the importance of estimation in Civil Engineering works.
C334.2	Prepare specification of items of works and analyse the rates for different items of works.
C334.3	Illustrate a detailed estimation for various construction projects.
C334.4	Interpret fundamental concepts of valuation.

Prerequisite:	The students must have more knowledge about basic fundamentals of mathematics, building construction materials and building structure components with designing.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C334.1	3	3	1	-	-	-	-	-	-	-	-	1	-	2	2
C334.2	3	3	2	-	2	-	-	-	-	-	-	1	-	2	3
C334.3	3	3	3	-	3	1	1	-	1	-	1	2	1	2	3
C334.4	2	2	-	-	2	-	-	-	1	1	-	2	1	2	3

LIST OF EXPERIMENTS

Activity No.	Name of Activity	Type	Hours
1	Drafting detailed specifications for minimum ten civil engineering items. (One each from Roads, Irrigation works, Water Supply & Sanitation & seven from buildings)	S	4
2	Analysing rate analysis of seven civil engineering items based on prevailing market rates. (Prepare excel sheet for minimum 5 items of works)	S	4
3	Detailed estimate of G + 1 residential framed structure using D.S.R.	O	8
4	Preparing detailed estimate for any one of the following: a) A stretch of a road about 1 Km. long including earthwork. b) A reach of canal about 1 Km. long. c) A factory shed of steel frame. d) Underground Water Tank.	S	8
5	Working out quantities of steel reinforcement for a column footing, a column, a beam and a slab by preparing bar bending schedule.	O	8
6	Valuation reports for building of residential purpose or commercial purpose	S	8
7	Prepare the detailed estimation of building used in Practical No. 3 by using software.	S	8

Type: S- Study**, O-** Operational

Text Books:

1	M. Chakraborty, "Estimating, Costing Specifications & valuation in Civil Engineering".
2	Dutta B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 2003.
3	S. C. Rangwala, "Estimating and Costing", Charotar Publ. House, Anand
4	B. S. Patil., "Civil Engineering, Contracts and Estimates", Universities Press Private Ltd., Hyderabad.
5	S. C. Rangwala, "Valuation of Real properties", Charotar Publ. House, Anand
6	G. S. Birdie, "A text book of Estimating & Costing", Dhanpat Rai & Sons.

Reference Books:

1	Roshan Nanavati, "Professional Practice (Estimating and Valuation)", (1984 Edition) U.B.S. Publishers, Distributers PVT. Ltd.5 Ansari Road, New Delhi.
2	Standard specifications Volumes I & II (P. W. D. Maharashtra) Govt. of Maharashtra.
3	C.P.W.D. specifications.
4	C.P.W.D. schedules of rates.

Codes:

1	IS 1200 (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works.
2	IS 3861-1966: Method of Measurement of Areas and Cubical Contents of buildings.
3	S. S. R. (State Schedule of Rates) & D. S. R. (District Schedule of Rates) for current year.
4	PWD Redbooks, Vol 1 & 2.

Course Plan

Course Title: Civil Engineering Software	
Course Code: 201CEP335	**Semester: VI**
Teaching Scheme: L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks: 50	**ESE Marks: N.A.**

Course Description: software development has effectively contributed in various civil engineering disciplines, as it provides engineers with the ability to perform variety of complex calculations, modeling, drafting, designing practice and several analysis processes for civil engineering infrastructure. The course deals with introductory part of various civil engineering software and its application to students.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 Understand the use of software in Civil Engineering Field.

2 Apply knowledge if software in Civil engineering problems

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C335.1	Demonstrate knowledge of civil engineering software.
C335.2	Apply the appropriate steps to complete software analysis and design.

Prerequisite:	Basic Knowledge of Civil Subjects

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C335.1	2	3	-	-	3	-	-	-	-	-	-	3	-	2	2
C335.2	2	3	-	-	3	-	-	-	-	-	-	2	-	2	3

Content	Hours
Introduction to Civil Engineering Software related to Structural Engg, Construction Management, Water Resources, Environmental Engineering, Surveying etc. • **Assignment 1** on list of software with application	6
Student must select one software and apply same for any 4 civil engineering problems • **Assignment 2** Software application on any 4 problems (Step followed/ process of software used and Printouts of output)	18

Reference link:

1	https://www.aicte-india.org/downloads/Commercial%20Software.pdf
2	https://www.edx.org/school/iitbombayx
3	https://fossee.in/

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Course Plan

Course Title : Ethics in Engineering	
Course Code: 201CEMC336	**Semester: VI**
Teaching Scheme: L-T-P : 2- 0-0	**Credits: N.A.**
Evaluation Scheme: ISE + MSE Marks : N.A.	**ESE Marks: 50**

Course Description: This course is designed to introduce undergraduate engineering students to the concepts, theory and practice of engineering ethics. It will allow students to explore the relationship between ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfill the needs of society.

