

## **Curriculum and Syllabi**

### **B.E CIVIL ENGINEERING**

#### **Semesters I to VIII**

#### **Regulations 2019**

(2021 Batch Onwards)

# **Dr. Mahalingam College of Engineering and Technology**

## **Department of Civil Engineering**

### **Vision**

To develop Competent Civil Engineers to meet the infrastructure challenges of India and the world.

### **Mission**

- To become one of the reputed departments offering Civil Engineering Program in the country.
- To produce excellent engineers to cope up with the changes through dynamic, innovative, and flexible curriculum.
- To provide a conducive environment for teaching & learning and to develop leaders with effective communication skills.
- To conduct quality research driven by industry & societal needs and provide affordable engineering solutions in an ethical way.

## **Programme: B.E. – Civil Engineering**

### **Programme Educational Objectives (PEOs) - Regulation 2019**

#### **B.E Civil Engineering graduates will:**

- PEO.1 Graduates who effectively demonstrate engineering knowledge, problem solving skill, design capabilities and entrepreneurial skills by providing practical solutions.
- PEO.2 Graduates who effectively demonstrate professionalism in multi-disciplinary engineering environment, leadership quality, teamwork and engage in life-long learning.
- PEO.3 Graduates who demonstrate an ethical commitment to the community and the profession through involvement with professional societies.
- PEO.4 Graduates who make contributions to knowledge and establish best engineering practice through research and development.

### **Programme outcomes (Pos) – Regulations 2019**

- PO.1 Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.
- PO.2 Problem Analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- PO.3 Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO.4 Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO.5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- PO.6 The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- PO.7 Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO.8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO.9 Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO.10 Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO.11 Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO.12 Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **PROGRAMME SPECIFIC OUTCOMES (PSOs) - Regulations 2019**

- PSO.1 Problem Analysis:** Able to arrive solutions to real time problems related to various domains of civil engineering through problem solving skills.
- PSO2. Design and Management:** Able to design systems, components and processes considering safety, quality and cost consideration and able to prepare project documents, engineering drawings and construction schedules.

**Programme: B.E Civil Engineering**  
**2019 Regulations (2021 batch onwards)**  
**Curriculum for Semesters I to VIII**

Course Code	Course Title	Duration	Credits	Marks
19SHMG6101	Induction Program	3 Weeks	-	100

**Semester I**

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ENHG2101	Communication Skills – I	2	0	2	3	100	All
19MABC1101	Matrices and Calculus	3	1	0	4	100	AU, CE, EC, EI, EE, ME
19PHBN2101	Physics for Civil Engineering	3	0	2	4	100	-
19EESN2101	Basics of Electrical and Mechanical Engineering	3	0	2	4	100	-
19CESN3101	Engineering Drawing for Civil Engineering	0	0	4	2	100	-
19PSHG6001	Wellness for Students	0	0	2	1	100	All
<b>Total</b>		<b>11</b>	<b>1</b>	<b>12</b>	<b>18</b>	<b>600</b>	

**Semester II**

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19ENHG2201	Communication Skills – II	2	0	2	3	100	All
19MABC1201	Ordinary Differential Equations and Complex Variables	3	1	0	4	100	AU, CE, EC, EI, EE, ME
19CHBN2201	Chemistry for Civil Engineering	3	0	2	4	100	-
19CESN1201	Engineering Mechanics	3	1	0	4	100	-
19CSSC2001	C Programming	3	0	2	4	100	AU, CE, EC, EI, EE, ME
19CECN3201	Computer Aided Building Drawing Laboratory	0	0	4	2	100	-
19CHMG6201	Environmental Sciences	1	0	0	-	-	All
19PSHG6003	தமிழ்மரபு /Heritage of Tamils*	1	0	0	1	100	All
<b>Total</b>		<b>16</b>	<b>2</b>	<b>12</b>	<b>22</b>	<b>700</b>	

\* Applicable only for 2022 Batch

### Semester III

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABN1301	Transforms and Partial Differential Equations	3	1	0	4	100	All
19CECN1301	Construction Materials and Practices	3	0	0	3	100	-
19CECN1302	Transportation Engineering	3	0	0	3	100	-
19CECN1303	Surveying	4	0	0	4	100	-
19CESN1301	Solid Mechanics	3	1	0	4	100	-
19CECN3301	Surveying Practice Laboratory	0	0	3	1.5	100	-
19CECN3302	Materials Laboratory	0	0	3	1.5	100	-
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
19PSHG6004	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology**	2	0	0	1	100	All
<b>Total</b>		<b>18</b>	<b>2</b>	<b>8</b>	<b>23</b>	<b>800</b>	

\*\* Applicable only for 2022 Batch

### Semester IV

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19MABG1401	Probability and Statistics	3	1	0	4	100	All
19CECN1401	Hydraulics Engineering	3	1	0	4	100	-
19CECN1402	Concrete Technology	3	0	0	3	100	-
19CECN1403	Structural Analysis	3	1	0	4	100	-
19CECN3401	Hydraulics Engineering Laboratory	0	0	3	1.5	100	-
19CECN3402	Concrete and Transportation Engineering Laboratory	0	0	3	1.5	100	-
19PSHG6002	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	All
XXXXXXXXXX	One Credit Course	0	0	2	1	100	-
19CEPN6401	Mini – Project	0	0	4	2	100	-
<b>Total</b>		<b>14</b>	<b>4</b>	<b>12</b>	<b>24</b>	<b>900</b>	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	2 Weeks	1	100

\*Refer to clause: 4.8 in UG academic regulations 2019

### Semester V

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CESN1501	Geology and Soil Mechanics	3	1	0	4	100	-
19CECN1502	Design of RC Structures	3	1	0	4	100	-
19CECN1503	Environmental Engineering	4	0	0	4	100	-
XXXXXXXXXX	Professional Elective – I	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – II	3	0	0	3	100	-
XXXXXXXXXX	Open Elective – I	3	0	0	3	100	-
19CECN3501	Soil Mechanics Laboratory	0	0	3	1.5	100	-
19CECN3502	Environmental Engineering Laboratory	0	0	3	1.5	100	-
19PSHG6501	Employability Skills 1: Teamness and Interpersonal Skills	0	0	2	1	100	All
<b>Total</b>		<b>19</b>	<b>2</b>	<b>8</b>	<b>25</b>	<b>900</b>	<b>-</b>

