Department of Civil Engineering

Minutes of 4th BoS Meeting

Venue

Seminar Hall, Department of Civil Engineering

Sri Manakula Vinayagar Engineering College

Madagadipet, Puducherry – 605 107

Date & Time

22.02.2022 at 10.00 am

Department of Civil Engineering

23.02.2022

Minutes of 4th Board of Studies Meeting (UG)

The fourth Board of Studies meeting of Department of Civil Engineering was held on 22nd February 2022 at 10:00 a.m in the Seminar hall, Sri Manakula Vinayagar Engineering College with Head of the Department in the Chair.

The following members were present for the BoS meeting,

Sl.No	Name of the Member with Designation and official Address	Members as per UGC norms
1	Dr. S.Sundararaman Professor and Head Department of Civil Engineering, SMVEC, Madagadipet – 605107	Chairman
2	Dr R Senthil Professor& HOD Civil, Division of Structural Engineering, Department of Civil Engineering, College of Engg., Guindy, Anna University, Chennai	Subject Expert (Pondicherry University Nominee)
3	Dr.R.Malathy Professor and Dean (Research) Dept. of Civil Engineering, Sona College of Technology, Salem	Subject Expert (Academic Council Nominee)
4	Dr A Rose Enid Teresa Professor and Head Rajalakshmi Engineering College, Chennai	Subject Expert (Academic Council Nominee)
5	Dr.B.Parthiban Assistant Manager – Structural Designer, Fujita Engineering India Pvt. Ltd., Chennai	Representative from Industry
6	Shri. G. Abdul Hakkim Design Engineer Zamil Steel Buildings (P) Ltd, Chennai	Alumni Member

7	Dr. S. Jayakumar Controller of Examinations Professor in Civil Engineering, SMVEC, Madagadipet – 605107	Internal Member
8	Ms.G . Yamuna Assistant Professor, Department of Civil Engineering, SMVEC, Madagadipet – 605107	Internal Member
9	Mr. K. Srinivasan Assistant Professor, Department of Civil Engineering, SMVEC, Madagadipet – 605107	Internal Member
10	Mrs. D.Sathiyasree Assistant Professor, Department of Civil Engineering, SMVEC, Madagadipet – 605107	Internal Member
11	Mrs. D.Jaichithra Associate Professor, Department of English, SMVEC, Madagadipet – 605107	Internal Member
12	Dr.T Sivaranjini Assistant Professor, Department of Physics, SMVEC, Madagadipet – 605107	Internal Member
13	Dr.S.Deepa Professor, Department of Chemistry, SMVEC, Madagadipet – 605107	Internal Member
14	Mr.M.Devanathan Assistant Professor, Department of Mathematics, SMVEC, Madagadipet – 605107	Internal Member

Agenda of the Meeting

1. Review of 3rd BoS Meeting
2. To discuss and approve the B.Tech. Degree Professional Elective Courses for VIII semester under Pondicherry University Regulation 2013 for the students admitted in the Academic Year 2018 – 19 (Final Year) and VI semester under Regulation 2019 for the students admitted in the Academic Year 2019-20 (Third Year)
3. To discuss and approve the B.Tech. Degree Open Elective Course for the VI semester under Regulation 2019 for the students admitted in the Academic Year 2019-20 (Third Year)
4. To discuss and approve the B.Tech. Degree Certification Course for the VI semester under Regulation 2019 for the students admitted in the Academic Year 2019-20 (Third Year) & III semester under Regulation 2020 for the students admitted in the Academic Year 2020-21 (Second Year)
5. To discuss and approve the B.Tech. Degree, Skill Development Courses for the VI semester under Regulation 2019 for the students admitted in the Academic Year 2019-20 (Third Year)
6. To discuss and approve the modifications/suggestions to be incorporated in the selective subjects of IV Semester under Regulation 2020.
7. To discuss and approve the syllabi for V & VI Semester under Regulation 2020 for B.Tech. Civil Engineering for the students admitted in the year 2020-21
8. To discuss and approve the panel of examiners
9. To discuss about the Ph.D programme admission.
10. Any other item with the permission of chair

Minutes of the Meeting

Dr. S. Sundararaman, Chairman, BoS opened the meeting by welcoming and introducing the external members, to the internal members and thanked them for accepting to become the member of the Board of Studies and the meeting thereafter deliberated on agenda items that had been approved by the Chairman.

BoS / 2021 / CIVIL / UG / 4.1

Chairman BoS, appraised the minutes of 3rd BoS, its implementation and then it is confirmed with the approval for the incorporation of minor revisions needed as mentioned below.

S.No	Regulation	Semester	Subject Name with code	Unit	Particulars
1	2019	VII	U19CEE75 / Advanced Design of RCC Structures	II	As per the suggestion by the members the method of design (Limit State or Working stress) and Reinforcement detailing is included for all structural elements design in Professional Elective Course "U19CEE75 / Advanced Design of RCC Structures" in the Semester VII.
2	2019	VIII	U19CET81 / Construction Management	III	In VIII Semester, for the course "U19CET81/ Construction Management", incorporation of MS - Excel to understand concepts of Project Planning & Scheduling is explicitly mentioned.
3	2019	VIII	U19CEE84/ Design of Industrial Structures	III, IV & V	In VIII Semester, the Professional Elective Course "U19CEE84 /Design of Industrial Structures", the topic of Unit III & IV is being rephrased as 'Design of Industrial Steel Structures & Design of Industrial RCC Structures' respectively. Also in Unit V, Introduction to Design of Mezzanine building, prefabrication & its erection concepts is introduced as suggested by the members
4	2019	VIII	U19CEE89/ Pre- Stressed Concrete Structures	II	In the Professional Elective Course "U19CEE89/ Pre-Stressed Concrete Structures" in VIII Semester, topic of Unit II

						is changed to 'Design of Shear & Flexural members' instead of 'Shear & Flexure Design'.

The above corrections are approved by BoS members and the details are given in Annexure I.

BoS / 2021 / CIVIL / UG / 4.2	Discussed and approved the B.Tech. Degree Professional Elective Courses "CEE10 Site Investigation Methods and Practices & CEE21 Bridge Engineering" has been chosen for VIII semester under Pondicherry University Regulation 2013 for the students admitted in the Academic Year 2018 – 19 (Final Year) and "U19CEE64 Municipal Solid Waste Management" has been chosen for VI semester under Regulation 2019 for the students admitted in the Academic Year 2019-20 (Third Year) **The list of professional elective courses and syllabi for the chosen course has been attached in Annexure II.**
BoS / 2021 / CIVIL / UG / 4.3	Discussed and approved the B.Tech. Degree Open Elective Course "U19EEO63 / Conventional and Non – Conventional Energy Sources" has been chosen for VI semester under R2019 for the B.Tech – Civil students admitted in the Academic Year 2019 – 20 (Third Year) **The list of open elective courses and syllabi for the chosen course U19EEO63 / Conventional and Non – Conventional Energy Sources has been attached in Annexure III.**
BoS / 2021 / CIVIL / UG / 4.4	Discussed and approved the B.Tech. Degree Certification Course "U19CEC65/ Internet of Things" has been chosen for VI semester under Regulation 2019 for the B.Tech - Civil students admitted in the Academic Year 2019-20 (Third Year) and for III Semester, "U20CEC387/Total Station" has been chosen under Regulation 2020 for the students admitted in the Academic Year 2020-21 (Second Year) **The list of Certification courses, chosen course has been highlighted and attached in Annexure IV.**
BoS / 2021 / CIVIL / UG /	Discussed and approved the B.Tech. Degree "Skill Development Courses 7: U19CES61/ Foreign Language/ IELTS – II/ Career and Professional Skill Development Programme -II, Skill Development Courses 8: U19CES62/ Technical Seminar and Skill Development Courses 9: U19CES63/ NPTEL/MOOC - I" have been chosen for VI semester under R2019 for the B.Tech – Civil students admitted in the

4.5

Academic Year 2019 – 20 (Third Year)

The list of Skill Development courses, chosen courses have been highlighted and attached in Annexure V.

BoS / 2021 / CIVIL / UG / 4.6

Discussed and approved the modifications/suggestions incorporated in the selective subjects of IV Semester under Regulation 2020.

(i) Course: Design Of RC Elements (U20CET409) – The design of Shear, Torsion, Bond and Anchorage in Unit III is removed from the syllabus. Instead of combining the design of slab and column in Unit V, the limit state design of slab is introduced in Unit III and Limit state design of column is introduced in Unit IV.

(ii) Course - Geotechnical Engineering-II (U20CET410) the topic "spacing and depth of bore holes" in Unit I is rearranged to have continuity in study of the concepts.

(iii) Course - Alternative Building Materials And Technologies (U19CEE45)

(a) The title of Unit –II is changed from Components of Structural Masonry to "Alternative Building Materials" and subsequently the contents of the unit are also changed.

(b) In Unit -III Properties of Structural Masonry Mortars is completely removed as it is being repeated syllabus to the students and instead of that "Sustainable Materials" is included.

(c) In Unit – IV, 3D Printing Technology is included and Alternate Building Technologies: Use of arches in foundation, is deleted as it is ambiguous in this course of study.

(d) In Unit –V the title Modern Materials & Planning Control is changed to "Machines and Planning Control" as this would be the exact title for the syllabus present in that unit.

The corrected and updated syllabi are approved by BoS members and the details are given in Annexure VI.

BoS / 2021 / CIVIL / UG / 4.7

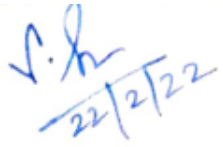
With respect to Regulation R-2020, the curriculum for 1 to 8 semesters and syllabi for 5th and 6th semesters, for B.Tech – Civil Engineering were discussed and the following comments are given by BoS members.

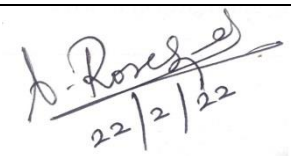
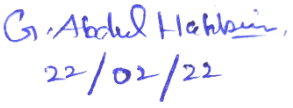
S.No	Regulation	Semester	Subject Name with code	Unit	Particulars
1	2020	V	U20CEP511/ Estimation Costing and Valuation Engineering	-	Members given the below suggestions for, the course "U20CEP511/ Estimation Costing and Valuation Engineering" I. In Experiment 2, instead of Estimation of Residential

						Building – I it can be mentioned as estimation of substructure. II. In Experiment 3, Estimation of Residential Building - II can be changed to estimation of super structure. III. To Include the estimate of underground water tank	
	2	2020	V	U20CEP509/ Sensors Applications in Civil Engineering Laboratory	-	Members suggested that in the course "U20CEP509/ Sensors Applications in Civil Engineering Laboratory", incorporation of wireless technology will be helpful to the students for understanding the recent advancement & it can be a study experiment rather than separate practical exercise.	
	3	2020	VI	U20CET614 / Design of Steel Structures	V	In, the Course "U20CET614 / Design of Steel Structures", the members suggested to change the syllabus of Unit V to Industrial Structure and Trusses. This is because the Unit I and Unit V deals with joints an connections and it is overlapping.	
	4	2020	V	U20CEE510/ Advanced Design of RCC Structures	V	Members suggested that the Professional Elective Course "U20CEE510/ Advanced Design of RCC Structures" Unit IV and V deals with bridges and Prestressed concrete structures which are a separate subjects and cannot be kept as separate units in this subject. Instead they	

	<table><tr><td></td><td></td><td></td><td></td><td></td><td>asked to think on the topics such as Flat slab, shear wall design and corbel grid floor system.</td></tr></table> **The above corrections are incorporated in V & VI Semester and the syllabi are approved by BoS members. (Given in Annexure VII)**
BoS / 2021 / CIVIL / UG / 4.8	The revised list of question paper setters and Evaluators (given in **Annexure VIII**) was presented and recommended by the BoS members to the Academic Council.
BoS / 2021 / CIVIL / UG / 4.9	Discussed and approved the Ph.D programme admission process. The board chairman appraised on the Ph.D entrance examination and the short listed candidates in written examination.
BoS / 2021 / CIVIL / UG / 4.10	The Board of Studies Members discussed on the conduction of End Semester Examination in January 2022. All the members appreciated the efforts taken by SMVEC to conduct offline mode of examination.

The meeting was concluded at 12:00 pm with vote of thanks by **Dr. S. Sundararaman**, Head of Department, and Department of Civil Engineering.

Sl.No	Name of the Member with Designation and official Address	Members as per UGC norms	Signature
1	Dr. S.Sundararaman Professor and Head Department of Civil Engineering, SMVEC, Madagadipet - 605107	Chairman	

2	Dr R Senthil Professor& HOD Civil, Division of Structural Engineering, Department of Civil Engineering, College of Engg., Guindy, Anna University, Chennai	Subject Expert (Pondicherry University Nominee)	
3	Dr.R.Malathy Professor and Dean (Research) Dept. of Civil Engineering, Sona College of Technology, Salem	Subject Expert (Academic Council Nominee)	
4	Dr A Rose Enid Teresa Professor and Head Rajalakshmi Engineering College, Chennai	Subject Expert (Academic Council Nominee)	
5	Dr.B.Parthiban Assistant Manager – Structural Designer, Fujita Engineering India Pvt. Ltd., Chennai	Representative from Industry	
6	Shri. G. Abdul Hakkim Design Engineer Zamil Steel (P) Ltd, Chennai	Alumni Member	
7	Dr. S. Jayakumar Controller of Examinations Professor in Civil Engineering, SMVEC, Madagadipet - 605107	Internal Member	
8	Ms. G. Yamuna Assistant Professor, Department of Civil Engineering, SMVEC, Madagadipet - 605107	Internal Member	
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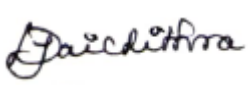
10	Mrs. D.Sathiyasree Assistant Professor, Department of Civil Engineering, SMVEC, Madagadipet - 605107	Internal Member	
11	Mrs. D.Jaichithra Associate Professor, Department of English, SMVEC, Madagadipet - 605107	Internal Member	

12	Dr.T Sivaranjini Assistant Professor, Department of Physics, SMVEC, Madagadipet - 605107	Internal Member	
13	Dr.S.Deepa Professor, Department of Chemistry, SMVEC, Madagadipet - 605107	Internal Member	
14	Mr.M.Devanathan Assistant Professor, Department of Mathematics, SMVEC, Madagadipet - 605107	Internal Member	

Dr.S.Sundararaman

HOD/Civil

Chairman –BoS (Civil)

Annexure I

U19CEE75 ADVANCED DESIGN OF RCC STRUCTURES

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the unified analysis of reinforced concrete structures
- Gain knowledge about the design of special reinforced concrete elements
- Understand the concept on yield line theory of slabs and to design flat slabs.
- Understand the design RCC slab culvert and bridge
- Analyze the prestressed concrete sections and design of beams.

Course Outcomes

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

CO1 - Analyze reinforced concrete structures **(K4)**
CO2 – Design special reinforced concrete elements **(K4)**
CO3 – Create an awareness on yield line theory of slabs and to design flat slabs. **(K2)**
CO4 - Design RCC slab culvert and bridge **(K5)**
CO5 - Analyze prestressed concrete sections and design of beams. **(K5)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION TO ANALYSIS OF REINFORCED CONCRETE STRUCTURES (9 Hrs)

Introduction to strut-tie model, equilibrium truss model, Bernoulli compatibility truss model, Mohr compatibility truss model, Introduction to non linear behavior of structures.