Course Objectives:

1 To enable the students to create an awareness on Engineering Ethics and Human Values
2 To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C336.1	Understand and appreciate the importance of human values in his professional career.
C336.2	Upon successful completion of the course, the student should be able to judge and assess the safety and risks associated with Engineering projects.
C336.3	Discuss the ethical issues related to engineering and realize the responsibilities and rights of Engineers in the society.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C336.1	-	-	-	-	-	1	2	3	3	3	2	1	1	1	1
C336.2	-	-	-	-	-	1	2	3	3	3	2	1	-	1	2
C336.3	-	-	-	-	-	1	2	3	3	3	2	1	1	1	2

Content	Hours
Unit 1. Human Values Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence– Character -Spirituality	6
Unit 2. Engineering Ethics Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg‘s theory – Gilligan‘s theory – Consensus and Controversy – Models of professional roles – Theories about right action .	6
Unit 3. Safety, Responsibilities and Rights Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights	6
Unit 4. Multinational Corporations – Environmental Ethics – Computer Ethics – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.	6

Text Books:

1	Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.
2	Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004.

Reference Books:

1	Charles B. Fleddermann, Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
2	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Engineering Ethics – Concepts and Cases, Cengage Learning, 2009.
3	John R Boatright, Ethics and the Conduct of Business, Pearson Education, New Delhi, 2003
4	Edmund G Seebauer and Robert L Barry, Fundamentals of Ethics for Scientists and Engineers, Oxford University Press, Oxford, 2001.

Course Plan

Course Title: Disaster Management	
Course Code: 201CEL330	**Semester: VI**
Teaching Scheme: L-T-P : 3-1-0	**Credits: 4**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To understand concepts of Disaster Management.
2 To study approach for disaster risk reduction.
3 To understand components of disaster risk reduction.
4 To know applications of modern technologies for disaster management.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C330.1	Explain concepts of Disaster Management.
C330.2	Illustrate types, causes and impacts of disaster.
C330.3	Summarize components of disaster risk reduction.
C330.4	List technologies and its applications for disaster risk management.

Prerequisite:	Basic knowledge of Environmental Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C330.1	2	1	-	-	-	2	1	-	-	-	1	1	1	-	2
C330.2	2	1	-	-	-	2	1	-	-	-	-	1	1	-	3
C330.3	2	1	-	-	-	2	1	-	-	-	-	1	1	-	2
C330.4	2	1	-	-	2	2	1	-	-	-	1	1	1	-	2

Content	Hours
Unit 1. Introduction to Disaster Management: Concepts of Disaster, Hazard, Vulnerability, Resilience, Prevention, Mitigation, Risks, Risk cycle, Risk Reduction, Risk matrix, Impact	5
Unit 2. Natural Disaster : Classification, Causes, Impacts & Practical Examples (Case studies) of Natural Disaster - Floods, Draught, Cyclones, Volcanoes, Earthquakes, Tsunami, Landslides, Thunder storms, Forest fires, Avalanches, etc.	6
Unit 3. Manmade Disasters : Classification, Causes, Impacts & Practical Examples (Case studies) of Man-made Disaster - Technological disasters , Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures(Building and Bridge), War & Terrorism, Armed conflicts.	6

Unit 4. Approaches to disaster risk reduction : Disaster Risk Reduction Strategies, Phases of Disaster, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Components of Disaster Relief-(Water, food, sanitation, shelter, Health and Waste Management), Community based DRR, Structural non-structural measures in DRR, Factors affecting Vulnerabilities, , Mainstreaming disaster risk reduction in development, Undertaking risk and vulnerability assessments, Policies for Disaster Preparedness Programs, Preparedness Planning, Public Awareness and Warnings	7
Unit 5. Rehabilitation, Reconstruction and Recovery : Reconstruction and Rehabilitation methods as a Means of Development ,Damage Assessment, Post Disaster effects and Remedial Measures, Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction, Sustainable and environmentally friendly recovery, Role of Government, International and NGO Bodies in Rehabilitation, Reconstruction and Recovery.	6
Unit 6. Technologies In Disaster Risk Management : Introduction, Concepts & Application - Database Management System (DBMS), Management Information System (MIS), Decision Support System, Geographical Information System, Remote Sensing, GPS, Transportation Emergency Response Application (TERA), ALIRT (Airborne Ladar Imaging Research Testbed).	6

List of Tutorials

Tutorial No.	Tutorial Details	Hours
1	Define and explain the vital terms in disaster management	1
2	Interpret the characteristics of vulnerability and factors affecting it.	1
3	Enlist and explain types of natural disasters, its causes and impacts	1
4	Enlist and explain types of man-made disasters, its causes and impacts	1
5	Identify and explain social impacts of disasters.	1
6	Interpret the causes of major disasters in India.	1
7	Enlist and elaborate on recent trends in global disaster.	1
8	List the components of disaster risk reduction and elaborate each one.	1
9	Explain mitigation and its types as component of DRR.	1
10	Describe role early warning system in DRR.	1
11	Compile salient features of Disaster Management Act, 2005	1
12	Elaborate on usefulness on Remote Sensing and GIS in disaster management.	1

Text Books:

1	Ghosh G.K. "Disaster Management" - APH Publishing Corporation
2	J. P. Singhal - Disaster Management - Laxmi Publications

Reference Books:

1	Dr. Mrinalini Pandey- Disaster Management - Wiley India Pvt. Ltd.
2	R K Bhandani, An overview on natural & man-made disasters and their reduction - CSIR, New Delhi
3	Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-12)
4	Jagbir Singh, Disaster Management - Future Challenges and Opportunities K W Publishers Pvt. Ltd.
5	H.N. Srivastava and G.D. Gupta, Management of Natural Disasters in developing countries - Daya Publishers, Delhi

Course Plan

Course Title: Green Building	
Course Code: 201CEL331	**Semester: VI**
Teaching Scheme: L-T-P : 3-1-0	**Credits: 4**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description: This course will provide current knowledge about sustainability and green buildings and bring awareness to innovative codes and standards by empowering our industry to apply sustainable design and construction strategies. This course provides introductions to green building and sustainability subject matters to help bring knowledge of environmental building strategies, policies and to help the design community and local government staffs demonstrate leadership in the community.