### Semester VI

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CECN1601	Foundation Engineering	3	1	0	4	100	-
19CECN1602	Design of Steel Structures	3	1	0	4	100	-
19CEEN10XX	Professional Elective – III	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – IV	3	0	0	3	100	-
XXXXXXXXXX	Open Elective – II	3	0	0	3	100	-
19CECN3601	Building Drawing Laboratory	0	0	3	1.5	100	-
19CECN3602	Computer Aided Design and Drafting Laboratory	0	0	3	1.5	100	-
19PSHG6601	Employability Skills 2: Campus to Corporate	0	0	2	1	100	All
19CEPN6601	Innovative and Creative Project	0	0	4	2	100	-
<b>Total</b>		<b>15</b>	<b>2</b>	<b>12</b>	<b>23</b>	<b>900</b>	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXXXXX	Internship or Skill Development*	2 - 4 Weeks	1	100

\*Refer to clause: 4.8 in UG academic regulations 2019

### Semester VII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CECN1701	Water Resources and Irrigation Engineering	4	0	0	4	100	-
19CECN1702	Construction Project Management	4	0	0	4	100	-
XXXXXXXXXX	Professional Elective – V	3	0	0	3	100	-
XXXXXXXXXX	Professional Elective – VI	3	0	0	3	100	-
XXXXXXXXXX	Open Elective – III	3	0	0	3	100	-
19CECN3701	Quantity Surveying and Estimation Laboratory	0	0	4	2	100	-
<b>Total</b>		<b>17</b>	<b>0</b>	<b>4</b>	<b>19</b>	<b>600</b>	

### Semester VIII

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEPN6801	Project	0	0	16	8	200	-
<b>Total</b>		<b>0</b>	<b>0</b>	<b>16</b>	<b>8</b>	<b>200</b>	

Course Code	Course Title	Duration	Credits	Marks
XXXXXXX	Internship or Skill Development*	8 - 16 weeks	4	100

\*Refer to clause: 4.8 in UG academic regulations 2019

**Total Credits (2021 batch): 166**

**Total Credits (2022 batch): 168**



### VERTICAL WISE ELECTIVES

Structural Engineering Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1002	Advanced Concrete Structures	3	0	0	3	100	-
19CEEN1008	Maintenance and Rehabilitation of Structures	3	0	0	3	100	-
19CEEN1011	Prefabricated Structures	3	0	0	3	100	-
19CEEN1012	Prestressed Concrete Structures	3	0	0	3	100	-
19CEEN1019	Seismic Design of Structures	3	0	0	3	100	-
19CEEN1020	Smart Materials and Structures	3	0	0	3	100	-
19CEEN1024	Experimental Techniques	3	0	0	3	100	-

Environmental Engineering Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1003	Air Pollution Management	3	0	0	3	100	-
19CEEN1007	Industrial Waste Management	3	0	0	3	100	-
19CEEN1009	Municipal Solid Waste Management	3	0	0	3	100	-
19CEEN1025	Environmental Impact and Risk Assessment	3	0	0	3	100	-
19CEEN1026	Climatic Change and Adaption	3	0	0	3	100	-
19CEEN1027	Disaster Mitigation and Management	3	0	0	3	100	-
19CEEN1028	Sustainable Engineering and Technology	3	0	0	3	100	-

Geotechnical Engineering Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1006	Ground Improvement Techniques	3	0	0	3	100	-
19CEEN1029	Subsurface Investigation and Instrumentation	3	0	0	3	100	-
19CEEN1030	Engineering behavior of Soil	3	0	0	3	100	-

19CEEN1031	Shallow Foundation	3	0	0	3	100	-
19CEEN1032	Deep Foundation	3	0	0	3	100	-
19CEEN1033	Soil Dynamics and Machine Foundation	3	0	0	3	100	-
19CEEN1034	Reinforced Soil Structure	3	0	0	3	100	

Water Resources Engineering Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1023	Hydrology	3	0	0	3	100	-
19CEEN1035	Groundwater Engineering	3	0	0	3	100	-
19CEEN1036	Irrigation Management	3	0	0	3	100	-
19CEEN1037	Irrigation Water Quality	3	0	0	3	100	-
19CEEN1038	Watershed Conservation and Management	3	0	0	3	100	-
19CEEN1040	Remote Sensing and GIS applications in Water Resources	3	0	0	3	100	-
19CEEN3001	Irrigation and Environmental Engineering Drawing	0	0	3	1.5	100	-

Construction Engineering and Management Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1001	Advanced Construction Techniques	3	0	0	3	100	-
19CEEN1004	Building Services	3	0	0	3	100	-
19CEEN1015	Quality Control and Assurance	3	0	0	3	100	-
19CEEN1018	Safety in Construction	3	0	0	3	100	-
19CEEN1041	Construction Personnel Management	3	0	0	3	100	-
19CEEN1042	Alternative Building Materials	3	0	0	3	100	-
19CEEN1043	Economics and financial Management in Construction	3	0	0	3	100	-

Transportation and Urban Planning Electives							
Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19CEEN1016	Railways, Airport and Harbour Engineering	3	0	0	3	100	-
19CEEN1021	Architecture and Town Planning	3	0	0	3	100	-
19CEEN1044	Pavement Engineering	3	0	0	3	100	-
19CEEN1045	Traffic Engineering and Management	3	0	0	3	100	-
19CEEN1046	Housing Planning and Management	3	0	0	3	100	-
19CEEN1047	Introduction to Intelligent Transport Systems	3	0	0	3	100	-
19CEEN1048	Urban Planning and Development	3	0	0	3	100	-

#### Diversified Electives

Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
		L	T	P			
19SCEC2001	Cyber Security	2	0	2	3	100	All
19MEEC1025	Fundamentals of Entrepreneurship	3	0	0	3	100	All
19MEEC1026	Design Thinking and Innovation	3	0	0	3	100	All
19ITEN1029	Intellectual Property Rights	3	0	0	3	100	All

#### Open Electives

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
19CEOC1001	Environmental Impact Assessment	3	0	0	3	100
19CEOC1002	Safety Engineering	3	0	0	3	100
19CEOC1003	Geographical Information System	3	0	0	3	100
19CEOC1004	Applied Design thinking concepts	3	0	0	3	100
19CEOC1005	Startup Fundamentals for Engineers	3	0	0	3	100

**Regulations 2019**

**Detailed Syllabi for  
Semesters I to VIII**

<b>Course Code: 19SHMG6101</b>	<b>Course Title: Induction Program</b> (common to all B.E/B.Tech programmes)
<b>Course Category: Mandatory Non-Credit Course</b>	<b>Course Level: Introductory</b>
<b>Duration: 3 Weeks</b>	<b>Max. Marks:100</b>

#### **Pre-requisites**

- Nil

#### **Course Objectives**

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources.
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus.
3. Explain the opportunity available for professional development.
4. Build universal human values and bonding amongst all the inmates of the campus and society.