UNIT II DESIGN OF SPECIAL REINFORCED CONCRETE ELEMENTS (WSM) (9 Hrs)

Design of Deep Beams (using C programming), Checking for Local Failures, Detailing of Deep Beams, Design of shear walls, Design of Corbels, Design of Nibs, Design of pile cap. Reinforcement detailing for all design.

UNIT III FLAT SLABS AND YIELD LINE THEORY (9 Hrs)

Concept and Advantages of Flat Slab - Design of flat slab using Direct Design method as per BIS code, use of design aids (SP16) - Introduction to yield line theory - Design of square and rectangular slabs for collapse loads using Yield line theory of slab - Design of circular and triangular slabs for collapse loads using Yield line theory of slabs.

UNIT IV DESIGN OF BRIDGES (9 Hrs)

Types of bridges and culverts - Simply supported girder bridges, Balanced cantilever and their behavior - Introduction to IRC Loading, impact loading - Codal Provisions for design - Design of slab culvert for Class AA, 70R, Class A.

UNIT V PRESTRESSED CONCRETE STRUCTURES (9 Hrs)

Basic concepts, Principle of prestressing methods and materials required - Stress and Strength concept and Load balancing concept - Analysis of sections subjected to flexure, Losses of prestress using Simple cable profile - Introduction to design of beams.

Text Books

1. Varghese.P.C, “Advanced Reinforced Concrete Design”, Pretince-Hall India, 2005..
2. Unnikrishna Pillai.S and Devadas Menon, “Reinforced Concrete Design,” Tata MacGraw Hill Publishing Company Limited, Second Edition, New Delhi, 2010
3. Krishnaraju .N, Pranesh .R.N, “Design of Reinforced concrete IS: 456-2000”, New age International Publication (P) Ltd., New Delhi, 2003.

Reference Books

1. Krishnaraju .N, “Prestressed Concrete”, Tata McGraw-Hill Education, 2008, New Delhi.
2. Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publications, New Delhi, 2007..
3. Johnson Victor.D, “Essentials Of Bridge Engineering”, 6/E, Oxford & IBH Publishing Company Pvt. Ltd.,Fourth edition, 2007.
4. IS : 456-2000 - Plain and Reinforced Concrete - Code of Practice
5. SP – 16 - Design Aids for Reinforced Concrete
6. IS : 1343:2012 - Prestressed concrete-code of practice
7. IRC 6-2010 - Standard Specifications and Code of Practice for Road Bridges Section : II Loads And Stresses

Web References

1. https://nptel.ac.in/courses/105/105/105105105/
2. https://nptel.ac.in/courses/105/105/105105104/
3. https://nptel.ac.in/courses/105/106/105106176/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19CET81 CONSTRUCTION MANAGEMENT

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the importance and basic functions of construction management
- Gain knowledge about various organization and planning system of construction
- Understand the scheduling and network analysis of project
- Impart the basic concepts of Contract and Tender
- Understand the M.I.S and labor, safety and related regulation

Course Outcomes

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

CO1 - Understand construction management importance **(K2)**
CO2 –Understand the various organization in the construction **(K2)**
CO3 –Become aware on scheduling and analysis **(K5)**
CO4 - Become aware on Contract and Tender **(K2)**
CO5 - Understand the M.I.S and labor, safety and related regulation **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I CONSTRUCTION PROJECT MANAGEMENT (9 Hrs)

Construction Project- Project Categories, Management objectives, functions- Project Development Process- Project Life Cycle- Project Team-Role of Project Manager-Management failure.

UNIT II ORGANIZATION AND PLANNING (9 Hrs)

Definition, Levels of Organization, Principles of Organization, process of organizing, Span of Control, Authority, Responsibility and Delegation –Forms of Organizations-merits and demerits of each.

UNIT III SCHEDULING AND NETWORK ANALYSIS (9 Hrs)

Scheduling: Definition, objectives, Importance of Planning, Scheduling and Controlling of Projects. Network Techniques in Construction Management- PERT, CPM, Time& cost optimization(MS Excel)

UNIT IV CONTRACTS (9 Hrs)

Contract and Contract document, Specification, Condition of Contract, Tender and Tender documents- Arbitration- M. Book-Muster roll.

UNIT V M.I.S APPLICATIONS AND CONSTRUCTION (9 Hrs)

Labour Legislations-Safety in Construction: Objectives, Steps in Safety Programme, Safety Costs, Safety Codes, Occupational Safety and Hazards, Accidents- Causes of Accident

Text Books

1. Clifford J Schexnayder, Kraig Knutson, Construction Management Fundamentals, Tata McGraw-Hill, 2011.
2. Ps Gahlot, Bm Dhir, Construction Planning & Management, New Age International (P) Ltd., 2014
3. Srinath,L.S., “PERT and CPM Principles and Applications “, Affiliated East West Press, 2015

Reference Books

1. Ravindra.S.V., Krishnamurthy.K.G., Construction & Project Management, CBS Publishers, 2010.
2. Steven McCabe, “Quality Improvement Techniques in Construction.” Longman, 2016
3. Moder.J., C.Phillips and Davis, “Project Management with CPM”, PERT and Precedence Diagramming, Van Nostrand Reinhold Co., Third Edition, 1995.
4. Shrivastava. U.K, Construction Planning & Management, Galgotia Publications Pvt. Ltd.,2014.
5. Ravindra.S.V., Krishnamurthy.K.G., Construction & Project Management, CBS Publishers, 2010.

Web References

1. https://nptel.ac.in/courses/105/104/105104161/
2. https://nptel.ac.in/courses/105/103/105103093/
3. https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ce20/ /

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CO3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19CEE84 DESIGN OF INDUSTRIAL STRUCTURES

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand about the planning and layout of buildings and its components.
- Have information about the functional requirements of industries.
- Perceive the design concepts of steel storage structures.
- Be acquainted with the design concepts of concrete storage structures.
- Familiarize the general principles of prefabrication and the functional requirements for precast concrete units

Course Outcomes

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

CO1 - Describe the general requirements for industries like cement, chemical and steel plants. **(K2)**
CO2 - Relate the functional requirements such as lighting, ventilation and fire safety of industries **(K2)**
CO3 - Design the steel storage structures like bunkers and silos **(K5)**
CO4 - Design the concrete storage structures like bunkers and silos **(K5)**
CO5 - Illuminate the functional requirements of Pre cast concrete units **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I PLANNING (9 Hrs)

Classification of Industries and Industrial structures – General requirements for industries like cement, chemical and steel plants – Planning and layout of buildings and components.

UNIT II FUNCTIONAL REQUIREMENTS (9 Hrs)

Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act

UNIT III DESIGN OF INDUSTRIAL STEEL STRUCTURES (9 Hrs)

Industrial roofs – Crane girders – Mill buildings – Design of Bunkers and Silos.

UNIT IV DESIGN OF INDUSTRIAL RCC STRUCTURES (9 Hrs)

Silos and bunkers – Chimneys (Using C programming) – Principles of folded plates and shell roofs.

UNIT V PREFABRICATION (9 Hrs)

Principles of prefabrication and erection – Prestressed precast roof trusses- Functional requirements for Precast concrete units- Introduction to design of industrial mezzanine building

Text Books

1. Mohamed A. El-Reedy, “Construction Management and Design of Industrial Concrete and Steel Structures”, CRC Press, 2010
2. Varghese.P.C., " Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2 nd Edition, 2003.
3. Bhavikatti.S.S., “Design of Steel Structures", J.K. International Publishing House Pvt.Ltd., 2009.

Reference Books

1. Henn W. "Buildings for Industry", Vol.I and II, London Hill Books, 2017
2. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, 1990
3. Structural Engineering Research Centre, Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Madras, 1982
4. Koncz.J., "Manual of Precast Construction", Vol.I and II, Bauverlay GMBH, 1971.
5. Ashoke Kumar Dasgupta, “Design of Industrial Structures Reinforced Cement Concrete and Steel”, CRC Press, 2021

6. IS: 9178-PART-I: Indian code of practice criteria for design of steel bins for storage of bulk materials, PART-II: General requirements and assessment of loads, PART-III: Design criteria and Bins designed for mass flow and funnel flow
7. IS:5503(PART- I)-1969: Indian Code of practice for silos for grain storage
8. IS 4995-1 (1974): Criteria for design of reinforced concrete bins for storage of granular and powdery materials, Part 1: General requirements and assessment of bin loads

Web References

1. https://nptel.ac.in/courses/105/106/105106113/
2. https://nptel.ac.in/courses/105/105/105105162/
3. https://nptel.ac.in/courses/105/105/105105105/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3
CO2	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO5	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19CEE89 PRE- STRESSED CONCRETE STRUCTURES

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the need for pre-stressing in a structure.
- Explain the methods, types and advantages of pre-stressing to the students..
- Aware of Design of compression and Tension Members
- Understand about methods and analysis of Composite Beams and Continuous Beams.
- Describe the principles of pre tensioned and post tensioned concrete bridge decks.

Course Outcomes

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

CO 1 - Understand the behaviour of pre-stressed concrete members and able to analyze the pre-stressed Concrete beams. **(K2)**
CO 2 - Design the pre-stressed concrete members for flexure and shear as per the relevant design code (IS 1343). **(K3)**
CO 3 - Design compression and tension members**(K3)**
CO 4 - Analyze and design of composite beams and continuous beams. **(K4)**
CO 5 - Choose the right pre-stressed bridge type suitable for construction process**(K5)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION (9 Hrs)

Basic concepts – Advantages and disadvantages - Materials of pre-stressing - Loss in pre-stress - Analysis of sections – Stress concept – Strength concept – Load balancing concept -Deflection of Pre-stressed Concrete members – Beam Deflection (Using C Programming)

UNIT II DESIGN OF SHEAR AND FLEXURAL MEMBERS (9 Hrs)

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre tensioned beams – Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams - Design for shear based on I.S. 1343 Code.

UNIT III DESIGN OF COMPRESSION AND TENSION MEMBERS (9 Hrs)

Design of compression members and tension members. Circular pre-stressing - Water tanks - Pipes - Analysis and design - IS Codal provisions.

UNIT IV COMPOSITE BEAMS AND CONTINUOUS BEAMS (9 Hrs)

Composite beams - Analysis and design. Partial pre-stressing - non-pre-stressed reinforcements. Analysis of Continuous beams - Cable layout - Linear transformation - Concordant cables.

UNIT V PRE-STRESSED CONCRETE BRIDGES (9 Hrs)

General aspects - Pretension pre-stressed bridge decks - Post tensioned pre-stressed bridge decks - Advantages over R.C. bridges

Text Books

1. Krishna Raju N., Pre-stressed concrete, Tata McGraw Hill Company, New Delhi 2012
2. Lin T.Y. and Ned.H.Burns, "Design of pre-stressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013
3. Dr. Y.R.M. Rao, J. P. Annie, P. Easwari, Pre-stressed Concrete Analysis and Design, G S Enterprises, 2017.

Reference Books

1. Ramaswamy G.S., Modern pre-stressed concrete design, Arnold Heinimen, New Delhi, 2012
2. David A.Sheppard, William R. and Philips, Plant Cast precast and pre-stressed concrete - A design guide, McGraw Hill, New Delhi 2011.
3. Praveen Nagaraja, Pre-stressed Concrete Design, Kindersley India, 2013
4. Dayaratnam.P., "Pre-stressed Concrete Structures", Oxford and IBH, 2013
5. IS1343:1980, Code of Practice for Pre-stressed Concrete, Bureau of Indian Standards, New Delhi, 2012

Web References

1. https://nptel.ac.in/courses/105/106/105106118/
2. https://www.youtube.com/watch?v=PZi50Miapc8
3. https://nptel.ac.in/courses/105/106/105106117

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	3	3	2	3	2	3	3	3	3	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

Annexure II

PROFESSIONAL ELECTIVE COURSE

Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19CEE61	Rock Engineering
2	U19CEE62	Intellectual Property Rights
3	U19CEE63	Shoring scaffolding and Form Work
4	U19CEE64	Municipal Solid Waste Management
5	U19CEE65	Advanced Structural Analysis

U19CEE64 **MUNICIPAL SOLID WASTE MANAGEMENT**

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

This course should enable the students to

- Impart knowledge on sources and generation of municipal solid waste.
- Gain adequate knowledge in reduction and recycle of waste.
- Understand the concept of collection methods and routes.
- Gain knowledge about the transport method of municipal solid waste
- Impart knowledge of disposal method of waste.

Course Outcomes

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

CO 1 - Understand the nature and characteristics of municipal solid wastes.**(K2)**
CO 2 - Understand the concept of reduction, reuse and recycling of waste. **(K4)**
CO 3 - Plan and design systems for storage, collection, transport, processing and disposal of municipal solid Waste.**(K3)**
CO 4 - Understand the issues on solid waste management from an integrated source.**(K4)**
CO 5 - Design and operate sanitary landfill.**(K5)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I SOURCES AND CHARACTERISTICS (9 Hrs)

Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics –functional Elements of solid waste management – Requirements and salient features of Solid waste management rules (2016) -Role of public and NGO"s- Public Private participation – Elements of integrated Municipal Solid Waste Management Plan.

UNIT II SOURCE REDUCTION, WASTE STORAGE AND RECYCLING (8 Hrs)

Waste Management Hierarchy –3R-Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public

health and economic aspects of open storage – case studies under Indian conditions – Recycling of Plastics, and Construction/Demolition wastes.

UNIT III COLLECTION AND TRANSFER OF WASTES (8 Hrs)

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance- options under Indian conditions – Field problems- solving.

UNIT IV PROCESSING OF WASTES (12 Hrs)

Objective(s) of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste -composting and biomethanation; Thermal processing options – case studies under Indian conditions.

UNIT V WASTE DISPOSAL (8 Hrs)

Land disposal of solid waste- Sanitary landfills – site selection- design and operation of sanitary landfills – Landfill liners– Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation.

Text Books

1. William A. Worrell, P. AarneVesilind (2012) Solid Waste Engineering, Cengage Learning, 2012.
2. John Pitchel (2014), Waste Management Practices-Municipal, Hazardous and industrial – CRC Press,Taylor and Francis, New York.
3. George Tchobanoglouset.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993.
4. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994.

Reference Books

1. CPHEEO (2014), "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization. Government of India, New Delhi.
2. George Tchobanoglous and FrankKreith (2002).Handbook of Solid waste management, McGraw Hill, New York.
3. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
4. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 1997.

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2. http://cpheeo.gov.in/upload/uploadfiles/files/Part1
3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	3	3	3	3	2	3	3	3	3	2
CO2	3	3	2	3	3	3	3	2	3	2	2	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3	3	2	3	3	3	2
CO4	2	3	2	3	2	3	2	3	3	2	2	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	2	3	3	3	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

Annexure III

OPEN ELECTIVE COURSES

Open Elective – II / Open Elective – III				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
3	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
4	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
5	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
7	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
8	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
9	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
10	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
11	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
12	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL
13	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics

		L	T	P	C	Hrs
U19EEO63	**CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES**					
	(Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To get knowledge on the status of conventional and non-conventional energy resources in world.
- To have a clear idea about the operation of conventional power plant and its associated equipment's.
- To learn about the concept of energy harvesting of solar through thermal and PV module
- To understand the technological basis for harnessing wind energy.
- To get a clear knowledge on power generation using Ocean, Tidal Energy and Bio-Energy

Course Outcomes

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

CO1 – Identify the world and Indian energy scenario and the necessity of renewable energy sources **(K1)**

CO2 – Gain knowledge for the generation of electrical power from various power plants **(K1)**

CO3 – Analyze and compare the various solar harvesting techniques **(K3)**

CO4 – Describe the aerodynamics of wind turbines and calculate their power, energy production**(K1)**

CO5 – Describe the construction and working principle of various equipment's used in Ocean, Tidal Energy and Bio-Energy power plants**(K2)**

UNIT I ENERGY RESOURCES (09 Hrs)

Perspective of energy resources – Forms of Energy – Conventional and non-conventional sources of energy– World's energy status - Energy reserves in India. Limitations of Conventional sources of energy efficiency – Renewable Energy Sources – Energy parameters – Energy Intensity - Gross Domestic product.