Program Specific Outcomes (PSOs):

PSO1	To design and execute cost effective Civil Engineering solutions for sustainable development.
PSO2	To develop entrepreneur skills among the graduates to fulfil the needs of society.

Course Objectives:

1 To make the students familiar with the concepts of sustainable architecture.

2 To implement concepts of energy conservation in construction practices.

3 To make students aware of rating systems in Green building.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C331.1	Explain the concept of Green Building.
C331. 2	Identify different materials for Green Building.
C331.3	Describe various rating systems for Green Building.

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Prerequisite:	Building construction , Building Planning and Design

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C331.1	3	3	-	-	-	-	3	-	-	-	-	3	1	-	2
C331.2	3	3	-	-	-	-	3	-	-	-	-	3	2	-	2
C331.3	3	3	-	-	-	-	3	2	-	-	-	3	2	-	2

Content	Hours
Unit 1. Energy and Energy conservation, Renewable Energy Resources, Non-renewable Energy Resources, Need of energy conservation, LEED India Rating System and Energy Efficiency. Functions of Government organization working for Energy conservation and Audit(ECA, Energy Conservation Act 2001	6
Unit 2. Green building: Definition &Benefits of Green building, Principles of green building [planning, Environmental design (ED) strategies for building construction.	6
Unit 3. Materials: Bamboo, Rice husk ash concrete, plastic bricks, Bagasse partic1e board, Insulated concrete forms. Reuse of waste materials-Plastic, rubber, Newspaper wood, Non-toxic paint, Green roofing.	6
Unit 4. Technical Standards & Certifications systems: Types of certification systems worldwide – LEEDS, BREEAM, ECOTEL, GREEN GLOBE, ENERGY STAR, GRIHA, IGBC etc.	6
Unit 5. Sustainable resources management: Concept of RWH system, Concept of Solar Water Heating, concept of lighting, Ventilation, Building Acoustics.	6
Unit 6. Smart Building Systems: Water Efficient fixtures**,** Energy efficient fixtures, cost efficiency for green building.	6

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List of Tutorials

Tutorial No.	Tutorial Details	Hours
1	Introduction to Green building concept	1
2	Energy and Energy conservation	1
3	Energy Audit	1
4	Environmental design (ED) strategies for building construction	1
5	Materials used in green building construction.	1
6	Reuse of waste materials in green building construction	1
7	Technical Standards & Certifications systems	1
8	Sustainable resources management- RWH system	1
9	Sustainable resources management- Solar Water Heating, lighting, Ventilation , Building Acoustics	1
10	Smart Building Systems- Water Efficient fixtures	1
11	Smart Building Systems- Energy efficient fixtures	1
12	Case study of any building	1

Text Books:

1	Ravindra K Dhir, Sustainable construction materials

Reference Books:

1	Sandeep Mantri., A to Z of Practical building construction and its Management
2	Charles J. Kibert., Sustainable Construction: Green Building Design and Delivery
3	Jerry Yudelson, Green Building A to Z: Understanding the Language of Green Building
4	Antony Radford and Helen Bennetts, Understanding Sustainable architecture, Terry Williamson,

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Teaching and Evaluation Scheme from Year 2022-23

Department of Civil Engineering

Minor Degree in Environmental Sustainability

Sr. No	Course Code	Name of the Course	Semester	Teaching Scheme Per Week			Credits	Total Marks	Evaluation scheme			
				Lecture Hours	Tutorial Hours	Practical Hours			Type	Max. Marks	Min. Marks for Passing	
1	201CEMIL221	Introduction to Environmental Sustainability	IV	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
2	201CEMIL337	Sustainable Sanitation	V	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
3	201CEMIP338	Sustainable Sanitation Lab	V	-	-	2	1	50	ISE	50	20	
4	201CEMIL339	Environmental Management Systems	VI	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
5	201CEMIL340	Waste Management	VI	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
6	201CEMIP341	Waste Management Lab	VI	-	-	2	1	25	ISE	25	10	
7	201CEMIL446	Occupational Health & Safety	VII	3	-	-	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
8	201CEMIP447	Occupational Health & Safety Lab	VII	-	-	2	1	25	ISE	25	10	
Summary		**Total**		**15**	**-**	**6**	**18**	**600**				
		Total Credits		**18**				**Total Marks**			**600**	

ISE: *In Semester Evaluation* ***MSE:*** *Mid Semester Examination* ***ESE:*** *End Semester Examination*

Note 1 : Tutorials and practical shall be conducted in batches with batch strength not exceeding 20 students.