#### **List of Activities:**

1. History of Institution and Management: Overview on NIA Education Institutions-Growth of MCET – Examination Process-OBE Practices – Code of Conduct – Centre of Excellence
2. Lectures by Eminent People, Motivational Talk – Alumni, Employer
3. Familiarization to Dept./Branch: HoD Interaction – Senior Interaction – Department Association
4. Universal Human Value Modules: Module 1, Module 2, Module 3 and Module 4
5. Orientation on “Professional Skill Courses”
6. Proficiency Modules – Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cell, Clubs and its events
8. Creative Arts: Painting, Music and Dance
9. Physical Activity: Games and Sports, Yoga and Gardening
10. Group Visits: Visit to Local areas and Campus Tour

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1: Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-

High-3; Medium-2; Low-1

## **SEMESTER I**

<b>Course Code: 19ENHG2101</b>		<b>Course Title: COMMUNICATION SKILLS – I</b> (Common to all B.E/B.Tech Programmes)	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>2: 0: 2</b>	<b>Credits:3</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- The student should have undergone English as his/her first or second language in school.

### **Course Objectives**

The course is intended to:

1. Listen and understand monologues and dialogues of a native speaker on par with B1 of CEFR level.
2. Speak in simple sentences to convey their opinions and ideas on par with B1 of CEFR level.
3. Read and infer a given text on par with B1 of CEFR level.
4. Draft basic formal written communication on par with B1 of CEFR level.

### **UNIT I – LISTENING**

**15 Hours**

Importance of active listening –Physical condition needed for active listening –Identifying relevant points while taking notes – Framing questions at different linguistic contexts – Listening for specific details of concrete monologues and dialogues –Listening to organize ideas – Developing ideas –Listening to compose paragraphs – Paraphrasing the aural input.

### **UNIT II – SPEAKING**

**15 Hours**

Importance of note making to practice speaking – Traditional note making, developing Mind map – Collecting points from various sources – Identifying relevant ideas needed for the speech –Using mind-map to organize thought processing – Prioritizing the ideas – Types of sentences –Frequently used words (Institution, home and leisure) – Mother Tongue Influence – Expressing the thoughts in simple sentences – Tenses & Voices (Active & Passive) – Postures, gestures and eye contact – Intonation and Sentence stress – Express one's thoughts coherently.

### **UNIT III – READING**

**15 Hours**

Reading strategies – Skimming –Scanning – Interpretation of visual data – Factual texts on subjects of relevance – Inferring texts – Reading to write a review –Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend.

### **UNIT IV – WRITING**

**15 Hours**

Writing Simple and short sentences – Writing E-mail, Memo, Note and Message – Letter Writing – Importance of punctuations – Identifying the main points – Organising the main ideas – Writing a draft.

## LABORATORY COMPONENT

### LIST OF TASKS:

1. BEC Preliminary Listening Test–1 & Speaking Test–1.
2. BEC Preliminary Listening Test–2 & Speaking Test–2.
3. BEC Preliminary Listening Test–3 & Speaking Test–3.
4. BEC Preliminary Listening Test–4 & Speaking Test–4.
5. BEC Preliminary Listening Test–5 & Speaking Test–5.
6. BEC Preliminary Listening Test–6 & Speaking Test–6.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Listen actively and paraphrase simple messages and specific details of concrete monologues and dialogues	Apply
CO.2 Express one's views coherently in a simple manner	Apply
CO.3 Read and comprehend factual texts on subjects of relevance	Understand
CO.4 Write texts bearing direct meanings for different contexts maintaining an appropriate style	Apply

### Text Book(s):

- T 1. Whitby Norman, Business Benchmark Pre–intermediate to Intermediate Students' Book CUP Publications, 2nd Edition, 2014.
- T 2. Wood Ian, Williams Anne, Cowper Anna, Pass Cambridge BEC Preliminary, Cengage Learning, 2<sup>nd</sup> edition, 2015.
- T 3. Learners Book prepared by the faculty members of Department of English.

### Reference Book(s):

- R 1. BEC - Preliminary – Cambridge Handbook for Language Teachers, 2nd Edition, CUP 2000.
- R 2. Hewings Martin – Advanced Grammar in use – Upper–intermediate Proficiency, CUP, Third Edition, 2013.

### Web References:

1. <http://www.grammarinenglish.com> –Jan 23,2018
2. [https://www.northshore.edu/support\\_centre/pdf/listen-notes.pdf](https://www.northshore.edu/support_centre/pdf/listen-notes.pdf)
3. [http://www.examenqlish.com/BEC/BEC\\_Vantage.html](http://www.examenqlish.com/BEC/BEC_Vantage.html)

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	1	2	1	3	-	1	-	1
CO2	-	-	-	-	-	1	1	2	1	3	-	1	-	1
CO3	-	-	-	-	-	1	1	2	1	3	-	1	-	1
CO4	-	-	-	-	-	1	1	2	1	3	-	1	-	1

High–3; Medium–2; Low–1



<b>Course Code: 19MABC1101</b>		<b>Course Title: MATRICES AND CALCULUS</b> (Common to AU, CE, MC, ME, EC, EI & EE)	
<b>Course Category: Basic Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

**Pre-requisites**

➤ NIL

**Course Objectives**

The course is intended to:

1. Determine the canonical form of a Quadratic form using Orthogonal transformation
2. Use different testing methods to check the convergence of infinite series.
3. Apply differential and integral calculus to determine the evolutes of a curve and improper integrals.
4. Apply partial derivatives to find extreme values of functions of two variables.
5. Apply multiple integrals to find area of plane curves and volume of solids.

**UNIT I – MATRICES**

**9+3 Hours**

Rank of a matrix – System of linear equations – Symmetric – Skew symmetric and orthogonal matrices – (Definitions and examples only) – Eigenvalues and Eigenvectors – Diagonalization of symmetric matrices through orthogonal transformation – Cayley – Hamilton Theorem – Transformation of quadratic forms to canonical forms through orthogonal transformation.

**UNIT II – SEQUENCES AND SERIES**

**9+3 Hours**

Sequences – Definition and Examples – Series – Tests for convergence– Power series – series for exponential, trigonometric and logarithm functions – Comparison Test – Integral Test – Cauchy's root test – D Alembert's ratio test – Alternating series – Leibnitz's test.

**UNIT III – DIFFERENTIAL AND INTEGRAL CALCULUS**

**9+3 Hours**

Reading strategies – Skimming –Scanning – Interpretation of visual data – Factual texts on subjects of relevance – Inferring texts – Reading to write a review –Checking the accuracy of reading while presenting the interpreted data – Reading to comprehend.