UNIT II POWER PLANTS (09 Hrs)

Thermal power plant – layout, working principle. Gas turbine power plant – layout, working principle. Nuclear power plants: fuels, nuclear fuel cycle, reactors and nuclear waste management. Hydro Electric plants – Types, energy conversion schemes, environmental aspects.

UNIT III SOLAR ENERGY SYSTEMS (09 Hrs)

Solar radiation - Principles of solar energy collection –Types of collector – working principles - Characteristics - efficiency - Solar Energy applications – water heaters, air heaters, solar cooling; solar drying and power generation – solar tower concept – solar pump. Photovoltaic (PV) technology – photovoltaic effect – modelling - Characteristics – efficiency of solar cells.

UNIT IV WIND ENERGY SYSTEMS (09 Hrs)

General theory of wind mills – Types of wind mills – performance of wind machines–wind power – efficiency. Merits and Limitations of Wind energy system – Modes of wind power generation.

UNIT V ALTERNATE ENERGY SYSTEMS (09 Hrs)

Ocean and Tidal energy conversion - working principle of OTEC – Anderson closed cycle OTEC System. Tidal power – tides - tidal range - types of tidal power plants, single basin and double basins schemes. Bio-mass Energy – Biogas plants.

Text Books

1. S. Rao and Dr. B. B. Parulekar, "Energy Technology", Khanna Publication, 3rd Edition, 1999.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Education, 2nd Edition, 2009.
3. D. P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI, 2011

Reference Books

1. G. D. Rai, "Non-conventional energy sources", Khanna Publication. 4th Edition, 2002.
2. Pulfrey, David. L, "Photo voltaic Power Generation", Van Nostrand reinhold Company, 1983.
3. Abbasik, "Renewable Energy Sources and their Environment", PHI, 2008.

4. Steve Doty, Wayne C. Turner, “Energy Management Handbook”, Fairmont Press, 8th Edition, 2012.
5. S.A.Abbasi and N. Abbasi, “Renewable Energy Sources and Their Environmental Impact”, PHI, 2001.

Web References

1. https://www.tutorialspoint.com/renewable_energy/index.htm
2. https://nptel.ac.in/courses/112/107/112107291/
3. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/
4. https://www.jagranjosh.com/general-knowledge/nonconventional-sources-of-energy-1448698715-1
5. https://wb.gov.in/departments-power-and-non-conventional-energy-sources.aspx

COs / POs and PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
2	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
3	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
4	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
5	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

Annexure Ⅳ

EMPLOYABILITY ENHANCEMENT COURSES –(A).CERTIFICATION COURSES

Sl. No	Course Code	Course Title
1	U19CECX1	3ds Max
2	U19CECX2	Advance Structural Analysis of Building using E-tabs
3	U19CECX3	AutoCad for Civil
4	U19CECX4	Bridge Analysis
5	U19CECX5	Internet of Things
6	U19CECX6	Project Management
7	U19CECX7	Python Programming
8	U19CECX8	STAAD Pro V8i
9	U19CECX9	Total Station

		L	T	P	C	Hrs
U19CEC6X	**CERTIFICATION COURSE - VI**	**0**	**0**	**4**	**-**	**50**

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40 - 50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

Annexure V

EMPLOYABILITY ENHANCEMENT COURSES – (B).SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19CES31	Skill Development Course 1 : General Proficiency – I
2	U19CES32	Skill Development Courses 2 *
		1) MS Office – Word, Excel, Power Point
		2) Plane Table surveying
		3) Auto level survey
3	U19CES41	Skill Development Course 3 : General Proficiency – II
4	U19CES42	Skill Development Courses 4 *
		1) Measurements and Conversion
		2) Air Quality Monitoring
		3) Experience with On-Site Construction Observation and Management
5	U19CES51	Skill Development Course 5 : Foreign Language/ IELTS –I
6	U19CES52	Skill Development Course 6 : Presentation Skills using ICT
7	U19CES61	Skill Development Course 7 : Foreign Language/ IELTS – II
8	U19CES62	Skill Development Course 8 : Technical Seminar
9	U19CES63	Skill Development Course 9 : NPTEL/MOOC – I
10	U19CES81	Skill Development Course 10 : NPTEL/MOOC-II

U19CES61

SKILL DEVELOPMENT COURSE 7

(Foreign Language / IELTS – II)

L	T	P	C	Hrs
0	0	2	0	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation.

	SKILL DEVELOPMENT COURSE 8	L	T	P	C	Hrs
U19CES62	(Technical Seminar)	**0**	**0**	**2**	**0**	**30**

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 20 minutes.

In a session of three periods per week, 8 to 10 students are expected to present the seminar.

Each student is expected to present atleast twice during the semester and the student is evaluatedbased on that.

At the end of the semester, he / she can submit a report on his / her topic of seminar and marks aregiven based on the report.

A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

SKILL DEVELOPMENT COURSE 9

U19CES63

(NPTEL / MOOC - I)

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation

Annexure VI

SEMESTER IV

		L	T	P	C	Hrs
U20CET409	**DESIGN OF RC ELEMENTS**	**2**	**2**	**0**	**3**	**60**

Course Objectives

The course should enable the students to

- Gain knowledge on methods available for designing reinforced concrete structures
- Be familiar with design of beam using limit state method
- Know the behavior of RC beam in shear and torsion
- Be acquainted with the design of slab and column using limit state method
- Understand the design of footing and staircase using limit state method

Course Outcomes

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

CO1 - Select the methods for designing reinforced concrete structures **(K2)**
CO2 - Design the beam using limit state method **(K2)**
CO3 - Design the slab using limit state method **(K2)**
CO4 - Design the column using limit state method **(K2)**
CO5 - Design the footing and staircase using limit state method**(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I METHODS OF DESIGN OF CONCRETE STRUCTURES (12 Hrs)

Role of structural engineer in structural design – elements of structures – reinforced concrete – ductility versus brittleness – methods of design - advantages of limit state method over other methods - design codes and specification - Introduction to working stress method- Permissible stresses-Factor of Safety- -modular ratio and cracking moment-IS 456 - limit state philosophy as detailed in current IS code.

UNIT II LIMIT STATE DESIGN OF BEAM (12 Hrs)

Introduction to flexural members - Behaviour of RCC beam under flexure – Design of singly and doubly reinforced rectangular and flanged beams for flexure, bond, shear and torsion.

UNIT III LIMIT STATE DESIGN OF SLAB (12 Hrs)

Design of one way and two way slabs - Design of continuous (one-way only) slabs.

UNIT IV LIMIT STATE DESIGN OF COLUMN (12 Hrs)

Types of columns - design of short columns for axial, uni-axial and bi axial bending - design of long columns- use of design aids

UNIT V LIMIT STATE DESIGN OF FOOTING AND STAIRCASE (12 Hrs)

Design of Footings - Isolated footing with axial and eccentric loading- Combined Rectangular and Trapezoidal footing for two columns only, Design of Stair Case (ordinary and doglegged)

Text Books

1. Gambhir.M.L., "Design of Reinforced Concrete Structures", Prentice Hall of India Private Limited, 2012.
2. Dayaratnam, P., “Brick and Reinforced Brick Structures”, Oxford and IBH Publishing House, 2017
3. Punmia B.C, Ashok Kumar Jain, ArunK.Jain, "R.C.C. Designs Reinforced Concrete Structures", Laxmi Publications Pvt. Ltd., New Delhi, 2012
4. N. Krishnaraju, and R. N.Pranesh," Reinforced Concrete Design", New Age International Pvt. Ltd.,2009
5. Varghese P C, Limit State Design of Reinforced Concrete, Prentice Hall of India, Private, Limited New Delhi, 2008.

Reference Books

1. Mallick, D.K. and Gupta A.P., “Reinforced Concrete”, Oxford and IBH Publishing Company, 2007
2. Syal, I.C. and Goel, A.K., “Reinforced Concrete Structures”, A.H. Wheelers and Co. Pvt. Ltd., 2012
3. Ram Chandra.N. andVirendraGehlot, “Limit State Design”, Standard Book House, 2004.
4. Subramanian. N., "Design of Reinforced Concrete Structures", Oxford University, New Delhi, 2013.
5. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2007 & SP 16

Web References

1. https://nptel.ac.in/courses/105/105/105105105/
2. https://www.youtube.com/watch?v=1_SXPr_YTOU
3. https://nptel.ac.in/content/storage2/courses/105105104/pdf/m9l20.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	2	-	-	-	-	-	-	-	1	-	1
CO2	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
CO3	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
CO4	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1
CO5	3	2	1	1	3	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U20CET410	GEOTECHNICAL ENGINEERING-II	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Impart knowledge on common method of sub soil investigation and sampling Methods.
- Learn about the method of improving Bearing capacity of the soil.
- Gain knowledge about, investigate the soil condition and to design a suitable foundation.
- Gain knowledge about design procedure for shallow and deep foundation.
- Understand about the earth pressure on cohesion less and cohesive soil.

Course Outcomes

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

CO1 - Analyze the method of soil exploration and sampling. **(K4)**

CO2 - Get knowledge on bearing capacity and testing methods. **(K3)**

CO3 - Select the type of foundation required for the soil at a place and able to design different types of foundation**. (K4)**

CO4 - Determine the load carrying capacity of pile foundation**. (K5)**

CO5 - Gain knowledge about retaining structures and Stability analysis**. (K4)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I SOIL EXPLORATION (12 Hrs)

Site investigation – Soil exploration methods- Hand augers and power drills- Wash boring - samplers-sampling method - Spacing and depth of bore holes - Standard Penetration Test - Static Cone Penetration Test - Dynamic Cone Penetration Test- Subsurface soundings - Geo physical method - Preparation of soil investigation Report.

UNIT II SHALLOW FOUNDATION (12 Hrs)

Classification of foundation- Types and selection criteria-- Methods to determine bearing capacity- Methods to increase BC-Terzaghi Analysis-Codal provision-Factors affecting bearing capacity -Settlement of foundations on granular and clay deposits- Seismic considerations in bearing capacity evaluation.

UNIT III FOOTINGS AND RAFTS (12 Hrs)

Types of Isolated footing-Combined footing- Mat foundation-Codal provision– Contact pressure and settlement distribution -Proportioning of foundation–design of foundation.

UNIT IV DEEP FOUNDATION (12 Hrs)

Pile foundations Introduction- classification-selection criteria- Individual and grouppile carrying capacity- static and dynamic approach-pile load tests- under reamed piles-IS Codal provisions. Methods to increase pile carrying capacity – Deep compaction methods – Grouting.

UNIT V RETAINING WALLS **(12 Hrs)**

Active and passive states –Definitions, Rankine's theory – Cohesion less and cohesive soil – Earth pressure on retaining walls of simple configurations – Culmann's Graphical method – Stability analysis of retaining walls – Codal provisions.

Text Books

1. Punmia B.C."Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd., New Delhi, 17th Edition, 2017.
2. Murthy, V.N.S.,"Text book of Soil Mechanics and Foundation engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
3. Purushothama Raj. P."Soil Mechanics and Foundation Engineering", 2nd Edition, Pearson Education, India 2013

4. Varghese, P.C.”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005

Reference Books

1. Venkatramaiah.C.,“Geotechnical Engineering”, New Age International Pvt. Ltd., New Delhi, 2017
2. Modi P N, "Soil Mechanics and Foundation Engineering", second Edition Standard Book House, New Delhi, 2017.
3. Coduto, D.P., "Geotechnical Engineering Principles and Practices", Prentice Hall of India Private Limited, New Delhi, 2002.
4. Michael A. Joyce "Site Investigation Practice”, E. & F.N. Spon, 1982

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2. https://nptel.ac.in/courses/105105176/
3. https://nptel.ac.in/courses/105/105/105105039/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	3	3	3	3	2	2	2	3	3	2
CO2	3	3	3	3	3	3	3	3	3	2	2	2	3	3	3
CO3	3	3	2	3	3	2	3	3	3	3	2	2	3	3	2
CO4	3	3	3	3	3	2	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	2	2	3	3	3	3	2	2	3	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19CEE45	ALTERNATIVE BUILDING MATERIALS AND TECHNOLOGIES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Gain knowledge on energy in building materials
- Aware about different types of alternative building materials
- Understand the Sustainable materials for construction
- Learn about the alternative building technologies
- Understand the concepts of equipment for construction and also planning control.

Course Outcomes

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

CO1 – Understand the various energies involved in the construction **(K2)**
CO2 – Understand the different types alternative materials**(K2)**
CO3 - Identify various eco-friendly materials **(K2)**
CO4 - Recognize suitable alternative building technologies **(K2)**
CO5 - Apply the cost concept involved in the planning of construction **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION (9 Hrs)

Energy in building materials, Environmental issues concerned to building materials, Embodied energy and life-cycle energy, Global warming and construction industry, Environmental friendly and cost-effective building technologies, Requirements for buildings of different climatic regions.

UNIT II ALTERNATIVE BUILDNG MATERIALS (9 Hrs)

Characteristics of building blocks for walls - Stones and Laterite blocks - Bricks and hollow clay blocks - Concrete blocks - Stabilized mud blocks - Fal-G Blocks - Manufacture of stabilized blocks.

UNIT III SUSTAINABLE MATERIALS (9 Hrs)

Fibre reinforced concretes – Types: metal and synthetic - Properties and applications - Fibre reinforced plastics – Types: organic and synthetic - Properties and applications. Building materials from agro and industrial wastes - Types of agro wastes - Types of industrial and mine wastes - Properties and applications

UNIT IV ALTERNATIVE BUILDING TECHNOLOGIES (9 Hrs)

Alternatives for wall constructions, composite masonry, confined masonry, cavity walls, Ferro cement and ferroconcrete building components, Materials and specifications, Properties, Construction methods, Applications. Top down construction, Mivan Construction Technique, 3D Printing Technology. Alternate Roofing Systems: Concepts, Filler slabs, Composite beam panel roofs.

UNIT V MACHINES & PLANNING CONTROL (9 Hrs)

Machines for manufacture of concrete, Equipment for production of stabilized blocks, Moulds and methods of production of precast elements, Cost concepts in buildings, Cost saving techniques in planning, design and construction, Cost analysis: Case studies using alternatives.

Text Books

1. KS Jagadish, B V Venkatarama Reddy and K S Nanjunda Rao, “Alternative Building Materials and Technologies”, New Age International Publishers, 2017.
2. BT Ashwini Manjunath, “Alternative Building Materials and Technology”, Medtech Publisher, 2017.
3. Trevor M. Letcher and Janet L. Scott, “Materials for a Sustainable Future”, Royal Society of Chemistry, 2012

Reference Books

1. S Christian Johnson, “Concrete Technology”, Dipti Press, 2017.
2. G.C Sahu and Jayagopal Jena, “Building Materials and Construction”, McGraw hill Publication, 2015.
3. B C Punmia and Ashok kumar jain, “Building Construction”, Laxmi Publication, 2019.

4. M.S. Shetty, “Concrete Technology (Theory and Practice)”, S. Chand & Company Ltd., 2019.
5. S.K. Duggal, “Building Materials”, 5th edition, New age International Publication, 2020.