Note 2 : ESE will be conducted for 100 marks and converted to 50 Marks

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Course Plan

Course Title: Introduction to Environmental Sustainability	
Course Code: 201CEMIL221	**Semester: IV**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Sustainable environment in industry ensures that the resources are used conservatively and efficiently. Sustainable industrialization reduces environmental impact by shifting toward eco-friendly development and upholding ethical responsibility to ensure a cleaner and safer environment. Sustainable environment practices result in lower greenhouse gas emissions and conserve water, energy and natural resources. This course deals with significance of environmental sustainability to industry and organizations.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability
PSO2	To develop abilities in graduates to suit to the requirements of the varied industry

Course Objectives:

1 To understand the importance of environmental sustainability
2 To know sustainable development goals
3 To aware about the individual, social responsibilities and role of government toward sustainable development.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C221.1	Describe the basics of sustainable development and its concepts.
C221.2	Summarize dimensions of environmental sustainability and its applications.
C221.3	Explain sustainable development goals in the context of social, industrial context.

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Prerequisite:	Environmental Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C221.1	2	-	-	1	-	2	3	-	-	-	-	-	1	1	2
C221.2	2	1	-	-	-	2	3	-	-	-	-	-	1	1	2
C221.3	2	1	-	-	-	2	3	-	-	-	-	-	1	1	2

Content	Hours
Unit 1: Introduction Evolution and History of sustainability, Brundtland commission report, Principles of sustainable development, Objectives, Conceptualization of sustainability, Boundaries of sustainable development.	6
Unit 2: **Sustainable development framework** Pillars of sustainable development, Impediments to achieving sustainability, Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development	6
Unit 3: Issues of environmentally sustainable urban environment: Sustainable urban transport, Sustainable transport indicators, Engineering tools for assessment and design for environment and sustainability.	6
Unit 4: Strategies for promoting environmentally sustainable development: Sustainable Development Goals (SDG), Capacity Building, Human Rights and Intergenerational Equity, Environmental and Human Health, Sustainable Cities	6

Unit 5: Social and environmental responsibilities: Responsibilities towards environmentally sustainable development, Role of local Government, Steps for adopting sustainability approach, behaviour change communication, Corporate Social Responsibility (CSR).	6
Unit 6: Green Technology for Sustainable Development: Clean - green energy technology alternatives to reduce greenhouse gas emissions, advantages, mitigation and adaptation	6

Text Books:

1	Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainable development by. ISBN 978-94-007-1591-2.
2	Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978-0415590730.
3	Chopra, K., and Kadekodi, G.K. (1999), Operationalizing Sustainable Development, Sage Publication, New Delhi.

Reference Books:

1	LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002.
2	Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.

Course Plan

Course Title: Sustainable Sanitation	
Course Code: 201CEMIL337	**Semester: V**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:

The course aims to equip the students with fundamental understanding, knowledge and skills to contribute to the practice of sustainable sanitation. The students would develop as competent professionals in the field of sanitation with the ability to plan and implement the sanitation techniques that is inclusive and sustainable.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability.
PSO2	To develop abilities in graduates to suit to requirements of the varied industries.

Course Objectives:

1 To understand sustainable sanitation and wastewater management in different contexts.

2 To understand the various components of building sanitation.

3 To study the government schemes & policies for sustainable sanitation.

COs	**At the end of successful completion of course, the students will be able to…**
C337.1	Analyze sustainable sanitation and wastewater management in different contexts.
C337.2	Illustrate the various components of building sanitation.
C337.3	Describe the government Schemes & Policies for Sustainable Sanitation.

Prerequisite:	Environmental Studies.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C337.1	2	2	1	1	-	2	3	-	-	-	-	-	1	1	4
C337.2	2	1	-	-	1	2	3	-	-	-	-	-	1	1	3
C337.3	2	1	1	1	-	2	3	-	-	-	-	-	1	1	2

Content	Hours
Unit 1. Water and Sanitation: Introduction to Sustainable Development Goal-6 Current Scenario Targets and Indicators	6
Unit 2. Sanitation Planning: Current status of water pollution in Indian context: Problems, Issues and Challenges Problems of dominant approach in municipal wastewater Management shifts in sanitation planning The Emergent alternative solutions Strategies to alternative sanitation planning	6
Unit 3. Technology options in wastewater management: Technology options in wastewater management Steps for sanitation planning Developing sanitation zones and waste watershed zones	6
Unit 4. Fecal Sludge Management: Current status of Fecal Sludge Management in Indian context: Problems, Issues and Challenges. Approaches and tools to fecal sludge management strategies. Steps to fecal sludge management.	6

Unit 5. Building Sanitation: Definitions of the terms related to building sanitation- Water pipe, Rain water pipe, Soil pipe, Waste pipe, Vent pipe, anti-siphonage pipe, etc. Traps, Sanitary Fittings- Water closets, flushing cistern, bath tubs, wash basin, water fountains, sinks and urinals. Systems of plumbing- one pipe, two pipes, single-stack and single-stack partially ventilated system.	6
Unit 6. Government Schemes & Policies for Sustainable Sanitation: National Urban Sanitation Policy National Water Policy National Rural & Urban Health Mission Central Rural Sanitation Programme National Policy on Faecal Sludge and Septage Management (FSSM)	6

Text Books:

1	Arno Rosemarin, Nelson Ekane, Ian Caldwell, Elisabeth Kvarnstrom, Jennifer McConville, Cecilia Ruben, Madeleine Fogde, Pathways for Sustainable SanitationAchieving the Millennium Development Goals.
2	Petra Bongartz, Naomi Vernon, John Fox, Sustainable Sanitation for All: Experiences, challenges and innovations.
3.	G. S. Birdie, J. S. Birdie, Water Supply and Sanitary Engineering, Dhanpat Rai Publishing Company.