**UNIT IV – MULTIVARIABLE DIFFERENTIATION**

**9+3 Hours**

Writing Simple and short sentences – Writing E-mail, Memo, Note and Message – Letter Writing – Importance of punctuations – Identifying the main points – Organising the main ideas – Writing a draft.

**UNIT V – MULTIVARIABLE INTEGRATION**

**9+3 Hours**

Multiple Integration: Double integrals – Change of order of integration in double integrals – Change of variables (cartesian to polar, cartesian to spherical and cartesian to cylindrical) – Triple integrals – Applications: areas and volumes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Determine the canonical form of a Quadratic form using Orthogonal transformation	Apply
CO.2 Use different testing methods to check the convergence of infinite series.	Apply
CO.3 Determine the evolute of a curve and evaluate improper integrals using beta gamma functions	Apply
CO.4 Apply partial derivatives to find extreme values of functions of two variables.	Apply
CO.5 Apply multiple integrals to find area of plane curves and volume of solids	Apply

#### Text Book(s):

- T1. Erwin kreyzig, "Advanced Engineering Mathematics", 10th edition, John Wiley & Sons, 2015.
- T2. Veerarajan T., "Engineering Mathematics for First Year" , Tata McGraw-Hill, New Delhi, 2011.
- T3. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, 1st edition, 2017.

#### Reference Book(s):

- R 1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2010.
- R 2. N.P.Bali and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publication, 9th edition, 2010.
- R 3. B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition, 2014.

#### Web References:

- [https://onlinecourses.nptel.ac.in/noc16\\_ma05](https://onlinecourses.nptel.ac.in/noc16_ma05)
- <https://nptel.ac.in/courses/122101003/2>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19PHBN2101</b>		<b>Course Title: PHYSICS FOR CIVIL ENGINEERING</b>	
<b>Course Category: Basic Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 2</b>	<b>Credits:4</b>	<b>Total Contact Hours:75</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

1. Determine the equilibrium condition of particles and rigid bodies.
2. Inculcate the knowledge of elastic properties of materials.
3. Calculate geometric properties like centre of gravity, moment of inertia and mass moment of inertia for various sections.
4. Explain the principles of waves and acoustics for civil engineering applications.
5. Determine the quality of materials through Non-Destructive Testing (NDT).

### **UNIT I – BASICS OF MECHANICS**

**9 Hours**

Review of fundamental laws of mechanics – scalars, vectors – Newton's law of mechanics, Gravitational law. Particles and rigid body, Concept of force and its effect on rigid body system of forces–Free body diagram–principle of transmissibility–equilibrium conditions–equilibrium of particles subjected to coplanar and non-coplanar force system – equilibrium of particles subjected to coplanar Triangle law, Parallelogram law and Lami's theorem.

### **UNIT II – PROPERTIES OF MATTER**

**9 Hours**

Elasticity – Stress strain diagram and its uses – Elastic constants – Factors affecting elastic modulus and tensile strength – Twisting couple – Torsion stress and deformations – Torsion pendulum: Theory and experiment – Bending of beams – Bending moment – Cantilever: Theory and experiment – I shaped girders – Stress due to bending in beams.

Viscosity: Coefficient of viscosity, streamline and turbulent flow, Reynold's number, Experimental determination of low and high viscous liquids: *Poiseuille's and Stoke's* method.

### **UNIT III – PROPERTIES OF SURFACES AND SOLIDS**

**9 Hours**

Centroid and centre of mass– Centroid of lines and areas – Area moments of inertia of plane areas –Theorems of Pappus – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia–Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle.

### **UNIT IV – WAVES AND ACOUSTICS**

**9 Hours**

Introduction to waves–Longitudinal and transverse waves, speed of wave motion. Seismic waves: P waves, S waves, Surface waves, Love waves, Rayleigh waves– isolation of structures against seismic waves.

Classification of sound – decibel– Weber–Fechner law – Sabine's formula– derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting

acoustics of buildings and their remedies. Methods of sound absorptions – absorbing materials – noise and its measurements, sound insulation and its measurements, impact of noise in multi-storeyed buildings.

## UNIT V – NON-DESTRUCTIVE TESTING (NDT)

9 Hours

Liquid Penetrant Method – Characteristics of Liquid Penetrant Testing materials, X-Ray Radiographic testing: Tube shift method – Exposure factor – Attenuation – Principle of Ultrasonic testing: Ultrasonic transducer – Couplant – Ultrasonic flaw detector: Pulse echo system, transmission, A, B & C scan displays - Inspection standards.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Determine the equilibrium condition of particles and rigid bodies using the law of mechanics	Understand
CO.2 Explain the elastic properties of materials.	Understand
CO.3 Calculate geometric properties like centre of gravity, moment of inertia and mass moment of inertia for various sections.	Understand
CO.4 Explain the principles of waves and the factors affecting acoustics of buildings and their remedies.	Understand
CO.5 Describe the Non-Destructive Testing (NDT) methods to inspect the quality of materials.	Understand

### Text Book(s):

- T 1. F. P. Beer, E. R. Johnston Jr, "Vector Mechanics for Engineers (in SI Units): Statics and Dynamics", 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.
- T 2. M.N. Avadhanulu, P.G. Kshirsagar, "A Textbook of Engineering Physics", S. Chand & Co., New Delhi, 2011.

### Reference Book(s):

- R 1. D.S. Mathur, "Properties of Matter", S. Chand & Co., New Delhi, 2012.
- R 2. V. Rajendran, "Engineering Physics", Tata McGraw-Hill Publishing Co. Ltd., New Delhi 2017.
- R 3. R. C. Hibbeler, "Engineering Mechanics: Combined static and dynamics", Prentice Hall, 2010.

### Web References:

- <http://www.physicsclassroom.com/>
- <http://nptel.ac.in/course.php?disciplineId=115>

### LIST OF EXPERIMENTS (ANY FIVE):

#### ENGINEERING PHYSICS LABORATORY

- Determination of Young's Modulus of the material – Cantilever bending method.
- Determination of Moment of inertia of the metallic disc – Torsional Pendulum method.
- Determination of Rigidity modulus of the metallic wire – Torsional Pendulum method.
- Determination of Viscosity of less viscous liquid – *Poiseuille's method*.
- Determination of Viscosity of high viscous liquid – *Stoke's method*.