Web Reference

1. https://nptel.ac.in/courses/105/102/105102175/
2. https://nptel.ac.in/courses/105/102/105102195/
3. https://alison.com/course/sustainable-architecture-energy-efficiency-and-quality

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	3	3	2	-	2	1	3	3	2	2
CO2	2	-	-	-	3	2	3	2	-	2	1	3	3	3	2
CO3	3	-	-	-	3	3	3	3	-	2	1	3	3	3	2
CO4	3	-	-	-	3	3	3	3	3	3	1	3	3	3	2
CO5	3	-	-	2	2	3	3	3	3	3	1	3	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

SEMESTER – V

		L	T	P	C	Hrs
U20BST551	**OPERATIONS RESEARCH** (Common to CIVIL, AI & DS & MECHATRONICS)	2	2	0	3	60

Course Objectives

This course should enable the students to

- Understand the role of operation research in decision making.
- Provide knowledge and training in using optimization techniques.
- Impart the various operation research models for effective problem solving.
- Understand the basics and the methods of solving game theory and network problems.
- Acquire knowledge in principles of Queuing Theory.

Course Outcomes

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

CO1 - Understand the characteristics of different types of decision-making environments. **(K2)**
CO2 - Solve Transportation Models and Assignment Models. **(K3)**
CO3 - Design new simple models by using critical path method.**(K3)**
CO4 - Understand the applications of game theory. **(K2)**
CO5 - Apply Queuing theory and solve problems related to it. **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I LINEAR PROGRAMMING (12Hrs)

Stages of development of Operations Research – Applications of Operations Research – Limitations of Operations – Introduction to Linear Programming – Graphical Method – Simplex Method – Duality.

UNIT II TRANSPORTATION PROBLEMS (12Hrs)

Basic feasible solution by different methods - Fixing optimal solutions- Stepping stone method- MODI method- Assignment problem – Formulation – Optimal solution.

UNIT III NETWORKS MODELS (12 Hrs)

Shortest Path Problem – Floyd's Algorithm – Minimum Spanning Tree Problem - CPM/PERT – Crashing of a Project network.

UNIT IV THEORY OF GAMES (12 Hrs)

Rectangular games – Minimax theorem – graphical solution of 2 x n or m x 2 games – game with mixed strategies.

UNIT V QUEUING THEORY (12 Hrs)

Basic Waiting Line Models:(M/M/1):(GD/α/α) – (M/M/1):(GD/N/α) – (M/M/C):(GD/α/α) – (M/M/C):(GD/N/α).

Text Books

1. Michael W.Carter, Camille C.Price, Ghaith Rabadi, "Operation Research – A Practical Introduction" Chapman and Hall/CRC; 2nd Edition 2018.
2. Jiongmin Yong, "Optimization Theory: A concise Introduction", World scientific publishing company, 2018.
3. John F. Shortle, James M. Thompson, Donald Gross, Carl M. Harris, "Fundamentals of Queuing Theory", 5th Edition, 2018.

Reference Books

1. A. Ravi Ravindran, "Operations Research Methodologies", Taylor and Francis, 2019.
2. Hasting, Kevin J. "Introduction to the Mathematics of Operations Research with Mathematics", Taylor and Francis, 2019.
3. A.M.Natarajan, P.Balasubramane and A.Tamilarasi, "Operations Research", Pearson. 2nd Edition,

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2014.
4. J. K. Sharma, "Operations Research Theory and applications", Macmillan India Ltd, 5th Edition, 2013.
5. Hamdy A. Taha, "Operations Research: An Introduction", Pearson Publications, 10th Edition, 2020.

Web References

1. https://www.researchgate.net/publication/313880623
2. https://nptel.ac.in/courses/117/103/117103017/
3. https://nptel.ac.in/courses/111/107111107128/
4. https://youtu.be/MrOwmSYqkiE
5. https://youtu.be/4U3B5lr-MqM

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	-	1	1	-	-
CO2	3	2	1	1	-	1	-	-	-	-	-	1	1	-	-
CO3	3	2	1	1	-	1	-	-	-	-	2	1	1	-	-
CO4	2	1	-	-	-	-	-	-	-	-	2	1	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	2	1	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CET511	STRUCTURAL ANALYSIS - I	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

This course should enable the students to

- Analyze statically indeterminate beams by using Force method
- Analyze the pin jointed frame by using Force method
- Analyze statically indeterminate beams and frames by using Slope deflection method
- Analyze statically indeterminate beams and frames by using Moment distribution method
- Analyze the statically determinate and indeterminate structures of suspension bridges

Course Outcomes

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

CO1 – Understand the concept of degree of static indeterminacy of force method **(K3)**
CO2 – Apply the concept of redundant frames by using force method **(K3)**
CO3 – Apply the fundamental principles of structural analysis for indeterminate structures **(K3)**
CO4 – Evaluate the structural behavior of indeterminate structures **(K3)**
CO5 – Analyze the behavior of a typical suspension bridges **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I FORCE METHOD **(12 Hrs)**

Concept of static and kinematic indeterminacies – Introduction to force and displacement methods - Analysis of continuous beams with maximum three redundant forces by force method

UNIT II ANALYSIS OF FRAMES **(12 Hrs)**

Analysis of trusses with internal and external redundancy with maximum one redundant of simply supported and cantilever truss by force method.

UNIT III SLOPE DEFLECTION METHOD **(12 Hrs)**

Slope deflection equations – Equilibrium conditions – Analysis of continuous beams and portal frames without sway - Non-sway analysis

UNIT IV MOMENT DISTRIBUTION METHOD **(12 Hrs)**

Stiffness and carry over factors – Distribution and carry over moments – Analysis of continuous beams and portal frames without sway - Non-sway analysis

UNIT V SUSPENSION BRIDGES **(12 Hrs)**

Analysis of Suspension bridges with statically determinate structures of two hinged stiffening girders and statically indeterminate structures of three hinged stiffening girders

Text Books

1. Vaidyanathan R and Perumal P, Structural Analysis, Vol. 1 & 2, Laxmi Publications Pvt. Ltd, New Delhi, 2016, 4th Edition
2. Bhavikatti,S.S, Structural Analysis, Vol. 1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2010, 4th Edition
3. B.C.Punmia, Ashok Kumar Jain, Arun K. Jain, "Theory of Structures", Laxmi Publications Pvt. Ltd, 2017, 13th Edition
4. Arun Shyam,Karuna Basker, Structural Analysis, Medtech Publisher, 2019
5. Roy Sujit Kumar, Chakrabarty Subrata, Fundamentals of Structural Analysis: With Computer Analysis and Applications Paperback, S Chand & Company Publisher, 2003, 2nd Edition

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Reference Books

1. Dr.R.P. Rethaliya, Structural Analysis-I, Atul Prakashan Publisher, 2020
2. Dr. Suresh R. Parekar, H.M. Somayya, Structural Analysis-I, Nirali Prakashan Publisher, 2014
3. Wang. C. K., Intermediate Structural Analysis, McGraw Hill Publishing Co., Tokyo, Fourth Edition, 2017.
4. Jindal, R. L., Indeterminate Structural Analysis, S. Chand and Company. New Delhi, 2000.
5. Thandavamoorthy, "Analysis of Structures", Oxford and IBH Publishers, New Delhi.2008

Web References

1. https://nptel.ac.in/courses/105105166/
2. https://onlinecourses.nptel.ac.in/noc20_ce35/unit?unit=50&lesson=51
3. https://nptel.ac.in/courses/105101085/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CET512 ENVIRONMENTAL ENGINEERING – I

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the basics, importance, and methods of water supply.
- Gain knowledge on various sources and properties of water.
- Understand the various methods of conveyance and distribution system of water.
- Learn the objectives and methods of water treatment and to study the features and function of different water treatment units.
- Learn the importance of rain water harvesting and water pollution.

Course Outcomes

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

CO1 - Estimate the future population **(K2)**
CO2 - Understand the different water sources and the characteristics of water and their analysis **(K2)**
CO3 - Design the distribution network and Conveyance **(K4)**
CO4 - Understands the various water treatment process **(K2)**
CO5 - Construct the Water Management system **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K**5** – Evaluate

UNIT I INTRODUCTION TO WATER SUPPLY (9 Hrs)

Environmental Engineering - Role of Environmental Engineer - Water supply - development of public water supply - need for protected water supplies - objectives of water supply systems - water supply scheme-quantity of water - estimating requirements - Design period – per capita consumption - fluctuations in demand pattern - population forecast – Arithmetic, Incremental, Geometric methods.

UNIT II SOURCES, QUALITY AND STANDARDS OF WATER (9 Hrs)

Sources of water - surface and ground water sources – Quality of water - physical, chemical and biological aspects - analysis of water - water quality.

UNIT III CONVEYANCE AND DISTRIBUTION SYSTEM (9 Hrs)

Intake structures - pipe materials - hydraulics of flow in pipes - laying, jointing, testing of pipes - pumping stations - selection of pumps - methods of distributing water - storage and distribution reservoirs - analysis of distribution system Hardy- cross method of balancing - equivalent pipes.

UNIT IV WATER TREATMENT SYSTEM (9 Hrs)

Definition of unit process and unit operations - objectives of water treatment - methods and sequence of treatment of water - aeration , coagulation, flocculation filtration and disinfection – principles, functions and design - sedimentation - flocculation- filter units - miscellaneous methods -iron and manganese removal - deflouridation and demineralization.

UNIT V WATER MANAGEMENT (9 Hrs)

Sustainable Development-Rain Water harvesting-Methods-Water Pollution- Causes and effects- Role of regulatory bodies and Local bodies-CPCB-TWAD Board- CMWSSB etc-Water Act 1974-Case Studies related to Effective Water Management.

Text Books

1. Garg, S.K., - Environmental Engineering I, Khanna Publishers, New Delhi, 2016
2. Modi, P.N., - Environmental Engineering I , Standard Book House, Delhi, 2016
3. Duggal K.N., - Elements of Environmental Engineering S.Chand and Co. Ltd., New Delhi, 2019

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Reference Books

1. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 2015.
2. Hand book on Water Supply and Drainage, SP35, B.I.S., New Delhi,1987.
3. GrayN.F,WaterTechnology,ElsevierIndiaPvt.Ltd.,NewDelhi, 2016.
4. Birdie, G.S. and Birdie, Water Supply and Sanitary Engineering, DhanpatRaiand Sons,2016.
5. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2016.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements.
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. nptel.ac.in/courses/105/104/105104102/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	2	3	2	2	3	2	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CET513	INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the concept of measurement system
- Familiarise about accuracy and precision
- Understand about different types of sensors
- Understand about sensor installation
- Understand about data analysis

Course Outcomes

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

CO1 - Identify the type of transducer **(K2)**
CO2 - Create mathematical model of transducer **(K4)**
CO3 - Identify the various types of sensor **(K2)**
CO4 - Design the sensor **(K4)**
CO5 - Analyse and interpret the data **(K4)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K**5** – Evaluate

UNIT I **(9 Hrs)**

Generalized scheme of a measurement system –Units and standards – Static calibration – Errors in measurements–Classification of errors, Limiting error and probable error – Error analysis –Classification of transducers – Selection of transducers

UNIT II **(9 Hrs)**

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range -Dynamic characteristics: – Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp and sinusoidal inputs

UNIT III **(9 Hrs)**

Fundamentals of Measurement, Sensing and Instrumentation covering definition of measurement and instrumentation, physical variables, common types of sensors; Describe the function of these sensors; Use appropriate terminology to discuss sensor applications; and qualitatively interpret signals from a known sensor type, types of instrumentation, Sensor Specifics, Permanent installations, Temporary installations;

UNIT IV **(9 Hrs)**

Sensor Installation and Operation covering to: i) Predict the response of sensors to various inputs; ii) Construct a conceptual instrumentation and monitoring program; iii) Describe the order and methodology for sensor installation; and iv) Differentiate between types of sensors and their modes of operation and measurement and v) Approach to Planning Monitoring Programs, Define target, Sensor selection, Sensor siting, Sensor Installation & Configuration, Advanced topic, Sensor design, Measurement uncertainty

UNIT V **(9 Hrs)**

Data Analysis and Interpretation covering a) Fundamental statistical concepts, b) Data reduction and interpretation, c) Piezometer, Inclinometer, Strain gauge, etc. d) Time domain signal processing, e) Discrete signals, Signals and noise and f) a few examples of statistical information to calculate are: Average value (mean), On average, how much each measurement deviates from the mean (standard deviation), Midpoint between the lowest and highest value of the set (median), Most frequently occurring value (mode), Span of values over which your data set occurs (range)

Text Books

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann

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2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press

3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis

Reference Books

1. Ilya Gertsbakh (2010), Measurement Theory for Engineers, Springer
2. Patranabis, Sensors and Transducers, Second Edition, PHI Publisher

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements.
2. https://swayam.gov.in/nd1_noc20_ce23/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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CO1	2	1	-	-	-	1	-	-	-	-	-	1	-	-	-
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CO3	3	2	1	1	-	1	-	-	-	-	2	1	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	2	1	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	2	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEP508	MODELING AND ANALYSIS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

The course should enable the students to:

- Acquire basic understanding of Modeling and Analysis software
- Understand the different kinds of analysis and apply the basic principles
- Find out the stress and other related parameters of beams, frames with loading conditions
- Learn to apply the basic principles to carry out seismic analysis
- Know the natural frequency of different kind of beams

Course Outcomes

At the end of Course students will be able to

CO1 – Demonstrate the basic features of an analysis package **(K3)**
CO2 – Analyze the structure using E-TABS software **(K3)**
CO3 – Design the structure using E-TABS software **(K3)**
CO4 – Performing analysis and interpretation of results for final design **(K3)**
CO5 – Students would have gained knowledge on the usage of the software **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

List of Experiments

1. Introduction to Structural Analysis and Design using ETABS
2. Introduction to various commands of ETABS and their applications in detail.
3. Analysis and Design of Trusses
4. Analysis and Design of continuous beams with fixed at both ends
5. Analysis and Design of continuous beams with simply supported at both ends
6. Analysis and Design of Plane Frames
7. Modeling Analysis and Design of G+1 Story building
8. Modeling and Analysis of G+5 Story building
9. Analysis and Design of 2D Reinforced Concrete Frame
10. Seismic Analysis and Design of 10 Story RC building

Software Required

- ETABS

Web References

1. https://www.youtube.com/watch?v=KgvQxd58BN0
2. https://www.youtube.com/watch?v=LOtuwW9-G68

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CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 – High

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U20CEP509	SENSORS APPLICATIONS IN CIVIL ENGINEERING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

This course should enable the students to

- Understand the different sensors
- Calibration of sensor
- Measurement of signal processing

Course Outcomes

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

CO1 – Identify the sensor **(K2)**

CO2 – Understand the errors in sensor **(K2)**

CO3 – Analyse the digital signal processing **(K2)**

KNOWLEDGE LEVEL: K1 – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

LIST OF EXPERIMENTS

1. Instrumentation of typical civil engineering members/structures/structural elements
2. Use of different sensors, strain gauges, inclinometers,
3. Performance characteristics
4. Errors during the measurement process
5. Calibration of measuring sensors and instruments
6. Measurement, noise and signal processing
7. Analog Signal processing
8. Digital Signal Processing
9. Demonstration & use of sensor technologies
10. A comprehensive study of data transmission in wireless sensor network.