Reference Books & websites :

1	Abeysuriya, K., Cynthia , M., & Willets, J. (2010). Urban Sanitation Through the Lens of Thomas Kuhn. In J. in John R. McNeill (Ed.), Environmental History: As if Nature Existed (pp. 65-84). New York: Oxford University Press
2	https://www.un.org/sustainabledevelopment/water-and-sanitation/
3	http://www.sulabhenvis.nic.in/Home.aspx

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SEM-V (Academic Year-2023-24)

Course Plan

Course Title : Sustainable Sanitation Lab	
Course Code : 201CEMIP338	**Semester : V**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 50	**ESE Marks : NA**

Course Description:

Sustainable sanitation laboratory deals with the determination and study of parameters of water and waste water which are important for hygienic conditions at residential, industrial and commercial establishments. It also covers the study of systems of sanitation, plumbing fixtures and materials.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability
PSO2	To develop abilities in graduates to suit to requirements of the varied industries.

Course Objectives:

1. To study the quality parameters of water and waste water as per the I.S. 10500 & Pollution control Board norms.
2. To understand systems of sanitation and plumbing lay out

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C338.1	Assess the quality parameters of water and wastewater as per the I.S. 10500 & Pollution control Board norms.
C338.2	Demonstrate the abilities to select a system of sanitation and prepare plumbing layout.

Prerequisite:	Engineering Chemistry, Environmental Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C338.1	2	2	2	-	-	2	2	2	-	-	-	-	1	1	3
C338.2	2	2	2	-	-	2	2	2	-	-	-	-	1	1	3

LIST OF EXPERIMENTS:

Experiment No	Title of the experiment	Type	Hours
A.	**Determination of parameters of Water and Wastewater (Minimum 6)**		
1	pH	O	2
2	Acidity	O	2
3	Alkalinity	O	2
4	Solids (Total Suspended Solids, Total Dissolved Solids, Total Solids)	O	2
5	Residual Chlorine	O	2
6	Optimum dose of alum by jar test.	O	2
7	Turbidity	O	2
8	Dissolved Oxygen (DO)	O	2
9	Biochemical Oxygen Demand (BOD)	O	2
10	Chemical Oxygen Demand (COD)	O	2
11	Oil & Grease	O	2
B.	**Study of systems of sanitation/plumbing**	S	6
C.	**Demonstration of plumbing fixtures/Site visit to treatment plant**	S	6

Text Books:

1	G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering"- Dhanpat Rai Publisher.
2	B. C. Punmia, Ashok Kumar, A. K. Jain, "Water Supply Engineering" - Laxmi Publisher.
3	B. C. Punmia, Ashok Kumar, A. K. Jain, "Waste Water Engineering" - Laxmi Publisher.

Reference Books:

1	Metcalf & Eddy, "Waste Water Engineering Treatment & Disposal" –Tata McGraw Hill

Reference Manuals:

1	"Manual on Water Supply and Treatment"- Government of India Publication, 1993
2	"Manual on Sewerage & Sewage Treatment" Ministry of Urban Development Govt. of India Msy-2000.

Codes:

1	**IS:10500**

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Course Plan

Course Title: Environmental Management System	
Course Code: 201CEMIL339	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
Environmental Management Systems course deals with the implementation of effective environmental management system in organizations managing the various environmental aspects. The course emphasizes on the requirements prescribed in ISO 14001:2015. ISO 14001:2015 standard is an International Standard followed worldwide for the environmental management in organizations.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability
PSO2	To develop abilities in graduates to suit to the requirements of the varied industry

Course Objectives:

1 To study scope of ISO 14001:2015,Environmental Management System standard
2 To know requirements of ISO 14001: 2015 Environmental Management System standard
3 To understand the requirements & procedures for EMS audit.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C339.1	Discuss scope and benefits of ISO standards and aims of EMS.
C339.2	Illustrate the process and requirements of EMS audit as per ISO 19011 standard.
C339.3	Explain the auditory and managerial aspects

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Prerequisite:	Engineering Management

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C339.1	2	2	-	-	-	2	2	1	-	-	-	-	1	1	2
C339.2	2	2	-	-	-	2	2	1	-	-	-	-	1	1	2
C339.3	2	2	-	-	-	1	1	1	-	-	2		1	1	2