6. Determination of velocity and compressibility of ultrasonics in given liquid.

7. Verification of Lami's Theorem

**Course Articulation Matrix\***

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	1	1	-	1	-	1	-	-
CO2	2	1	-	-	-	-	1	1	-	1	-	1	-	-
CO3	2	1	-	-	-	-	1	1	-	1	-	1	-	-
CO4	2	1	-	-	-	-	1	1	-	1	-	1	-	-
CO5	2	1	-	-	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19EESN2101</b>		<b>Course Title: BASICS OF ELECTRICAL AND MECHANICAL ENGINEERING</b>	
<b>Course Category: Engineering Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 2</b>	<b>Credits:4</b>	<b>Total Contact Hours:75</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- NIL

#### **Course Objectives**

The course is intended to:

1. Explain the basic concepts and laws of electrical engineering
2. Describe the basics of wiring
3. Explain the basic concepts of electronics engineering
4. Explain the concepts of Conventional and Non-conventional power sources
5. Explain the concepts of Refrigeration and Air conditioning systems

#### **UNIT I – INTRODUCTION TO ELECTRICAL ENGINEERING**

**9 Hours**

DEFINITION – symbol and units of electrical quantities–Active and passive elements –ohms law statement illustration, and limitation – Kirchhoff's law statement and illustration – Resistance in series and voltage division technique – Resistance in parallel and current division technique – Method of solving a circuit by Kirchhoff's law – Star to delta and delta to star transformation

#### **UNIT II – INTRODUCTION TO AC MACHINES AND WIRING**

**9 Hours**

Construction, Principle of Operation of Single phase and Three phase Induction machines – BASIC OF WIRING: Basic components of Wiring (Wires, Switches, Fuses, sockets, plug, lamps and lamp holders, rating of different accessories and its functions). TYPES OF CIRCUIT: Open circuit –Closed circuit –Short circuit. WIRING METHODS: Series circuit –Parallel circuit – Combination of series and parallel circuit. Illustration of House Wiring–Safety Precautions and measures

#### **UNIT III – INTRODUCTION TO ELECTRONICS ENGINEERING**

**9 Hours**

Intrinsic and extrinsic semiconductor, PN junction diode – construction – working, bipolar junction transistor – construction – working, static and dynamic characteristics of instruments – units and standards of measurements – general measurements systems – data acquisition systems – sensors in civil engineering – acoustic emission sensor – fibre optic sensor

#### **UNIT IV – CONVENTIONAL AND NON-CONVENTIONAL POWER PLANTS**

**9 Hours**

Power plant – Definition, Classifications – Layout of Steam power plant, hydroelectric power plant, Diesel power plant, nuclear power plant, Solar power plant, wind energy conversion system, Bio- gas power plant, Geothermal power plant, OTEC, MHD, and Tidal power plant.

#### **UNIT V – REFRIGERATION AND AIR CONDITIONING SYSTEMS**

**9 Hours**

Refrigeration – terminologies, COP, Refrigerant – types and properties, Classifications – Vapour compression refrigeration system, vapour absorption refrigeration system, Layout of a

typical domestic refrigerator. Air conditioning system – definition, classifications – working of the window, split and year-round air conditioning systems.

### LIST OF EXERCISES:

1. Making of two-way staircase wiring for lamp and making of internal wiring of tube light and checking connection.
2. Making of a domestic wiring circuit to connect a light, a fan with a regulator and a socket
3. VI Characteristics of PN Diode and common emitter configuration of BJT.
4. Study of wind turbine power plant and solar power plant
5. Study and performance analysis of vapour compression refrigeration system
6. Study and performance analysis of Air Conditioning system.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the basic concepts and laws of electrical engineering.	Understand
CO.2 Describe the basics of wiring.	Understand
CO.3 Explain the basic concepts of electronics engineering.	Understand
CO.4 Explain the concepts of Conventional and Non-conventional power sources.	Understand
CO.5 Explain the concepts of Refrigeration and Air conditioning systems.	Understand

### Text Book(s):

- T1. S.C. Arora and S Domkundwar, “A course in Power Plant Engineering” Dhanpatrai & Sons, New Delhi, 2008.
- T2. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, (2006).
- T3. Kalsi .H.S, “Electronics Instrumentation”, 3<sup>rd</sup> Edition (copyright 2010, Second Reprint 2011) Tata McGraw Hill, New Delhi, 2010

### Reference Book(s):

- R 1. Manohara Prasad, “Refrigeration and Air conditioning”, New Age International, 2004.
- R 2. Bhattacharya, “Electrical Machines”, Tata McGraw Hill, Second Edition, 2008.
- R 3. Ray C. Mullin, Phil Simmons, “Electrical Wiring Commercial” Cengage learning, 2011
- R 4. John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, “Electrical Safety Handbook” Tata McGraw Hill third edition, 2005
- R 5. Ming L. Wang, Jerome P. Lynch, HoonSohn “Sensor Technologies for Civil Infrastructures, Volume 1: Sensing Hardware and data collection methods and performance assessment”, Elsevier–2014

- R 6. Millman J, Halkias .C and Satyabratajit, "Electronic Devices and Circuits", Second Edition, Tata McGraw-Hill, New Delhi, 2007
- R 7. Jeyachandran.K, Natarajan.S. & Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
- R 8. Electrical practices laboratory manual for civil engineers – MCET.

**Web References:**

1. <https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment>

**Course Articulation Matrix\***

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	1	2	3	-	-	-	-
CO2	1	-	-	-	-	-	-	1	2	3	-	-	-	-
CO3	1	-	-	-	-	-	-	1	2	3	-	-	-	-
CO4	1	-	-	-	-	-	-	1	2	3	-	-	-	-
CO5	1	-	-	-	-	-	-	1	2	3	-	-	-	-

\*Subject to change based on assessment.  
High-3; Medium-2; Low-1



<b>Course Code: 19CESN3101</b>		<b>Course Title: ENGINEERING DRAWING FOR CIVIL ENGINEERING</b>	
<b>Course Category: Engineering Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 4</b>	<b>Credits:2</b>	<b>Total Contact Hours: 60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- Understand and develop the skill of drawing different symbols of civil engineering drawings, building components, orthographic projection, isometric views of simple objects and buildings, perspective view of simple building, plan and elevation residential buildings.

### **UNIT I – INTRODUCTION TO ENGINEERING DRAWING**

**3+9 Hours**

Importance of graphics in engineering applications – Size, layout and folding of drawing sheets – Lettering and dimensioning – Methods of Dimensioning – BIS standards and symbols in civil engineering drawing – building terminologies as per NBC – First angle projection – projection of points and lines.

### **UNIT II – ORTHOGRAPHIC PROJECTION**

**3+9 Hours**

Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – layout of views –Orthographic projection of simple objects – drawing views of doors, windows, dog legged staircase.

### **UNIT III – ISOMETRIC PROJECTIONS**

**3+9 Hours**

Isometric Projection of solids – practices on simple solids like prisms, pyramids, cylinder& cone – practices on simple residential buildings.