Reference Books

1. Alan S Morris (2001), Measurement and Instrumentation Principles, 3rd/e, Butterworth Hienemann
2. David A. Bell (2007), Electronic Instrumentation and Measurements 2nd/e, Oxford Press
3. S. Tumanski (2006), Principle of Electrical Measurement, Taylor & Francis

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	-	-	1	-	-	-
CO3	3	2	1	1	-	1	-	-	-	-	2	1	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	2	1	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	2	1	-	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CEP510	REVIT ARCHITECTURE	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

The course should enable the students to:

- Get exposed to the usage of software
- Learn the concepts of planning and orientations.
- Create a full 3D Elements like walls, doors, windows, components, floors, ceilings, roofs, stairs.
- Create a full 3D architectural project model
- Learn the concept of walkthrough in Revit Architecture.

Course Outcomes

At the end of Course students will be able to

CO1 - Describe building information modeling methodology and its benefits. **(K3)**

CO2 - Use different parts of the Revit Architecture user interface and work with different types of architectural elements and families. **(K3)**

CO3 - Use the different views listed in the Project Browser, control the visibility and graphical **(K3)**

CO4 - Representation of objects in architecture model, and work with elevation, section, and 3D views. **(K4)**

CO5 - Set up a project and transfer standards between projects, add and modify levels in project model, create and modify grids. **(K4)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

List of Experiments

1. Introduction
2. Core concepts
3. Touring the Revit Workspace
4. Starting a Project in Revit
5. Levels, Grids, and Columns
6. Using walls
7. Doors and Windows
8. How to use components
9. Use of columns and their types
10. Use of stairs and their types
11. Railing in Revit
12. Ramps
13. Floors
14. Roof
15. Text
16. Camera
17. Walk through
18. 3D modeling of Residential building

Reference Books

1. Shah.M.G., Kale. C.M. and Patki. S.Y., "Building Drawing with an Integrated Approach to Build Environment", Tata McGraw Hill Publishers Limited, 2019.
2. Dr. N. Kumaraswamy, A. KameswaraRao, Charotar Publishing- Building planning and Drawing,2017
3. Marimuthu V.M., Murugesan R. and Padmini S., "Civil Engineering Drawing-I", Pratheeba Publishers, 2018.

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Web References

1. https://www.google.com/search?q=revit+architecture+tutorialandrlz=1C1CHBD_enIN877IN877andoq=REVIT+ARCHITECTURE+tandaqs=chrome.1.69i57j0l7.13121j0j8andsourceid=chromeandie=UTF-8
2. https://www.youtube.com/watch?v=cJz20pnOGrw
3. https://www.pdfdrive.com/revit-architecture-d18827665.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	3	1	-	-	2	3	-	3	3	2	3
CO2	3	1	2	1	3	1	-	-	2	3	-	3	3	2	3
CO3	3	1	2	1	3	1	-	-	2	3	-	3	3	2	3
CO4	3	1	2	1	3	1	-	-	2	3	-	3	3	2	3
CO5	3	1	2	1	3	1	-	-	2	3	-	3	3	2	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEP511	ESTIMATION COSTING AND VALUATION ENGINEERING	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

This course should enable the students to

- Understand the basics knowledge of estimation, costing and valuation of civil engineering works.
- Analyze the estimate gives an idea of time required for the completion of the work.
- Understand the standard schedule of rates of the current year.
- Provide the knowledge on various cost estimate for civil projects
- Analyze the rates and estimate the various construction works

Course Outcomes

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

CO1 - Measure and Estimate various elements in Civil Engineering works **(K2)**
CO2 - Prepare Detailed Estimate for a given building **(K3)**
CO3 - Rate analysis for different types of works **(K2)**
CO4 - Estimate the material quantities, prepare a bill of quantities and tender documents of project **(K2)**
CO5 - Prepare value estimates and report for a residential building. **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

LIST OF EXPERIMENTS

1. Introduction about Estimation, Costing and Valuation
2. To prepare a detailed and abstract estimate of Single roomed building for substructure (Load Bearing Structure)
   a. Earthwork Excavation for foundations
   b. P. C. C. (1:4:8) for foundations
   c. Brick Masonry in CM (1:5) for foundation and basement
   d. River sand filling for basement
   e. Plinth beam
3. To prepare a detailed and abstract estimate of Single roomed building for superstructure (Load Bearing Structure)
   a. Brick Masonry in CM (1:6) for superstructure
   b. R.C.C (1:2:4) for lintels, beams etc.
   c. R.C.C (1:2:4) for slabs
   d. Cement concrete (1:5:10) flooring
   e. Flooring with mosaic tiles
   f. Plastering with CM (1:6) for superstructure
   g. Plastering with CM (1:5) for ceiling
   h. White washing with two coats
   i. Color washing with two coats
   j. Supply and fixing of doors and windows
4. To prepare a detailed and abstract Estimate of Single storied Residential Building (Framed Structure)
5. Estimate of Septic tank with Soak pit
6. Estimate of Isolated column and Footing
7. Estimate of Box Culvert
8. Estimate of Underground Rectangular Water Tank
9. Estimation of Bar bending schedule
10. Analysis of Rates
11. Valuation

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Reference Books

1. D.D Kohli and R.C Kohli, “A Text Book of Estimating and Costing (Civil)”, S. Chand and Company Ltd., 2013
2. V. N. Vazirani, S. P. Chandola, Civil Engineering Estimating, Costing & Valuation, Khanna Publishers, 1968
3. Rangwala, Estimation, Costing and Valuation, Charotar Publishing house Pvt Ltd, 17th Edition, 2017
4. S.P. Mahajan, Sanjay Mahajan, Quantity Surveying and Valuation book, Tech India Publication series, 2017
5. Govt of Tamil Nadu PWD – “Standard Schedule of Rates”, 2017-18

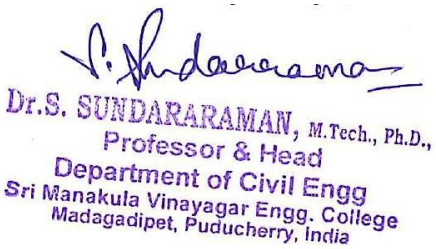
Web References

1. https://mis.wbprd.gov.in/Engineering/Document/BoxCulvertorMinorBridgeSampleEstimate.pdf
2. https://www.cphbooks.in/product/estimating-costing-and-valuation/
3. https://www.flipkart.com/estimating-costing-civil-engineering-theory-practice-including-specification-valuation

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	1	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High



U20CEC5XX	CERTIFICATION COURSE - V	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40 - 50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20CES504	SKILL DEVELOPMENT COURSE 4 (Foreign Language / IELTS - I)	L	T	P	C	Hrs
		0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HOD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting, Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation.

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		L	T	P	C	Hrs
U20CES505	SKILL DEVELOPMENT COURSE 5 (Presentation Skills using ICT)	0	0	2	0	30

The methodology used is "learning by doing", a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

CT skills

- Understand ICT workflow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained for this course is not considered for CGPA calculation.

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U20CEM505	INDIAN CONSTITUTION	L	T	P	C	Hrs
		2	0	0	-	30

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

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SEMESTER – VI

U20CET614	DESIGN OF STEEL STRUCTURES	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

This course should enable the students to

- Gain knowledge on the limit state design of steel structures and the design of connections
- Be familiar with the design concepts of steel structural members subjected to tension.
- Understand the design concepts of the structural steel members subjected to compression.
- Be familiar with the design concepts of structural members subjected to bending.
- Be acquainted with the design of connections

Course Outcomes

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

CO1 – Design steel structural joints using bolts and welds. **(K5)**
CO2 – Design the structural members subjected to tension. **(K5)**
CO3 – Design single and compound compression members and the laced and battened columns. **(K5)**
CO4 – Design laterally supported and unsupported beams subjected to axial bending. **(K5)**
CO5 – Design the steel connection. **(K5)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT– I INTRODUCTION TO LIMIT STATE DESIGN (12 Hrs)

Properties of steel - Structural steel sections - types of connections, terminologies, failures in bolted and welded joints, Design of Joints – lap joint, single cover butt joint and double cover butt joint using bolts and welds under axial loading - Efficiency of joints.

UNIT – II DESIGN OF TENSION MEMBERS (12 Hrs)

Types of sections - Design of single and double angle tension member under Axial Loading using bolts and welds – Concept of shear lag –Design of tension Splices- Use of Lug Angles.

UNIT – III DESIGN OF COMPRESSION MEMBERS (12 Hrs)

Theory of columns - Modes of failures, Design of axially loaded compression members, design of Built- up columns, Design of Lacings and Battens, Design of Column Splices.

UNIT – IV DESIGN OF FLEXURAL MEMBERS (12 Hrs)

Modes of failures, Design of beam, design of laterally supported beam, design of laterally unsupported beam, design of built up beam – plate girder.

UNIT – V INDUSTRIAL STRUCTURES AND TRUSSES (12 Hrs)

Gantry girder (design procedure) - Design of purlins - Types of roof trusses for different spans- Estimation of dead, live and wind loads.

Text Books

1. N.Subramanian , "Design of Steel Structures" , Oxford University press, 2018.
2. S.K.Duggal, "Limit State Design of Steel Structures", Tata McGrraw Hill Education Pvt. Ltd, 2019
3. Dayaratnam.P, "Design of Steel Structures", Wheeler and Co Ltd., Allahabad, 2012
4. S.S.Bhavikatti, "Design of Steel Structures ", I.K. International Publishing House, 2019
5. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013
6. IS 800 -2007, General Construction in Steel - Code of Practice.
7. SP 6-1 (1964): ISI Handbook for Structural Engineers -Part1 Structural Steel Sections [CED 7: Structural Engineering and structural sections]

Reference Books

1. Dr.Ramachandra, Virendra Gehlot, "Limit State Design of Steel Structures", Standard Publishers, 2012
2. Dr. V.L.Shah, S.S.Karve, "Limit State Design of Steel Structures", Structures Publications, 2012.

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3. Punmia B.C, Ahok Kumar Jain and Arun Kumar Jain, "Comprehensive Design of Steel Structures", Lakshmi publications (P) Ltd., New Delhi, 2015.
4. Arya, A.S. and Ajmani, J.L., "Design of Steel Structures", Nem Chand and Bros, Roorkee, 2011.
5. Salmon and Johnson, "Steel Structures- Design and Behaviour", Intext Educational Publishers, 1993

Web References

1. https://nptel.ac.in/courses/105105162/
2. https://nptel.ac.in/courses/105106113/
3. https://nptel.ac.in/courses/105106112/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	3	3	3	3	3	1	3	3	3	3
CO2	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO3	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CET615 **STRUCTURAL ANALYSIS – II**

L	T	P	C	Hrs
2	2	0	3	60

Course Objectives

This course should enable the students to

- Analyze the arches and cables with same and different level conditions
- Analyze statically determinate and indeterminate beams for ILD by using Rolling load and Muller Breslau's Principle
- Analyze statically indeterminate beams by using Flexibility Matrix method
- Analyze statically indeterminate beams by using Stiffness Matrix method
- Understand the concept of shape factor for various sections and plastic analysis of beams and frames

Course Outcomes

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

CO1 - Apply suitable methods of analysis for various types of structures including arches and cables **(K3)**
CO2 - Analyze the effects of moving loads on structures using influence lines **(K3)**
CO3 - Identify the problem with static indeterminacy of beam by using force method **(K3)**
CO4 – Identify the problem with kinematic indeterminacy of beam by using displacement method **(K3)**
CO5 - Understand the principles of plastic theory and its applications **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I ARCHES AND CABLES **(12 Hrs)**

Arches as structural forms - Examples of arch structures - Types of arches - Analysis of three hinged with same and different level and two hinged with same level - Analysis of forces in cables with same and different level (Analysis the problem with C program)

UNIT II INFLUENCE LINES FOR DETERMINATE AND INDETERMINATE STRUCTURES (12 Hrs)

ILD for simply supported Moving loads – single, uniformly distributed load and several point loads – maximum bending moment and maximum shear force –absolute maximum bending moment – Muller - Breslau's Theorem - principle and its application.

UNIT III FLEXIBILITY MATRIX METHOD **(12 Hrs)**

Equilibrium and compatibility - Determinate vs Indeterminate structures - Indeterminacy - Primary structure - Compatibility conditions - Analysis of continuous beams (with redundancy restricted to two).

UNIT IV STIFFNESS MATRIX METHOD **(12 Hrs)**

Displacement method or stiffness method - General – Procedure – Stiffness matrix – Procedure for stiffness matrix – Stiffness coefficient - comparison of Flexibility and Stiffness methods - Analysis of continuous beams (with redundancy restricted to two)

UNIT V PLASTIC ANALYSIS OF STRUCTURES **(12 Hrs)**

Introduction - Plastic modulus - Shape factor - Load factor – Plastic hinge concepts - redistribution of moments – collapse mechanism - Upper and lower bound theorems - Plastic moment of resistance - Plastic analysis of continuous beams and portal frames without sway.

Text Books

1. Vaidyanathan R and Perumal P, Structural Analysis, Vol. 2, Laxmi Publications Pvt. Ltd, New Delhi, 2017, 3rd Edition
2. Bhavikatti,S.S, Structural Analysis, Vol. 2, Vikas Publishing House Pvt. Ltd., New Delhi, 2018, 4th Edition
3. B.C.Punmia, Ashok Kumar Jain, Arun K. Jain, " Theory of Structures", Laxmi Publications Pvt. Ltd, 2017, 13th Edition
4. Pandit G.S, and Gupta S. P, "Structural Analysis a Matrix Approach", Tata McGraw Hill Publications, New Delhi, 2008

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5. L.S. Negi and R.S. Jangid, "Structural Analysis", Tata McGraw-Hill Publications, New Delhi, Sixth Edition, 2003

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1. Wang. C. K., Intermediate Structural Analysis, McGraw Hill Publishing Co., Tokyo, Fourth Edition, 2017.
2. Jindal, R. L., Indeterminate Structural Analysis, S. Chand and Company. New Delhi, 2000.
3. Thandavamoorthy, "Analysis of Structures", Oxford and IBH Publishers, New Delhi.2008
4. Arun Shyam,Karuna Basker, Structural Analysis, Medtech Publisher, 2019
5. Roy Sujit Kumar, Chakrabarty Subrata, Fundamentals of Structural Analysis: With Computer Analysis and Applications Paperback, S Chand & Company Publisher, 2003, 2nd Edition

Web References

1. https://nptel.ac.in/courses/105105166/
2. https://onlinecourses.nptel.ac.in/noc20_ce35/unit?unit=50&lesson=51
3. https://nptel.ac.in/courses/105101085/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CET616 ENVIRONMENTAL ENGINEERING – II

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the basics of sewage, types of sewers and method of collection of sewage
- Learn the features of various sewer materials and appurtenances
- Learn the objectives and methods of sewage treatment and to study the features and function of different primary treatment units.
- Study the features and function of different secondary treatment units.
- Learn the objectives and methods of sewage disposal and methods of solid waste and sludge management.

Course Outcomes

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

CO1 - Study, analysis and design sewerage systems **(K2)**

CO2 - select and use various techniques, materials and modern engineering practices to laying and construction of sewerage system. **(K3)**

CO3 - Design various treatment methods in primary treatment units. **(K4)**

CO4 - Design various treatment methods in secondary treatment units. **(K4)**

CO5 - Gain knowledge in various sewage disposal methods **(K2)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K**5** – Evaluate

UNIT I INTRODUCTION (9 Hrs)

Sewage Characteristics – sewer, sewage and sewerage -methods of collection - conservancy system, water carriage system - classification of sewerage systems- quantity of sanitary sewage - fluctuation in sewage flow - design of flow of sewage for separate, storm and combined sewers – full flow and partial flow conditions - design of separate sewers using Manning's formula..