Content	**Hours**
Unit 1: Introduction to ISO, ISO History, Need of International Standards, Standard Development Process, Benefits of ISO Standards, Environmental Management System (EMS) and Sustainable Development, Concept of Life Cycle Analysis, Aim of EMS, Deming's PDCA Cycle, Scope of ISO 14001:2015 Standard, Terms and Definitions	6
Unit 2: Leadership and Commitment, Environmental Policy, Organizational Roles, Responsibilities and Authorities, Planning, Actions to address Risks and Opportunities, General Requirements, Environmental Aspects – Impacts Analysis, Compliance Obligations, Environmental Objectives,Planning Actions to achieve Environmental Objectives.	6
Unit 3: Support – Resources, Competence, Awareness, Communication – Internal and External Communication, Documented Information – Creating and Updating, Control of Documented Information, Operation – Operational Planning and Control, Emergency Preparedness and Response.	6

Unit 4: Performance Evaluation – Monitoring, Measurement, Analysis and Evaluation, Evaluation of Compliance, Checklists, Calibration and Records, Standard Operating Procedures, Work Instructions.	6
Unit 5: Internal Audit, Internal Audit Programme, Terms and Definitions, Principles of Auditing, Managing Audit Programme, Audit Activities, Audit Checklists and Reports, Competence and Evaluation of Auditors.	6
Unit 6: Management Review - Need, Role of Management Representative, Role of Top Management, Improvement, Nonconformity and Corrective Action, Continual Improvement.	6

Text Books & Reference Books:

1	International Standard ISO 14001:2015 – Environmental Management Systems – Requirements with Guidance for Use
2	International Standard ISO 14004:2016 - Environmental Management Systems - General guidelines on implementation
3	International Standard ISO 19011 – Guidelines for Environmental Management System auditing.
4	Environmental Management Systems Auditors Course Manual by Confederation of Indian Industries

Course Plan

Course Title: Waste Management	
Course Code: 201CEMIL340	**Semester: VI**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
For sustainable and hygienic environment, management of waste is very important. Variety of wastes is produced in industry. The composition and characteristics of waste vary from city to city as well as from industry to industry. Broadly the wastes can be categorised in to municipal solid waste, industrial waste, hazardous waste, e waste, biomedical waste as well as plastic waste. The course deals with elements of waste management system, characterization, waste to energy concepts, waste management policies and legislation.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability
PSO2	To develop abilities in graduates to suit to the requirements of the varied industry

Course Objectives:

1 To understand importance of waste management for better environment.
2 To study characteristics of waste, elements of waste management system,
3 To know Waste Management Policies and its legislation

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C340.1	Discuss characteristics of wastes and waste management system
C340.2	Illustrate treatment technology and energy conversion options for wastes
C340.3	Explain technical and legal aspects related to waste management

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Prerequisite:	Engineering Chemistry, Environmental Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C340.1	2	2	1	-	-	2	3	-	-	-	-	-	1	1	2
C340.2	2	2	2	1	1	2	3	-	-	-	-	-	1	1	3
C340.3	2	2	-	-	-	2	3	2	-	-	-	-	1	1	2

Content	Hours
Unit 1: Introduction to wastes Definition of waste and their classification, Important quality parameters of different types of wastes, Wastes suitable for energy production, Solid wastes and its classification, Elements of solid waste management, Waste water and their classification	6
Unit 2: Characterization and analysis of wastes Types of wastes generated in industry and its effects on environment, Characterization of solid wastes- Physical, Chemical, Energy content, Heating value Analysis of wastes: Proximate analysis, Ultimate analysis, Fusing point of ash, Leaching properties, Characterization of waste water- Physical, Chemical.	6
Unit 3: **Elements of waste management system** Waste generation, storage, collection, separation & processing, transfer and transport, Integrated waste management using waste hierarchy, Principles of the waste hierarchy, waste prevention or reduction, reuse, recycling/composting, energy recovery and disposal	6
Unit 4: Treatment technologies for solid waste a) Composting: Concept of composting, Principles of composting process. Methods – i) Manual Composting methods, ii) Mechanical Composting, iii) Vermicomposting. b) Land filling: Concept, Methods- Area method, Trench method and Ramp method. c) Incineration of waste: Types of incinerators, Products of incineration process, Pyrolysis of waste.	6

Unit 5: Waste to Energy Need of energy production from wastes, Routes of energy production from waste, **Energy production from organic waste**- Anaerobic digestion and biogas production, types of anaerobic digestion process, operation of anaerobic digester. **Energy production from waste plastic-** Classification of plastics, plastic waste generation, options for proper management, code for recyclable Plastics and suitability for energy production, recycling through pyrolysis, converting waste plastic to fuels. **Refuse Derived fuels (RDF)-** Fundamentals of densification, types of briquetting, Briquettingprocess and their comparison, Briquette characteristics, application of briquettes.	6
Unit 6: Waste Management Policies and its legislation Need for appropriate and updated legislation, Public concern and education, Rules and regulations for Waste Management by Ministry of Environment & Forest, Highlights of: •E-Waste Management Rules, 2016 •Plastic Waste Management Rules, 2016 •Construction and demolition Waste Management Rules, 2016 •Hazardous and other wastes Management Rules, 2016 •Biomedical Waste Management Rules, 2016 •The water (prevention and control of pollution) Act, 1974, Role of Central Pollution Control Board and Maharashtra Pollution Control Board in management of waste from various sources.	6