### **UNIT IV –PERSPECTIVE PROJECTIONS**

**3+9 Hours**

Concepts of Perspective projection of simple solids like prisms, pyramids by Visual Ray Method – Concepts of Perspective projection of building by vanishing point method.

### **UNIT V – BUILDING DRAWING**

**3+9 Hours**

Introduction to types & Orientation of buildings – types of foundations – trusses. Drawing of different views of Isolated wall foundation – column footing (stepped footing, combined footing, trapezoidal footing) – drawing of plan and elevation view of two room building.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Draw the various symbols used for civil engineering drawings.	Apply
CO.2 Draw the orthographic views of building components.	Apply
CO.3 Draw the isometric views of simple objects and buildings.	Apply
CO.4 Draw the perspective view of residential building.	Apply
CO.5 Draft plan and elevation of residential buildings.	Apply

#### **Text Book(s):**

- T 1. Rangawala, "A text book of Civil Engineering Drawing", Charotar publishers, 3<sup>rd</sup> edition, 2017.
- T 2. N. Kumaraswamy & A. Kameswara Rao, "Building Planning and Drawing", Charotar publishers, 8<sup>th</sup> edition, 2015

#### **Reference Book(s):**

- R 1. Anurag A. Kandya, "Elements of Civil Engineering" Charotar publishers, 3<sup>rd</sup> edition, 2017 (Reprint)
- R 2. B.P. Verma, "Civil Engineering Drawing & House Planning", Khanna publishers, 12<sup>th</sup> edition, 2006

#### **PUBLICATIONS OF BUREAU OF INDIAN STANDARDS**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. The mode of delivery is like practical.
6. National building code of India (SP-7) Volume 1, Part 3 – "Development control rules and general building requirements", third revision 2016.

#### **Web References:**

1. <http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html>
2. [http://web.iitd.ac.in/~achawla/public\\_html/201/lectures/sp46.pdf](http://web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf)

#### **List of Experiments:**

1. Lettering, Dimensions & drawing of civil engineering drawing symbols.
2. Orthographic projection of simple solids
3. Drawing of elevation of doors & windows
4. Drawing of plan & elevation of dog legged staircase
5. Isometric projection of simple solids & buildings
6. Perspective projection of simple solids and buildings
7. Drawing of different views of foundation.
8. Drawing plan and elevation of two room building.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	2	2	-	2	2	-
CO2	1	-	-	-	-	-	-	-	2	2	-	2	2	-
CO3	1	-	-	-	-	-	-	-	2	2	-	2	2	-
CO4	1	-	-	-	-	-	-	-	2	2	-	2	2	-
CO5	1	-	-	-	-	-	-	-	2	2	-	2	2	-

High-3; Medium-2; Low-1

## **SEMESTER II**

<b>Course Code: 19ENHG2201</b>		<b>Course Title: COMMUNICATION SKILLS – II</b> (Common to all B.E/B.Tech Programmes)	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>2: 0: 2</b>	<b>Credits:3</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Communication Skills – I

### **Course Objectives**

The course is intended to:

- Listen and understand monologues and dialogues of a native speaker on par with B2 of CEFR level.
- Speak in simple sentences to convey their opinion and ideas on par with B2 of CEFR level.
- Read and infer a given text on par with B2 of CEFR level.
- Draft basic formal written communication on par with B2 of CEFR level.

### **UNIT I – LISTENING**

**15 Hours**

Importance and purpose of extensive listening and intensive listening –Body Language – Listening tasks on complex and abstract themes – Correlating Ideas related to listening input – importance of empathetic – listening for main ideas – Paraphrasing– Listening to native speakers English – Compound and Complex sentences – Developing ideas – Listening to compose paragraphs.

### **UNIT II – SPEAKING**

**15 Hours**

Jotting down ideas collected from listening to speak – organising the ideas – Expressing one's view coherently – Understanding grammatical elements (Noun – Pronoun Antecedent) – Expressing ideas assertively – Answering questions during presentations – Understanding the use of discourse markers – word stress and sentence stress – voice modulation and pauses – Highlighting significant points – interpretation of visual data – Using verbal cues – Preparing simple hand – outs.

### **UNIT III – READING**

**15 Hours**

Reading strategies – Skimming &Scanning – Inferring meaning– Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques – Reading different types of texts and their contexts with speed – Note making – Reading a review – Paraphrasing – Reading to comprehend

### **UNIT IV – READING**

**15 Hours**

Reading strategies – Skimming &Scanning – Inferring meaning– Barriers to reading – sub vocalisation, Eye fixation, Regression – Speed Reading Techniques – Reading different types

of texts and their contexts with speed – Note making – Reading a review – Paraphrasing – Reading to comprehend.

### **UNIT V – WRITING**

**15 Hours**

Reported speech & Concord (Subject – verb Agreement) – Report writing – Different kinds of Report – Structure of the report – Writing Proposal – Plagiarism – References – Appendices – Techniques for Report writing – Registers.

### **LABORATORY COMPONENT**

#### **LIST OF TASKS:**

1. BEC Vantage Listening Test-1 & Speaking Test-1.
2. BEC Vantage Listening Test-2 & Speaking Test-2.
3. BEC Vantage Listening Test-3 & Speaking Test-3.
4. BEC Vantage Listening Test-4 & Speaking Test-4.
5. BEC Vantage Listening Test-5 & Speaking Test-5.
6. BEC Vantage Listening Test-6 & Speaking Test-6.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Listen actively and empathetically, and paraphrase discussions and presentations on complex and abstract themes and topics	Apply
CO.2 Express one's views coherently, fluently and confidently highlighting the significant points with supporting details	Apply
CO.3 Read and comprehend different types of texts and their contexts reasonably at moderate speed	Understand
CO.4 Write detailed reports on variety of subjects synthesizing information gathered during listening & reading citing appropriate references	Apply

#### **Text Book(s):**

- T 1. Whitby Norman, Business Benchmark Upper Intermediate Students' Book CUP Publications, 2nd Edition, 2014.
- T 2. Learners Book prepared by the faculty members of Department of English.

#### **Reference Book(s):**

- R 1. Cambridge BEC Vantage - Practice Tests, Self-study Edition, Cambridge University Press, 2002
- R 2. Hewings Martin - Advanced Grammar in use - Upper-intermediate Proficiency, CUP, Third Edition, 2013.