UNIT II SEWAGE MATERIALS, COMSTRUCTION AND APPURTENANCES (9 Hrs)

Materials for pipe sewers - construction - laying, jointing, dewatering and testing - sewer appurtenances - traps - plumbing system of drainage – one pipe system and two pipe system of plumbing - sanitary fittings.

UNIT III PRIMARY TREATMENT (9 Hrs)

Primary treatment - objectives - screening - grit chamber and primary sedimentation tanks design.

UNIT IV SECONDARY TREATMENT (9 Hrs)

Principles, functions and design - activated sludge unit and trickling filter - septic tank - sludge digestion tank - oxidation pond- aerobic reactor- anaerobic reactor.

UNIT V SEWAGE DISPOSAL AND SOLID WASTE MANAGEMENT (9 Hrs)

Sewage Disposal – Dilution - self-purification of running streams - oxygen sag curve- land disposal - sewage farming - deep well injection - soil dispersion system. Objectives of sludge treatment - properties and characteristics of sludge - sludge digestion - thickening - dewatering - conditioning - drying beds - biogas recovery. Solid waste -generation-collection-conveyance-disposal.

Text Books

1. Garg, S.K., - Environmental Engineering II, Khanna Publishers, New Delhi, 2016.
2. Modi, P.N., - Environmental Engineering II, Standard Book House, Delhi, 2018
3. Duggal K.N., - Elements of Environmental Engineering II, S.Chand and Co. Ltd., New Delhi, 2019

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B.Tech. Civil Engineering

Reference Books

1. Manual on Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 2013.
2. Metcalf and Eddy, M.C., Wastewater Engineering - Treatment and Reuse II , 4Th Edition, McGraw Hill India, 2016.
3. Birdie, G.S. and Birdie, Water Supply and Sanitary Engineering, DhanpatRaiand Sons,2016.
4. Punmia, B.C., Ashok K Jain and Arun K Jain, "Wastewater Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2016.

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. nptel.ac.in/courses/105/104/105104102/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	2	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CET617 TRANSPORTATION ENGINEERING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the geometric design of highways
- Gain the knowledge about the pavement components and design of their elements
- Familiar with the basic elements and design principles of Railway track
- Understand the basic elements and design principles of Airport layout
- Familiar with the basic elements of harbor engineering

Course Outcomes

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

CO1 - Understand & Analyze the geometric design of highways **(K3)**
CO2 - Understand the various test procedures for highway materials and design theories **(K2)**
CO3 - Design the railway track **(K4)**
CO4 - Prepare airport layout and design traffic control **(K3)**
CO5 - Understand the various concepts and components of harbor **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I HIGHWAY GEOMETRY (10 Hrs)

Significance of highway planning –Factors influencing highway alignment –Engineering surveys for alignment, conventional and modern methods -Classification of highways –Typical cross sections - Cross sectional elements - Sight Distances, Factors affecting Sight Distances, PIEV theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance [Derivations and Problems in SSD and OSD]- Gradients and its types, Design of Horizontal Alignments - Super elevation, Widening of Pavements on Horizontal Curves and Transition Curves [Derivation of Formulae and Problems] Design of Vertical Alignments - Rolling, Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves

UNIT II PAVEMENT COMPONENT AND DESIGN (9 Hrs)

Pavement components - Types of pavements - Highway materials — Tests on aggregates and Tests on bitumen - Calculation of stresses – Single layer, Two layer theory, Westergaard's theory, Bradbury theory (Problems in stress calculation) - Pavement Design Factors in the design of flexible and rigid pavements- CBR methods - IRC recommendations on flexible pavement design (IRC37) and Rigid pavement (IRC58) (Problems in design of flexible pavement) - Highway drainage and its types - Pavement failures - Pavement evaluation – Benkelman beam deflection method

UNIT III RAILWAY ENGINEERING (9 Hrs)

Permanent way and its elements – Functions, requirements and types of Rails, Sleepers and Ballast - Rail fixtures and fastenings - Gauge and its types -Coning of wheels - Defects in rails - Super elevation – Cant deficiency, negative cant (Problems) - Widening of gauge on curves (Problems) - Transition Curves and Shift (Problems) - Points and crossings – Turn outs - Design of turnouts (Problems) – Stations and Yards - classification of stations and yards

UNIT IV AIRPORT ENGINEERING (9 Hrs)

Components of Airport - Airport organization – Types of airport - Runway orientation - Wind rose diagram (Problems), Basic runway length and corrections, Geometric design of Runway (Problems on Runway length) Runway Marking – Runway Lighting - Design of exit taxiway (Problems), Airport drainage

UNIT V HARBOUR ENGINEERING (8 Hrs)

Definition of Terms - Harbors, Ports, Docks, Tides and Waves, Littoral Drift, Satellite Ports - Requirements and Classification of Harbors - Site Selection & Investigation - Dry and Wet Docks - Position of Light Houses, Navigating Terminal Facilities – Port Buildings, Warehouse, Transit Sheds, Inter-modal Transfer Facilities,

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Mooring Accessories, Navigational Aids Coastal Structures- Piers, Breakwaters, Wharves, Jetties, Quays, Spring Fenders Coastal Shipping

Text Books

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2015.
2. S C Saxena and S P Arora, "A Textbook of Railway Engineering", Dhanpat Rai Publication, 2010.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010

Reference Books

1. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2019.
2. Rangwala, "Airport Engineering", Charotar Publishing House, 2018.
3. S P Bindra, A Course in Docks and Harbour Engineering, Dhanpat Rai and Sons, New Delhi, 2018.
4. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Fifth Revision), IRC: 37-2018
5. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, (Third Revision), IRC: 58-2017

Web References

1. https://nptel.ac.in/courses/105101087/
2. https://nptel.ac.in/courses/105107123/
3. https://nptel.ac.in/courses/114106025/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CEP612 TRANSPORTATION ENGINEERING LABORATORY

L	T	P	C	Hrs
0	0	2	1	30

Course Objectives

This course should enable the students to

- Understand the procedures of testing of road aggregates
- Understand the procedures of testing of bitumen
- Understand the Marshall mix design
- Understand the procedures of testing of bituminous mix
- Familiar with test on subgrade soil

Course Outcomes

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

CO1 - Carry out the test on aggregate **(K3)**
CO2 - Conduct the test on bitumen **(K3)**
CO3 - Design the pavement **(K4)**
CO4 - Investigate the test on bituminous mix **(K3)**
CO5 - Carry out the test on subgrade soil **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

LIST OF EXPERIMENTS

I. Tests on Aggregate:
1. Shape Tests (Elongation index, Flakiness index, Angularity number)
2. Impact test
3. Crushing value
4. Los Angles Abrasion test
5. Specific gravity
6. Water absorption

II. Tests on Bitumen:
1. Penetration Value
2. Ductility
3. Softening point
4. Flash & fire point
5. Specific gravity
6. Viscosity of cutback Bitumen

III. Tests on Bituminous Mix
1. Marshall's test on bituminous mixes
2. Bitumen Extraction test by Centrifuge Extractor

IV. Test on Sub-grade soil
1. C.B.R. Test - (on sub grade soil)

Reference Books

1. Kadiyali L R, "Highway Engineering", Khanna Book Publishing Co Pvt Ltd, 2019.
2. Kadiyali L R, Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 2019.
3. Bureau of Indian Standards (BIS) Publications on Highway Materials
4. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Fifth Revision), IRC: 37-2018
5. Indian Standard (IS), Methods of test for soil, Part 16 (Second Revision), IS: 2720 (Part 16) – 1987.

Web References

1. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-21.pdf
2. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-26.pdf
3. https://nptel.ac.in/content/storage2/courses/105101087/downloads/Lec-26.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CEP613	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

This course should enable the students to

- Aware about water and its importance to human survival.
- Understand how to classify and analyze various quality parameters of raw water.
- Prepare water quality assessment report.
- Suggest required type of treatment to purify raw water.
- Analyze different quality requirements for industrial waters and domestic waters.

Course Outcomes

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

CO1 - Discuss about importance of water and its quality analysis. **(K5)**

CO2 - Analyze various physico-chemical and biological parameters of water in case of quality requirements. **(K5)**

CO3 - Assess complete water quality assessment for EIA and domestic supplies. **(K5)**

CO4 - suggest various types of treatment methods required to purify raw water with different contaminants. **(K5)**

CO5 - Apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions. **(K5)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

LIST OF EXPERIMENTS

Sampling and preservation methods and significance of characterization of water and wastewater.

PHYSICAL ANALYSIS

1. Determination of Turbidity by using Nephlometer.
2. Measurement of pH
3. Measurement of Conductivity
4. Measurement of Total Solids.
5. Estimation of Suspended, volatile and fixed solids

CHEMICAL ANALYSIS

6. Estimation of Alkalinity.
7. Estimation of Chlorides.
8. Estimation of Hardness.
9. Estimation of Residual Chlorine
10. Estimation of Dissolved Oxygen.
11. Estimation of Manganese.
12. Jar test for the determination of optimum coagulant Dose.
13. COD test for water and waste water..

BIOLOGICAL ANALYSIS

14. BOD test for water and waste water
15. Estimation of E-Coli.

Text Books

1. Garg, S.K., - Environmental Engineering Iand II, Khanna Publishers, New Delhi, 2016
2. Modi, P.N., - Environmental Engineering Iand II, Standard Book House, Delhi, 2016
3. Duggal K.N., - Elements of Environmental Engineering S.Chand and Co. Ltd., New Delhi, 2019

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Reference Books

1. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 2015.
2. Hand book on Water Supply and Drainage, SP35, B.I.S., New Delhi,1987.
3. Manual on Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 2013.
4. Metcalf and Eddy, M.C., Wastewater Engineering - Treatment and Reuse II , 4Th Edition, McGraw Hill India, 2016.
5. IS10500 Indian Standards for Drinking Water.
6. IS 2490 Indian Standards for Industrial and sewage effluent discharge.

Web References

1. https://swayam.gov.in/nd1_noc20_ce23/preview
2. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements?force=true

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	2	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEP614	DESIGN AND DRAWING LABORATORY (RCC AND STEEL)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

This course should enable the students to

- Prepare working drawings for concrete structures
- Prepare working drawings for steel structures
- Preparation of layout of the structure with detailed design details
- Preparation of working drawings with all dimensions required for execution/ fabrication of structures
- Increase ability to communicate with people through drawings

Course Outcomes

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

CO1 – Understand the importance of basic concepts and principles of Design and Drawing. **(K5)**
CO2 – Design steel and concrete structures. **(K5)**
CO3 – Draft various concrete and steel structures / elements. **(K5)**
CO4 – Detail various concrete and steel structures / elements. **(K5)**
CO5 – Use the drawing instruments effectively and able to dimension the given figures. **(K5)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

Detailed Design and Drawing of the following RCC elements/Structures:

1. Continuous beams and slab systems.
2. Rectangular Combined footings.
3. Cantilever retaining walls
4. Elevated - circular and rectangular water tanks (excluding staging)
5. Staircases.

Detailed Design and Drawing of the following Steel elements/Structures:

1. Roof trusses and joints including purlins.
2. Stiffened welded seat connections – moment resisting welded connections for beams.
3. Welded plate girder.
4. Gantry girder.
5. Self-supporting chimney

Text Books

1. N.Subramanian , "Design of Steel Structures" , Oxford University press, 2018.
2. S.K.Duggal, "Limit State Design of Steel Structures", Tata McGrraw Hill Education Pvt. Ltd, 2019
3. S.S.Bhavikatti, "Design of Steel Structures ", I.K.International Publishing House, 2019
4. Gambhir.M.L., "Design of Reinforced Concrete Structures", Prentice Hall of India Private Limited, 2012.
5. Punmia B.C, Ashok Kumar Jain, Arun K.Jain, "R.C.C. Designs Reinforced Concrete Structures", Laxmi Publications Pvt. Ltd., New Delhi, 2012
6. N. Krishnaraju, and R. N.Pranesh," Reinforced Concrete Design", New Age International Pvt. Ltd.,2009
7. Varghese P C, Limit State Design of Reinforced Concrete, Prentice Hall of India, Private, Limited New Delhi, 2008.

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Reference Books

1. IS 800 -2007, General Construction in Steel - Code of Practice.
2. SP 6-1 (1964): ISI Handbook for Structural Engineers -Part1 Structural Steel Sections [CED 7: Structural Engineering and structural sections]
3. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2007
4. IS 3370-2 (2009): Code of Practice Concrete structures for the storage of liquids, Part 2: Reinforced concrete structures [CED 2: Cement and Concrete]

Web References

1. https://nptel.ac.in/courses/105105162/
2. https://nptel.ac.in/courses/105106113/
3. https://nptel.ac.in/courses/105106112/
4. https://nptel.ac.in/courses/105/105/105105105/
5. https://www.youtube.com/watch?v=1_SXPr_YTOU

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	3	3	3	3	3	1	3	3	3	3
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CO3	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	T	P	C	Hrs
U20CEC6XX	CERTIFICATION COURSE - VI	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40 - 50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20CES606	SKILL DEVELOPMENT COURSE 6 (Foreign Language / IELTS – II)	L	T	P	C	Hrs
		0	0	2	0	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation.

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U20CES607	SKILL DEVELOPMENT COURSE 7 (Technical Seminar)	L	T	P	C	Hrs
		0	0	2	0	30

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 20 minutes.

In a session of three periods per week, 8 to 10 students are expected to present the seminar.

Each student is expected to present atleast twice during the semester and the student is evaluatedbased on that.

At the end of the semester, he / she can submit a report on his / her topic of seminar and marks aregiven based on the report.

A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.

Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

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SKILL DEVELOPMENT COURSE 9

U20CES608

(NPTEL / MOOC - I)

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation

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U20CEM606	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

This course should enable the students to

- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

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

CO1 - Understand philosophy of Indian culture.
CO2 - Distinguish the Indian languages and literature.
CO3 - Learn the philosophy of ancient, medieval and modern India.
CO4 - Acquire the information about the fine arts in India.
CO5 - Know the contribution of scientists of different eras.

UNIT I INTRODUCTION TO CULTURE

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT II INDIAN LANGUAGES, CULTURE AND LITERATURE

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

UNIT III RELIGION AND PHILOSOPHY

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY & ENGINEERING)

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

Reference Books

1. Kapil Kapoor, "Text and Interpretation: The India Tradition", ISBN:81246033375,2005
2. "Science in Samskrit", Samskrita Bharti Publisher,ISBN13:978-8187276333,2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450494-X,200
4. S.Narain,"ExaminationsinancientIndia",AryaBookDepot,1993
5. SatyaPrakash,"FoundersofSciencesinAncientIndia",VijayKumarPublisher,1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990,2014

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PROFESSIONAL ELECTIVES

Professional Elective – II (Offered in Semester V)

U20CEE506	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Study the geotechnical problems in various types of soils and suggestions
- Learn the suitable dewatering techniques
- Learn the appropriate grouting materials and techniques to strengthen the soil.
- Study the stabilization techniques.
- Understand the various geo synthetic materials for soil.

Course Outcomes

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

CO1 - Assess the geo-technical problems in various types of soils and suggest suitable ground improvement techniques. **(K4)**

CO2 - Choose suitable dewatering techniques for construction sites where the ground water table is at a higher level. **(K4)**

CO3 - Select the appropriate grouting materials and techniques to strengthen the soil. **(K2)**

CO4 - Apply the stabilization techniques for soil. **(K3)**

CO5 – Understand the design and application of geo synthetics materials.

KNOWLEDGE LEVEL: K1 – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION (9 Hrs)

Introduction: Need – methods – suitability – Mechanical modification: principle - Surface compaction: Field compaction and equipments, compaction specification and controls. Vibration methods: dynamic consolidation, vibratory rollers, Vibro floatation.