Text Books:

1	Bhide, A. D. and Sundaresan, B. B. (2001). Solid Waste Management – Collection, Processing and disposal. Mudrashilpa offset printers, Nagpur.
2	T. V. Ramachandra, Municipal Solid Waste Management, Published by Common Wealth of Learning, Canada; Centre for Ecological Sciences, I ISc, Karnataka Environment Research Foundation
3	Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993
4	Peavy, H. S., Rowe, D. R. and Tchobanoglous, G. (1985) Environmental Engineering, McGraw-HillBook Company, Singapore

Reference Books:

1	CPHEEO, Manual on Municipal Solid Waste Management, Govt. of India,2014
2	George, T. and Frank, K. Handbook of Solid Waste Management: McGrawHills.

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Course Plan

Course Title: Waste Management Lab	
Course Code: 201CEMIP341	**Semester: VI**
Teaching Scheme: L-T-P : 0-0-2	**Credits: 1**
Evaluation Scheme: ISE Marks : 25	**TW Marks: NA**

Course Description:
Variety of wastes is produced in the use and process of raw material to get end product. The waste varies in its composition and characteristics. Waste management is effective when planned on the 3 R principles. The waste needs to be looked as resource and recovery of materials and energy is possible based on characteristics of the wastes. This laboratory course deals with determination of various characteristics and interpretation of suitable method of disposal and potential of waste in energy recovery.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability
PSO2	To develop abilities in graduates to suit to the requirements of the varied industry

Course Objectives:

1 To understand the characteristics of waste important for waste management.
2 To study standard laboratory procedure for determination of waste characteristics
3 To identify potential of waste for energy recovery.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C341.1	Interpret characteristics amenable for effective waste management.
C341.2	Carry out laboratory experiments for determination of parameters of waste.
C341.3	Estimate potential of waste to convert into energy.

Prerequisite:	Engineering Chemistry, Environmental Studies

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Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C341.1	2	2	1	-	-	2	2	2	-	-	-	-	1	1	2
C341.2	2	2	2	-	-	2	2	2	-	-	-	-	1	1	3
C341.3	2	2	2	-	-	2	2	2	-	-	-	-	1	1	2

List of Experiments

Experiment No	Title of the experiment	Type	Hours
1	Study of Composition of waste	S	2
2	Determination of bulk density of waste	O	2
3	Determination of moisture content.	O	2
4	Determination of pH	O	2
5	Determination of calorific value	O	2
6	Determination of proximate analysis	O	2
7	Determination of ultimate analysis	O	2
8	Visits to solid waste disposal sites / plants & preparation of report	S	10

Text Books:

1	Bhide, A. D. and Sundaresan, B. B. (2001). Solid Waste Management – Collection, Processing and disposal. Mudrashilpa offset printers, Nagpur.
2	T. V. Ramachandra, Municipal Solid Waste Management, Published by Common Wealth of Learning, Canada; Centre for Ecological Sciences, I ISc, Karnataka Environment Research Foundation
3	Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993

Reference Books:

1	CPHEEO, Manual on Municipal Solid Waste Management, Govt. of India,2014
2	George, T. and Frank, K. Handbook of Solid Waste Management: McGrawHills.

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Course Plan

Course Title: Occupational Health & Safety	
Course Code: 201CEMIL446	**Semester: VII**
Teaching Scheme: L-T-P : 3-0-0	**Credits: 3**
Evaluation Scheme: ISE + MSE Marks : 20 + 30	**ESE Marks: 50**

Course Description:
The course explains and deals with the concept and need of safety in industries, Importance of risk assessment & management, Safety Management Systems, Accidents in Industries, Occupational health and industrial hygiene, Various preventive methods for occupational Health Problems, Introduction to legal aspects of safety etc.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability.
PSO2	To develop abilities in graduates to suit to requirements of the varied industries.

Course Objectives:

1. To study the concept and need of safety in industries.
2. To understand accident prevention techniques, industrial hygiene & occupational disease.
3. To understand various safety management systems, OSHAS 18001 management system

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C446.1	Interpret need of safety as well as unsafe acts and conditions in industries.
C446.2	Illustrate risk assessment and accident theories, prevention techniques
C446.3	Explain significance of occupation health, safety and industrial hygiene

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Prerequisite:	Environmental Engineering, Engineering Management

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO 1**	**PSO 2**	**BTL**
C446.1	2	2	-	1	-	3	2	2	-	-	-	-	1	1	2
C446.2	2	2	1	1	1	3	2	-	-	-	-	-	1	1	3
C446.3	2	2	-	-	-	3	2	-	-	-	-	-	1	1	2

Content	**Hours**
Unit 1: Concept and Need of Safety in Industries, Various Hazards in Industries, Safety department and its role. Evolution of modern safety concept, Purpose, Overview of Audit Systems, Scope and Background, Intended Audience, Period of Applicability, Identification of unsafe acts of workers and unsafe conditions.	6
Unit 2: Introduction to Risk Assessment & Management, Safety Management Systems, Concept of an accident, Definition and Various Causes, Accidents in industries& its Cost, Accident Prevention Techniques, Reportable and Non Reportable Accidents, Principles of Accident Prevention, Theories of Accidents, Accident Investigation and Reporting, Domino sequence, Supervisory role, Role of safety committee.	6
Unit 3: Safety in Industries-, Safe Design and Layout of Plants and Equipment, Machine Guarding, Safe Storage & Handling of Hazardous chemicals, MSDS, Good House Keeping. Job Safety Analysis, Safety Checklists, Safety Inspections, Confined Space Entry, Work Permit System, Lock Out- Tag Out System	6