#### **Web References:**

1. <http://www.grammarinenglish.com> - Jan 23, 2018
2. [https://www.northshore.edu/support\\_centre/pdf/listen-notes.pdf](https://www.northshore.edu/support_centre/pdf/listen-notes.pdf)
3. [http://www.examenglish.com/BEC/BEC\\_Vantage.html](http://www.examenglish.com/BEC/BEC_Vantage.html)

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	1	3	-	1	-	1
CO2	-	-	-	-	-	-	-	2	1	3	-	1	-	1
CO3	-	-	-	-	-	-	-	2	1	3	-	1	-	1
CO4	-	-	-	-	-	-	-	2	1	3	-	1	-	1
CO5	-	-	-	-	-	-	-	2	1	3	-	1	-	1

High-3; Medium-2; Low-1

<b>Course Code: 19MABC1201</b>		<b>Course Title: ORDINARY DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES</b> (Common to AU, CE, MC, ME, EC, EI, EE)	
<b>Course Category: Basic Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits: 4</b>	<b>Total Contact Hours: 60</b>	<b>Max Marks:100</b>

### Pre-requisites

- Matrices and Calculus

### Course Objectives

The course is intended to:

1. Explain the concepts of vector differentiation and integration.
2. Determine the solution of second and higher order ordinary differential equations
3. Construct analytic functions
4. Use the concept of complex integration to evaluate definite integrals.
5. Apply Laplace transform techniques to solve ordinary differential equations

### UNIT I - VECTOR CALCULUS

**9+3 Hours**

Gradient – Divergence – Curl – Line integrals – Surface integrals – Volume integrals – Theorems of Green, Gauss and Stokes (without proof) and their applications.

### UNIT II - COMPLEX VARIABLES (DIFFERENTIATION)

**9+ 3 Hours**

Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping ( $w=z+a$ ,  $w=az$ ,  $w=1/z$ ) – Mobius transformation and their properties.

### UNIT III - COMPLEX VARIABLES (INTEGRATION)

**9+3 Hours**

Contour integrals – Cauchy Integral formula (without proof) – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series–Residues – Cauchy Residue theorem (without proof) – Evaluation of real definite integrals around unit circle and semi circle (Excluding poles on the real axis).

### UNIT IV - ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS

**9+3 Hours**

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation– Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations

### Unit V - LAPLACE TRANSFORM

**12 Hours**

Laplace Transform – Properties of Laplace Transform – Laplace transform of integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method – Applications on engineering problems.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the concepts of vector differentiation and integration.	Apply
CO.2 Use the concept of complex variables to construct analytic functions	Apply
CO.3 Use the concept of complex integration to evaluate definite integrals	Apply
CO.4 Use the concept of complex integration to evaluate definite integrals	Apply
CO.5 Apply Laplace transform techniques to solve ordinary differential equations	Apply

**Text Book(s):**

T1. Erwin kreyzig, Advanced Engineering Mathematics, 9<sup>th</sup> edition, John Wiley & Sons, 2015.

T2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2011.

T3. Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11th Reprint, 2017.

**Reference Book(s):**

R.1 G.B. Thomas and R.L Finney, Calculus and Analytic Geometry, 9<sup>th</sup> edition, Pearson, Reprint, 2010.

R.2 N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2010.

R.3 B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36<sup>th</sup> Edition, 2014.

**Web References:**

1. [https://onlinecourses.nptel.ac.in/noc16\\_ma05](https://onlinecourses.nptel.ac.in/noc16_ma05)

2. <https://nptel.ac.in/courses/122101003/2>

3. <https://nptel.ac.in/courses/111105035/22>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	-	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	-	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	-	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	-	1	-	1	-	1	-	-
CO5	3	2	1	1	-	-	-	1	-	1	-	1	-	-

High-3; Medium-2; Low-1



<b>Course Code: 19CHBN2201</b>		<b>Course Title: CHEMISTRY FOR CIVIL ENGINEERING</b>	
<b>Course Category: Basic Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 2</b>	<b>Credits: 4</b>	<b>Total Contact Hours:75</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

1. Explain the chemistry of water and water conditioning methods.
2. Explain the mechanism of corrosion and corrosion control
3. Explain different renewable energy sources and storage devices.
4. Describe the preparation, properties and applications of engineering plastics
5. Describe the chemistry of building materials in modern construction.

### **UNIT I - WATER TECHNOLOGY**

**9 Hours**

. Water quality parameters–Types of water- Hardness of water – Types, expression, units, problems - determination of hardness by EDTA method – Boiler feed water - boiler troubles (scale, sludge, priming, foaming, caustic embrittlement, Boiler corrosion) - Water conditioning methods – Internal conditioning – phosphate, calgon and sodium aluminate conditioning, External conditioning – demineralization, Desalination of brackish water-reverse osmosis process

### **UNIT II - CORROSION AND CONTROL**

**9 Hours**

Corrosion- causes- consequences - types- chemical, electrochemical corrosion (galvanic, differential aeration-Pitting corrosion), factors influencing corrosion (Based on Metal and Environment)-corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function

### **UNIT III - ENERGY SOURCES AND STORAGE DEVICES**

**9 Hours**

Introduction – Nuclear energy - nuclear fission - nuclear fusion - nuclear chain reactions - nuclear reactor power generation - classification of nuclear reactor - solar energy conversion - solar cells - wind energy, Batteries - Types of batteries- alkaline battery - lead storage battery - lithium-ion battery.

### **UNIT IV - POLYMERS, PLASTICS AND COMPOSITES**

**9 Hours**

Polymers–definition-polymerization-types-addition and condensation polymerization-classification – Terminologies – Plastics – Classification, Engineering plastics (PVC, Teflon, Polycarbonates, Polyurethanes, PET)– preparation, properties and uses, Compounding of plastics – Moulding technique – blow and extrusion. Polymer composites – FRP and ceramic matrix composites.

## UNIT V - CHEMISTRY OF BUILDING MATERIALS

9 Hours

Chemistry of lime and gypsum, Cement – chemical composition, classification, manufacture by wet and dry process, setting and hardening of cement, chemical reactions during the hydration of cement, waterproof and white cement–properties and uses, Chemistry and applications of ceramics, fly ash and glass in construction

### LABORATORY COMPONENT

#### LIST OF EXPERIMENTS:

1. Estimation of hardness of water by EDTA method.
2. Determination of corrosion rate of mild steel by weight loss method.
3. Determination of molecular weight of polymer by viscometric method.
4. Determination of percentage of calcium oxide in cement by titrimetric method
5. Estimation of strength of hydrochloric acid by pHmetry.
6. Determination of iron in water by spectrophotometry.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Calculate hardness of water based on water quality parameters associated with water conditioning methods	Apply
CO.2 Explain the mechanism of corrosion and its control techniques.	Understand
CO.3 Explain different renewable energy sources and storage devices.	Understand
CO.4 Identify a suitable plastic for a specific engineering application.	Understand
CO.5 Describe the chemistry of building materials in modern construction.	Understand