UNIT II DRAINAGE AND DEWATERING (9 Hrs)

Drainage methods: Well point systems, deep well drainage, vacuum dewatering system, design of dewatering system – field permeability tests, dewatering by electro osmosis. Preloading, sand drains, wick drains- Thermal methods case studies.

UNIT III GROUT TECHNIQUES (9 Hrs)

Grouting: Classification – Methods – Types – grouts – equipments, grouting design and layout, grout monitoring – applications – Case studies.

UNIT IV STABILIZATION (9 Hrs)

Stabilization: cement stabilization, Lime stabilization – chemical stabilization - methods, principles, applications and field control. Stabilization using reinforcement – rock anchor- soil tie backs.

UNIT V GEO SYNTHETICS (9 Hrs)

Geo synthetics: Geotextiles, Geogrids, Geomembranes, Geonets, Geomats, Geomeshes, principles Design and applications – Case studies.

Text Books

1. Purushothama Raj, P. "Ground Improvement Techniques", Laxmi Publications, 2020.
2. NiharRanjanPatra, Ground Improvement Techniques, S.Chand Publishers 2012
3. Mittal.S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, 2013.

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Reference Books

1. Das, B.M. – "Principles of Foundation Engineering" 7th edition, Cengage learning, 2016
2. Robert M. Koerner , "Designing with Geosynthetics Vol. 1and2", Xlibris; 6 edition, 2012
3. Jie Han, Principles and Practice of Ground Improvement, John Wiley and Sons, 2015

Web References

1. https://nptel.ac.in/courses/105/108/105108075/
2. https://nptel.ac.in/courses/105/103/105103097/
3. https://nptel.ac.in/courses/105/101/105101201/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	-	1	-	-	-	-	-	1	2	2	2
CO2	2	3	3	3	1	2	2	-	-	-	-	1	2	2	2
CO3	3	3	2	2	2	1	-	-	-	-	2	1	2	2	2
CO4	2	1	-	-	-	-	-	-	-	-	2	1	2	2	2
CO5	3	3	3	3	2	-	-	-	-	-	2	1	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEE507	FUNDAMENTALS OF NANO SCIENCE	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Gain a general knowledge on Nano science and Nanotechnology
- Understand the classification of nanostructure.
- Understand the properties and design aspects of nanomaterial.
- Understand the surface modification of nanoparticles.
- Understand the smart materials and its behavior for product development.

Course Outcomes

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

CO1 - Recognize the history, background and the nature of the Nan science and technology. **(K2)**

CO2 - State the different type of nanostructures and analyze the top down and bottom up approach for nano scale device preparation and differentiate the different properties of nano materials. **(K2)**

CO3 - Distinguish the functionality of nanostructures and their characteristic evaluation and designing it. **(K3)**

CO4 - Recognize the surface modification of nanoparticles by surface fictionalization and their application. **(K5)**

CO5 - Appraise the different smart materials like thermos-responsive, piezo electric electrostrictive and biometric materials, smart gel, shape memory and their application towards product formation. **(K4)**

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY (9 Hrs)

History, background scope and interdisciplinary nature of nanoscience and nanotechnology, scientific revolutions, nanosized effects surface to volume ratio, atomic structure, molecules and phases, energy at the nanoscale molecular and atomic size, quantum effect.

UNIT II CLASSIFICATION OF NANOSTRUCTURES (9 Hrs)

Zero dimensional, one-dimensional and two dimensional nanostructure materials - semiconductors, ceramics and nanocomposites, size dependent phenomena, quantum dots, nanowires, nanotubes, nano sheets, nano and mesopores, misnomers and misconception of nanotechnology.

UNIT III PROPERTIES OF NANOMATERIALS AND DESIGN (9 Hrs)

Mechanical properties - Thermo physical properties - Electric properties - Electrochemical properties - Magnetic properties - Optical properties, Catalytic properties, properties of gas permeation and separation membranes. Functionality of nanostructures and their characteristic evaluation, Size effect in semiconductor nanoparticles- Particle size, shape density - Melting point, surface tension, wettability - Specific surface area and pore- assembly of nanoparticles and functionalization, Self-assembly. Nanoparticle dispersion and aggregation behavior.

UNIT IV SURFACE MODIFICATION OF NANOPARTICLES (9 Hrs)

Surface modification of inorganic nanoparticles by organic functional groups, Development of photo catalyst inserted into surface of porous alumino silicate - Dispersion control of nanoparticles in solvents - development of biodegradable PLGA nano spheres and application.

UNIT V SMART MATERIALS AND SYSTEMS (9 Hrs)

Thermo responsive materials, piezoelectric materials, electrostrictive and magnetostrictive materials, ER and MR fluids, biomimetic materials, smart gel, shape memory alloys.

Text Books

1. Edward L. Wolf, "Nanophysics and Nanotechnology - An Introduction to Modern Concepts in Nanoscience" Second Edition, John Wiley and Sons, 2006.

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2. K.W. Kolasinski, —Surface Science: Foundations of Catalysis and Nanosciencell, Wiley, 2002.
3. G.A. Ozin and A.C. Arsenault, — Nanochemistry : A chemical approach to nanomaterials ll,Royal Society of Chemistry, 2005.
4. Nanostrucrues and Nanomaterials synthesis, properties and applications, G. Cao, Imperaial College press 2004.

Reference Books

1. Y-WVladimir P. Torchilin (2006) Nanoparticulates as Drug Carriers, Imperial College Press.
2. M. Reza Mozafari (2007) Nanomaterials and Nanosystems for Biomedical Applications, Springer.
3. Nanotechnology – Basic Science and Emerging Technologies, Chapman and Hall/CRC 2002.
4. Nanomaterials Nanotechnologies and Design: An introduction for Engineers and architects, Micheal F. Ashby, P.J. Ferreria, D.L.Schodek.

Web Reference

1. https://nptel.ac.in/courses/118/104/118104008/
2. https://nptel.ac.in/courses/113/106/113106093/
3. https://nptel.ac.in/courses/118/102/118102003/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	-	1	-	-	-	-	-	1	2	2	1
CO2	2	3	3	3	1	2	2	-	-	-	-	1	2	2	1
CO3	3	3	2	2	2	1	-	-	-	-	2	1	2	2	1
CO4	2	1	-	-	-	-	-	-	-	-	2	1	2	2	1
CO5	3	3	3	3	2	-	-	-	-	-	2	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEE508	SMART CITY	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To familiarize the basic of smart techniques
- To understand the IoT methods to government and internationals e-practice
- To learn the current practices and future trends about smart city
- To introduce the capacity of critique the current practice and provide recommendations
- To understand about the various devices and uses

Course Outcomes

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

CO1 - Understand the fundamental knowledge of the sustainable and smart city **(K2)**
CO2 - Understand the technologies used for sustainable and smart cities **(K2)**
CO3 - Integrate and apply the learnt knowledge to conduct a case study in an organized way **(K3)**
CO4 - Present the study clearly to audiences **(K2)**
CO5 - Demonstrate critical thinking and discovery **(K3)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K5 – Evaluate

UNIT I INTRODUCTION AND APPLICATIONS **(9 Hrs)**

Introduction and Applications - Smart mobility - smart environment - smart people - smart governance - smart economy - smart living

UNIT II INTERNET OF THINGS **(9 Hrs)**

IoT and Low Energy Consuming Sensors – Processing - Transmission – Operating systems

UNIT III APPLICATION OF VARIOUS BUILDINGS **(9 Hrs)**

Methods to redesign and redefine back and front offices in order to build smarter and transparent governments.

UNIT IV SERVICES AND TECHNIQUES **(9 Hrs)**

Methodologies for user involvement, profiling customers and identifying needs; test methodologies to transfer these needs in appropriate services; and test techniques to fit the right channel to the specific services and customers thereby are setting a framework for a higher level of e-services in the NSR.

UNIT V TECHNOLOGIES AND APPLICATION **(9 Hrs)**

Pilot new service channels, Bluetooth services for public transport, online forms in mobile phones and wireless city services.

Text Books

1. Christopher Grant Kirwan, Zhiyong Fu, Smart Cities and Artificial Intelligence Convergent Systems for Planning, Design, and Operations, Elsevier Publisher, 2020
2. G.R. Kanagachidambaresan, Internet of things in smart technologies for sustainable urban development, Springer publisher, 2020
3. Jonathan Roichental, Smart cities for Dummies, The MIT Press, 2020
4. Ben Green,The Smart Enough City: Putting Technology in Its Place to Reclaim Our Urban Future, MIT Press, 2019
5. Anthony M, Townsend, Smart Cities – Big Data, Civic Hackers, and the Quest for a New Utopia, W. W. Norton & Company; Reprint edition , 2014

Reference Books

1. Rajendra Joshi, Smart Cities : Breaking the Poverty Barrier, Notion Press, 2019
2. Madrid, Lorenzo, Bower, Linda, Smart City 3.0, 2019

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3. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li
4. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by NicosKomninos
5. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia by Anthony Townsend

Web References

1. http://smartcities.gov.in/content/city_challenge.php?page=city-challenge--website.php
2. http://smartcities.gov.in/upload/smart_solution/5a277bcb24008BHUBANESWAR%20E-MOBILITY%20PLAN.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	3	-	-	-	-	-	-	1	2	2	1
CO2	2	1	-	-	3	-	-	-	-	-	-	1	2	2	1
CO3	3	2	1	1	3	-	-	-	-	-	-	1	2	2	1
CO4	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2
CO5	3	2	1	1	3	-	-	-	-	-	-	1	2	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CEE509	AIR AND NOISE POLLUTION	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Gain a basic knowledge on the air pollution on environment
- Understand the interaction of air pollutants on the meteorological parameters
- Understand about the control measures of air pollutants from various sources
- Understand the sources and control of indoor air pollution
- Understand the importance of Control of Noise pollution.

Course Outcomes

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

CO1 - Identify the types and sources of air pollutants**(K2)**
CO2 - Predict the effects of air pollutants on human health and the environment**(K2)**
CO3 - Choose appropriate technologies for removal of particulates and gaseous pollutants**(K2)**
CO4 - Measure the pollutant concentration in indoor environment**(K2)**
CO5 - Suggest the control techniques for Noise pollution. **(K2)**
KNOWLEDGE LEVEL: K1 – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION **(9 Hrs)**

Air pollutants – Sources – Classification of air pollutants – Particulates and gaseous pollutants – Effects of air pollutants on human health, vegetation and property – Global issues and air pollution – Global warming – Ozone layer depletion – Ambient air quality and emission standards – Air pollution indices – Air act.

UNIT II METEOROLOGY AND AIR POLLUTION **(9 Hrs)**

Meteorology and Air pollution – Atmospheric stability – Inversions – Mixing height –Plume behaviour – Plume rise estimation – Effluent dispersion theories –Air pollutants Modelling.

UNIT III CONTROL OF PARTICULATE POLLUTANTS **(9 Hrs)**

Control of Air pollutants: particulates – Filters – Gravitational settling chambers – Centrifugal-multiple type cyclones – Collection efficiency - Electrostatic precipitators – Wet collectors-Centrifugal spray scrubbers - Venturi scrubbers.

UNIT IV GASEOUS POLLUTION CONTROL **(9 Hrs)**

Gaseous pollution control – Absorption - Principles – Description of equipment, Adsorption – Principal adsorbents – Equipment descriptions – Condensation – Contact condensers, Incineration –Equipment description.

UNIT V NOISE POLLUTION CONTROL **(9 Hrs)**

Sound and noise - Source of noise pollution - Environmental and industrial noise -Effects of noise pollution - Fundamentals of sound - generation, propagation, etc., Sound measurement, sound level meters – Measures for prevention and control of noise -Environmental and industrial noise - Noise control legislation.

Text Books

1. Rao.M.N. et al., Air Pollution, Tata Mc.Graw Hill, 2018.
2. Rao.C.S., Environmental Pollution Control Engineering , New Age International Publishers, 2017.

Reference Books

1. Noel de Nevers, Air Pollution Control Engineering, Mc.Graw Hill, New York. 2016.
2. Stern, A.C., Air Pollution ,Vol.I, II and III, Academic Press, 2015.
3. Cunniff, P.F., Environmental Noise Pollution, John Wiley and Sons, 2017.

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Web References

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2. https://swayam.gov.in/nd1_noc20_ce23/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	2	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEE510 ADVANCED DESIGN OF RCC STRUCTURES

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand the unified analysis of reinforced concrete structures
- Gain knowledge about the design of special reinforced concrete elements
- Understand the concept on yield line theory of slabs and to design flat slabs.
- Understand the design RCC slab culvert and bridge
- Analyze the prestressed concrete sections and design of beams.

Course Outcomes

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

CO1 - Analyze reinforced concrete structures **(K4)**
CO2 – Design special reinforced concrete elements **(K4)**
CO3 – Create an awareness on yield line theory of slabs and to design flat slabs. **(K2)**
CO4 - Design RCC slab culvert and bridge **(K5)**
CO5 - Analyze prestressed concrete sections and design of beams. **(K5)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I INTRODUCTION TO ANALYSIS OF REINFORCED CONCRETE STRUCTURES (9 Hrs)

Introduction to strut-tie model, equilibrium truss model, Bernoulli compatibility truss model, Mohr compatibility truss model, Introduction to nonlinear behavior of structures.

UNIT II DESIGN OF SPECIAL REINFORCED CONCRETE ELEMENTS (WSM) (9 Hrs)

Design of Deep Beams (using C programming), Checking for Local Failures, Detailing of Deep Beams, Design of shear walls, Design of Corbels, Design of Nibs, Design of pile cap. Reinforcement detailing for all design.

UNIT III FLAT SLABS (9 Hrs)

Elements of flat slabs, Codal procedure for design of flat slabs, Behavior of flat slab in shear, One way and two way shear, Equivalent Frame Method, Openings in flat slabs, Effect of pattern loading in flat slabs

UNIT IV YIELD LINE THEORY (9 Hrs)

Design of slabs of various shapes and having various support conditions using yield line analysis approach.

UNIT V DESIGN OF BEAM COLUMN JOINTS (9 Hrs)

Types of joints, Joints in multistoried buildings, Forces acting on joints, Design of joints for strength, Anchorage requirement in joints and detailing of reinforcement in joints.

Text Books

1. Varghese.P.C, "Advanced Reinforced Concrete Design", Pretince-Hall India, 2005..
2. Unnikrishna Pillai.S and Devadas Menon, "Reinforced Concrete Design," Tata MacGraw Hill Publishing Company Limited, Second Edition, New Delhi, 2010
3. Krishnaraju .N, Pranesh .R.N, "Design of Reinforced concrete IS: 456-2000", New age International Publication (P) Ltd., New Delhi, 2003.

Reference Books

1. Krishnaraju .N, "Prestressed Concrete", Tata McGraw-Hill Education, 2008, New Delhi.
2. Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publications, New Delhi, 2007..
3. Johnson Victor.D, "Essentials Of Bridge Engineering", 6/E, Oxford & IBH Publishing Company Pvt. Ltd.,Fourth edition, 2007.