Unit 4: Occupational Health and Industrial Hygiene - Objectives, Need, Chronic and Acute Effects, Various Limits of Exposure-, LD50, LC50, TLV(TWA), STEL, OSHA Limits, Effects of Various Physical, Chemical and Biological Hazards in Industries on Human Health. Occupational Diseases in Various Industries and Causative Agent, Various Personal and Work Place Monitoring Systems	6
Unit 5: Preventive Methods for Occupational Health Problems, Protection of Workers against Harmful Agents and Conditions, LEVs, PPEs, Ergonomics, Health Monitoring and Medicine	6
Unit 6: Legal aspects of Safety, Safety in Engineering industries, Chemical industries, Construction industries, On site & Off site Emergency Management Plan, OSHAS 18001 management system and Auditing, Product Safety.	6

Text Books:

1	David L. Goetsch, Occupational Safety and health by, Prentice Hall, Ohio
2	Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3	Gayle Woodside,Hazardous Material and Hazardous Waste management, John Wiley &sons Inc.
4	K. Park,Textbook of Preventive and Social Medicine, BanarsidasBhanot Publishers.
5	Raja Sekhar Mamillapalli, Visweswara Rao, Occupational Health and Hygiene in Industries, Pharma Med Press / BSP Book
6	K.T. Kulkarni, Introduction to Industrial Safety, Pune Vidyarthi Griha

Text Books & Reference Books:

1	Lee Harrison, Environmental Health and Safety Auditing Handbook, Mac Graw Hill Inc.
2	Health Hazards of the Human Environment - WHO, Geneva

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Course Plan

Course Title : Occupational Health & Safety Lab	
Course Code : 201CEMIP447	**Semester : VII**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE Marks : NA**

Course Description:

The course deals with the practical aspects of occupational health and safety in various Industries, understanding of risk and types of accidents as well as management of safety in Industries. It also deals with the study of various preventive methods for occupational health problems and preventive measures.

Program Specific Outcomes (PSOs):

PSO1	To impart interdisciplinary knowledge and skills for enhancing employability.
PSO2	To develop abilities in graduates to suit to requirements of the varied industries.

Course Objectives:

1	To study practical aspects of occupational health and safety
2	To understand risk, types of accidents, management of safety in Industries and various preventive methods.

Course Outcomes (COs):

COs	**At the end of successful completion of course, the students will be able to…**
C447.1	Describe practical aspects of occupational health and safety
C447.2	Interpret causes of risks and accidents in industries
C447.3	Explain occupational health problems and preventive measures.

Prerequisite:	Engineering Chemistry, Environmental Studies

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
C447.1	2	2	1	-	-	2	2	2	-	-	-	-	1	1	2
C447.2	2	2	1	-	-	2	2	2	-	-	-	-	2	2	3
C447.3	2	2	1	-	-	2	2	2	-	-	-	-	2	2	2

LIST OF EXPERIMENTS

Activity No.	Activity/Task to be performed	Type	Hours
1	Study of need of Safety, Safety department and its role, Various Hazards in Industries.	S	2
2	Identification of unsafe acts of workers and unsafe conditions	S	2
3	Risk assessment, management & safety management systems	S	2
4	Study of theories of accidents, Principles of accident prevention & techniques, Accident Investigation and Reporting,	S	2
5	Safety in Industries, Plant layout & Machine Guarding	S	2
6	Safe Storage & Handling of Hazardous chemicals, MSDS, Principles of Good House Keeping.	S	2
7	Job Safety Analysis, Safety Checklists, Safety Inspections	S	2
8	Study of Confined Space Entry, Work Permit System, Lock Out- Tag Out System	S	2
9	Listing and study of Various Physical, Chemical and Biological Hazards in Industries.	S	2
10	Study of various Personal and Work Place Monitoring Systems	S	2
11	Study of preventive methods for Occupational Health Problems, Personal protective Equipment	S	2
12	Study of legal aspects of occupational health and safety.	S	2

Text Books:

1	David L. Goetsch, Occupational Safety and health by, Prentice Hall, Ohio
2	Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3	Gayle Woodside, Hazardous Material and Hazardous Waste management, John Wiley &sons Inc.
4	K. Park,Textbook of Preventive and Social Medicine, Banarsidas Bhanot Publishers.
5	Raja Sekhar Mamillapalli, Visweswara Rao, Occupational Health and Hygiene in Industries, Pharma Med Press / BSP Book
6	K.T. Kulkarni, Introduction to Industrial Safety, Pune Vidyarthi Griha

Reference Books:

1	Lee Harrison, Environmental Health and Safety Auditing Handbook, Mac Graw Hill Inc.
2	Health Hazards of the Human Environment - WHO, Geneva