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4. IS : 456-2000 - Plain and Reinforced Concrete - Code of Practice
5. SP – 16 - Design Aids for Reinforced Concrete
6. IS : 1343:2012 - Prestressed concrete-code of practice
7. IRC 6-2010 - Standard Specifications and Code of Practice for Road Bridges Section : II Loads And Stresses

Web References

1. https://nptel.ac.in/courses/105/105/105105105/
2. https://nptel.ac.in/courses/105/105/105105104/
3. https://nptel.ac.in/courses/105/106/105106176/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO2	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO3	3	3	3	3	1	3	3	3	3	3	1	3	3	3	3
CO4	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3
CO5	3	3	3	2	1	3	3	3	3	3	1	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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Professional Elective – III (Offered in Semester VI)

U20CEE611	ROCK ENGINEERING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

This course should enable the students to

- Impart knowledge on fundamentals of rock mechanics
- Apply its application in solving simple problems associated with rock slopes and underground openings.
- Understand the estimation of stresses by using various method
- Gain the knowledge on the mechanics of rock and its applications in underground structures and rock slope stability analysis.
- Understand the knowledge of rock stabilization

Course Outcomes

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

CO 1 - Understand classification of the rock, study the index properties of rock systems. **(K2)**
CO 2 - Understand the modes of rock failure, stares-strain characteristics, failure criteria. **(K3)**
CO 3 - Estimate the stresses in rocks. **(K4)**
CO 4 - Apply rock mechanics in engineering. **(K3)**
CO 5 - Get knowledge on rock stabilization **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K5 – Evaluate

UNIT I CLASSIFICATION AND INDEX PROPERTIES (9 Hrs)

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose

UNIT II ROCK STRENGTH AND FAILURE CRITERIA (9 Hrs)

Modes of rock failure – Strength of rock – Laboratory measurement of shear, tensile and compressive strength. Stress - strain behavior of rock under Hydrostatic compression and deviatory loading – Mohr –Coulomb failure criteria and Hock

UNIT III INITIAL STRESSES AND ITS MEASUREMENTS (9 Hrs)

Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – measurements of in-situ stresses

UNIT IV APPLICATION OF ROCK MECHANICS IN ENGINEERING (9 Hrs)

Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence

UNIT V ROCK STABILIZATION (9 Hrs)

Introduction – Rock support and Rock reinforcement – Principles – Support reaction curves – Shotcreting.

Text Books

1. Goodman, P.E. "Introduction to Rock Mechanics", John Wiley and Sons, 1999.
2. Stillborg B., "Professional User Handbook for rock Bolting", Tran Tech Publications, 1996.
3. Ramamurthy T., "Engineering in Rocks for Slopes Foundations and Tunnels", PHI Learning Pvt. Ltd., 3rd Edition, 2014
4. Brown, E.T. "Rock Characterisation Testing and Monitoring". Pergaman Press 1991.
5. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering", Oxford and IBH, 1991.

Reference Books

1. Braday, B.H.G. and Brown, E.T., Rock mechanics for underground mining (Third Edition), Kluwer Academic Publishers, Dordrecht, 2006
2. Vutukuri, V.S., Lama, R.D. and Saluja, S.S. Handbook on Mechanical Properties of Rocks. Vol. 1, Trans Tech. Publications, 1975.

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3. Zhang Lianyang. Engineering Properties of Rocks. Elsevier, 2005.
4. Bieniawski, Z.T.. Engineering Rock Mass Classifications. John Wiley and Sons, 1989.
5. John Jaeger and N. G. Cook. Fundamentals of Rock Mechanics. Wiley-Blackwell. 2007

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2. https://nptel.ac.in/courses/105/105/105105106/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	2	2	2	3	3	3	3	2	3	2	2	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U20CEE612	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

This course should enable the students to

- know general Knowledge about Intellectual Property Rights
- Understand about trademarks, Parents and Industrial Design
- know International Treaties and Conventions on IPRs and parents of India
- Gain an idea about different laws in IPR
- understand the concept of different IPR with case studies.

Course Outcomes

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

CO1- gain about Intellectual Property Rights.
CO2- Make details on trademarks, Parents and Industrial Design
CO3- Get details about Agreements and Legislations
CO4- Gain knowledge about different laws in IPR
CO5- Manage Intellectual Property portfolio to enhance the value of the firm.

KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and K**5** – Evaluate

UNIT I INTRODUCTION **(9 Hrs)**

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs **(10 Hrs)**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTS AND LEGISLATIONS **(10 Hrs)**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW **(9 Hrs)**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs **(7 Hrs)**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

Text Books

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002
3. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow

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1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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1. https://nptel.ac.in/courses/109/106/109106137/
2. https://nptel.ac.in/courses/109/105/109105112/
3. https://nptel.ac.in/courses/110/105/110105139/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	3	3	3	3	3	3	3	2	2	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEE613 SHORING SCAFFOLDING AND FORM WORK

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

This course should enable the students to

- Gain knowledge about the latest methods of form construction.
- Understand the materials associated with formwork
- Understand the design aspects of formwork under various requirements
- Understand the planning and erection aspects of form work
- Understand about a few special types of forms

Course Outcomes

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

CO1 - Understand few other special types of forms **(K2)**
CO2 - Study the planning and erection aspects of form work for buildings. **(K2)**
CO3 - Know the design of forms and shores. **(K3)**
CO4 - Study the design aspects of formwork under various requirements. **(K3)**
CO5 - Study the materials associated with formwork. **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I PLANNING, SITE EQUIPMENT AND PLANT FOR FORM WORK (9 Hrs)

Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

UNIT II MATERIALS ACCESSORIES PROPRIETARY PRODUCTS AND PRESSURES (9 Hrs)

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

UNIT III DESIGN OF FORMS AND SHORES (9 Hrs)

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

UNIT IV BUILDING AND ERECTING THE FORM WORK (9 Hrs)

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

UNIT V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS (9 Hrs)

Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed -Strength requirements -Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing

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Slope method - Form construction - Shafts. Slip Forms - Principles -Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

Text Books

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 2006.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 2003
3. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, McGraw -Hill, 2006. "Guide for Concrete Formwork", American Concrete Institute, Box No. 9150, Michigan 48219.
4. "Safety Requirements for Scaffolding", American National Standards Institute, New York, 1994

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1. Michael P. Hurst, Construction Press, London and New York, 2003.
2. "Safety Requirements for Scaffolding", American National Standards Institute. Broadway, New York, 10018.
3. Indian Concrete Institute, "Technical Monograph for Formwork", 2002.
4. Tudor Dinescu and Constantin Radulescu, "Slipform Techniques", Abacus Press, Turn Bridge Wells, Kent, 1992.
5. "Guide for Concrete Formwork", American Concrete Institute Detroit, Michigan, 1996.

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2. https://nptel.ac.in/courses/105/102/105102195/
3. https://nptel.ac.in/courses/105/102/105102088/

COs/POs/PSOs Mapping

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	3	3	-	3	-	2	3	2	2	3
CO2	3	2	3	3	2	3	3	-	3	-	3	3	2	2	3
CO3	3	2	2	2	3	3	3	-	3	-	2	3	2	2	3
CO4	3	2	2	2	3	3	3	-	3	-	2	3	2	2	2
CO5	3	2	2	2	3	3	3	-	3	-	2	3	2	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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Press, 2021
6. IS: 9178-PART-I: Indian code of practice criteria for design of steel bins for storage of bulk materials, PART-II: General requirements and assessment of loads, PART-III: Design criteria and Bins designed for mass flow and funnel flow
7. IS:5503(PART- I)-1969: Indian Code of practice for silos for grain storage
8. IS 4995-1 (1974): Criteria for design of reinforced concrete bins for storage of granular and powdery materials, Part 1: General requirements and assessment of bin loads

Web References

1. https://nptel.ac.in/courses/105/106/105106113/
2. https://nptel.ac.in/courses/105/105/105105162/
3. https://nptel.ac.in/courses/105/105/105105105/

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3
CO2	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3
CO5	3	1	1	3	3	3	3	3	3	3	2	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEE615 DESIGN OF INDUSTRIAL STRUCTURES

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

This course should enable the students to

- Understand about the planning and layout of buildings and its components.
- Have information about the functional requirements of industries.
- Perceive the design concepts of steel storage structures.
- Be acquainted with the design concepts of concrete storage structures.
- Familiarize the general principles of prefabrication and the functional requirements for precast concrete units

Course Outcomes

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

CO1 - Describe the general requirements for industries like cement, chemical and steel plants. **(K2)**
CO2 - Relate the functional requirements such as lighting, ventilation and fire safety of industries **(K2)**
CO3 - Design the steel storage structures like bunkers and silos **(K5)**
CO4 - Design the concrete storage structures like bunkers and silos **(K5)**
CO5 - Illuminate the functional requirements of Pre cast concrete units **(K2)**
KNOWLEDGE LEVEL: **K1** – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I PLANNING (9 Hrs)

Classification of Industries and Industrial structures – General requirements for industries like cement, chemical and steel plants – Planning and layout of buildings and components.

UNIT II FUNCTIONAL REQUIREMENTS (9 Hrs)

Lighting – Ventilation – Acoustics – Fire safety – Guidelines from factories act

UNIT III DESIGN OF INDUSTRIAL STEEL STRUCTURES (9 Hrs)

Industrial roofs – Crane girders – Mill buildings – Design of Bunkers and Silos.

UNIT IV DESIGN OF INDUSTRIAL RCC STRUCTURES (9 Hrs)

Silos and bunkers – Chimneys (Using C programming) – Principles of folded plates and shell roofs.

UNIT V PREFABRICATION (9 Hrs)

Principles of prefabrication and erection – Prestressed precast roof trusses- Functional requirements for Precast concrete units- Introduction to design of industrial mezzanine building

Text Books

1. Mohamed A. El-Reedy, "Construction Management and Design of Industrial Concrete and Steel Structures", CRC Press, 2010
2. Varghese.P.C., " Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2 nd Edition, 2003.
3. Bhavikatti.S.S., "Design of Steel Structures", J.K. International Publishing House Pvt.Ltd., 2009.

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1. Henn W. "Buildings for Industry", Vol.I and II, London Hill Books, 2017
2. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, 1990
3. Structural Engineering Research Centre, Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Madras, 1982
4. Koncz.J., "Manual of Precast Construction", Vol.I and II, Bauverlay GMBH, 1971.
5. Ashoke Kumar Dasgupta, "Design of Industrial Structures Reinforced Cement Concrete and Steel", CRC

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U20CEE614 **MUNICIPAL SOLID WASTE MANAGEMENT**

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

This course should enable the students to

- Impart knowledge on sources and generation of municipal solid waste.
- Gain adequate knowledge in reduction and recycle of waste.
- Understand the concept of collection methods and routes.
- Gain knowledge about the transport method of municipal solid waste
- Impart knowledge of disposal method of waste.

Course Outcomes

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

CO 1 - Understand the nature and characteristics of municipal solid wastes.**(K2)**

CO 2 - Understand the concept of reduction, reuse and recycling of waste. **(K4)**

CO 3 - Plan and design systems for storage, collection, transport, processing and disposal of municipal solid Waste.**(K3)**

CO 4 - Understand the issues on solid waste management from an integrated source.**(K4)**

CO 5 - Design and operate sanitary landfill.**(K5)**

KNOWLEDGE LEVEL: K1 – Remember, **K2** – Understand, **K3** – Apply, **K4** – Analyze and **K5** – Evaluate

UNIT I SOURCES AND CHARACTERISTICS **(9 Hrs)**

Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics –functional Elements of solid waste management – Requirements and salient features of Solid waste management rules (2016) -Role of public and NGO"s- Public Private participation – Elements of integrated Municipal Solid Waste Management Plan.

UNIT II SOURCE REDUCTION, WASTE STORAGE AND RECYCLING **(8 Hrs)**

Waste Management Hierarchy –3R-Reduction, Reuse and Recycling - source reduction of waste – On-site storage methods – Effect of storage, materials used for containers - segregation of solid wastes – Public health and economic aspects of open storage – case studies under Indian conditions – Recycling of Plastics, and Construction/Demolition wastes.

UNIT III COLLECTION AND TRANSFER OF WASTES **(8 Hrs)**

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of waste collection systems; Transfer stations –location, operation and maintenance- options under Indian conditions – Field problems- solving.

UNIT IV PROCESSING OF WASTES **(12 Hrs)**

Objective(s) of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste -composting and biomethanation; Thermal processing options – case studies under Indian conditions.

UNIT V WASTE DISPOSAL **(8 Hrs)**

Land disposal of solid waste- Sanitary landfills – site selection- design and operation of sanitary landfills – Landfill liners– Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation.

Text Books

1. William A. Worrell, P. AarneVesilind (2012) Solid Waste Engineering, Cengage Learning, 2012.
2. John Pitchel (2014), Waste Management Practices-Municipal, Hazardous and industrial – CRC Press,Taylor and Francis, New York.
3. George Tchobanoglouset.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993.
4. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994.

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Reference Books

1. CPHEEO (2014), "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization. Government of India, New Delhi.
2. George Tchobanoglous and FrankKreith (2002).Handbook of Solid waste management, McGraw Hill, New York.
3. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
4. R.E.Landreth and P.A.Rebers, "Municipal Solid Wastes – problems and Solutions", Lewis Publishers, 1997.

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3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	3	3	3	3	2	3	3	3	3	2
CO2	3	3	2	3	3	3	3	2	3	2	2	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3	3	2	3	3	3	2
CO4	2	3	2	3	2	3	2	3	3	2	2	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	2	3	3	3	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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Annexure VIII

DEPARTMENT OF CIVIL ENGINEERING

DETAILS OF EXAMINERS FOR QUESTION PAPER SETTER AND EVALUATORS

Sl. No	Name of the Examiner	Specialization	Year of Experience	Designation, Department and Institution in which currently working	Contact number and mail id
1.	Dr.S.Prakash Chandar	Construction Engineering and Management	11	Assistant Professor, Senior Grade Department of Civil Engineering, SRM Institute of Science and Technology, Chennai	9962042224 prakashs@srmist.edu.in
2.	Dr.S.Karuppasamy	Remote Sensing and GIS	17	Associate Professor, Department of Civil Engineering, SRM Institute of Science and Technology, Chennai	9791695481 karuppas@srmist.edu.in
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4.	Dr. S. Syed Ibrahim	Structural Engineering	7	Assistant Professor, Department of Civil Engineering, Sree Dattha Institute of Engineering and ScienceSheriguda, Hyderabad	8247443197 syed_ibms@yahoo.co.in
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				engineering, Tindivanam	
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31.	Dr.C.M Vivek Vardhan	Environmental Engineering	12	Associate Professor, Department of Civil Engineering, Malla Reddy Engineering College (Autonomous), Maisammaguda, Hyderabad	9985963959 vivekvardhan2@gmail.com
32.	Mr. R. K. Paramaguru	Concrete Technology	10	Associate Professor, Department of Civil Engineering, Saraswathy college of engineering and technology, Thindivanam	9790635529 rkparamaguru62@gmail.com
33.	Dr. S.Kandasamy	Concrete Technology	7	Assistant Professor, Department of Civil Engineering, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Avadi, Chennai	8190965230 skandasamyisha@gmail.com,
34.	Dr. P.Subashree	Structural Engineering	12.5	Assistant Professor, Department of Civil Engineering, Hindusthan College of Engineering and Technology, Coimbatore	6379559740 subasri03@gmail.com
35.	Dr. V. Subathra Devi	Concrete Technology	16	Associate Professor, Department of Civil Engineering, Saveetha Engineering College, Chennai	9791076767 subidevi@gmail.com
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		Water Resources		Engineering, Adhiparasakthi engineering college, Melmaruvathur Tamil Nadu	tdrdasan@gmail.com
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44.	Mr.S.Sudalai	Environmental Engineering	12	Associate Professor, Centre for Pollution Control and Environmental Engineering, School of Engineering and Technology, Pondicherry University. Puducherry	9894788723 ssudalai.cpe@gmail.com
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