#### Text Book(s):

- T 1. Jain & Jain, Engineering Chemistry (All India), 17<sup>th</sup> edition, Dhanpat Rai Publishing Company(P) Ltd, New Delhi, 2018
- T 2. Wiley Engineering Chemistry, Second Edition, Wiley India Pvt Ltd, New Delhi, 2011

#### Reference Book(s):

- R 1. Dara S.S., and Umare S.S., A text book of Engineering Chemistry, S.Chand & Co Ltd, New Delhi, 2014
- R 2. V.R.Gowariker, N.V.Viswanathan and Jayadev Sreedhar, Polymer Science, New Age International( P) Ltd, Chennai, 2006
- R 3. Renu Bapna and Renu Gupta, Engineering Chemistry, Macmillan India Publisher Ltd, 2010
- R 4. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2012
- R 5. Shoemaker D.P. and C.W.Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London, 2009

**Web References:**

1. <http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf>
2. <https://nptel.ac.in/courses/104106075/Week1/MODULE%201.pdf>
3. <https://nptel.ac.in/courses/103102015/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	1	1	-	3	3	-	3	-	-
CO2	2	1	-	-	-	1	1	-	3	3	-	3	-	-
CO3	2	1	-	-	-	1	1	-	3	3	-	3	-	-
CO4	2	1	-	-	-	1	1	-	3	3	-	3	-	-
CO5	2	1	-	-	-	1	1	-	3	3	-	3	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CESN1201</b>		<b>Course Title: ENGINEERING MECHANICS</b>	
<b>Course Category: Engineering Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours: 60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Physics for Civil Engineering

### **Course Objectives**

The course is intended to:

1. Gain knowledge on Equilibrium of rigid bodies.
2. Gain knowledge on application of equilibrium.
3. Gain knowledge on Friction.
4. Gain knowledge on Dynamics of particles.
5. Gain knowledge on Dynamics of rigid bodies.

### **UNIT I - EQUILIBRIUM OF RIGID BODIES**

**9+3 Hours**

Types of supports - Types of beams and loads - Free body diagram - Action and reaction forces - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force - Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions.

### **UNIT II - APPLICATION OF EQUILIBRIUM**

**9+3 Hours**

Introduction to static determinacy and indeterminacy of beams and trusses - Types of trusses - Analysis for member forces by method of joints and method of sections - Shear force and bending moment diagram - simply supported, cantilever and overhanging beams - Relationship between load, bending moment and shear force - Theory of simple bending, analysis of beams for stresses - Stress distribution at a cross section due to bending moment and shear force for cantilever, simply supported and overhanging beams with different loading conditions - Flitched Beams.

### **UNIT III – FRICTION**

**9+3 Hours**

Frictional force - Laws of Coulomb friction - Coefficient of Static and Kinematic friction -Block Friction - Motion Impending (Static and Kinematic) - Coplanar systems with friction (Ladder, Wedges and Screw).

### **UNIT IV - DYNAMICS OF PARTICLES**

**9+3 Hours**

Kinematics of particles - Displacements, Velocity and acceleration, their relationship - Relative motion - Rectilinear and Curvilinear motions

### **UNIT V - DYNAMICS OF RIGID BODIES**

**9+3 Hours**

Kinetics of rigid bodies - Newton's law - D' Alembert's principle - Work, Energy equation of particles - Impulse and Momentum - Impact of elastic bodies - Natural Frequency - Time period - Mode shapes.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Calculate the forces and moments using equilibrium equations	Apply
CO.2 Compute the forces acting on trusses and to draw SF & BMD for various beams	Apply
CO.3 Calculate the friction of screws, belts, wedges, ladders of different machine components.	Apply
CO.4 Calculate relative velocities of particles based on kinematic principles.	Apply
CO.5 Apply the concepts of dynamics of rigid bodies to calculate momentum.	Apply

#### Text Book(s):

- T 1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing company, New Delhi (2012).
- T 2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)
- T 3. Beer, F.P and Johnson Jr. E.R., "Mechanics of Materials", 7<sup>th</sup> Edition, McGraw-Hill Education, New york (2015)

#### Reference Book(s):

- R 1. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11<sup>th</sup> Edition, Pearson Education 2010.
- R 2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4<sup>th</sup> Edition, Pearson Education 2006.
- R 3. Raghu Ramakrishnan, Johannes Gehrke. "Database Management Systems", Third Edition, McGraw Hill International Edition, New Delhi 2013
- R 4. Jeffrey D.Ulman and Jennifer Widom, "A First Course in Database Systems", Third Edition, Prentice-Hall, New Delhi, 2012.
- R 5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
- R 6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.

#### Web References:

1. [http://nptel.ac.in/courses/112103109/\(updated 01-Mar-2019\)](http://nptel.ac.in/courses/112103109/(updated 01-Mar-2019))
2. [http://www.iitg.ac.in/ssg/me101.html\(updated 31-Jan-2015\)](http://www.iitg.ac.in/ssg/me101.html(updated 31-Jan-2015))
3. [https://www.coursera.org/learn/engineering-mechanics-statics\(updated 01-Mar-2019\)](https://www.coursera.org/learn/engineering-mechanics-statics(updated 01-Mar-2019))
4. [http://www.vssut.ac.in/lecture\\_notes/lecture1423904717.pdf \(updated 01-Aug-2014\)](http://www.vssut.ac.in/lecture_notes/lecture1423904717.pdf (updated 01-Aug-2014))

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2;Low-1

<b>Course Code: 19CSSC2001</b>		<b>Course Title: C PROGRAMMING</b> (Common to AU, CE, MC, ME, EC, EI, EE)	
<b>Course Category: Engineering Science</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 2</b>	<b>Credits: 4</b>	<b>Total Contact Hours:75</b>	<b>Max Marks:100</b>

### Pre-requisites

➤ NIL

### Course Objectives

The course is intended to:

1. Explain about computer organization and problem solving techniques
2. Write programs using appropriate programming constructs
3. Develop programs using arrays, functions & strings
4. Implement programs using pointers, structures& unions
5. Write programs using files & preprocessor directives

### UNIT I - INTRODUCTION

**7 Hours**

Generation and Classification of Computers –Basic Organization of a Computer – Software development life cycle – Problem Solving Techniques :Algorithm,Pseudocode and Flow Chart.

### UNIT II - C PROGRAMMING BASICS

**10 Hours**

Introduction to C programming – Structure of a C program – Keywords – Identifiers- Constants– Variables – Data Types – Operators and Expressions –Formatted & Unformatted I/O functions– Decision statements – Loop control statements.

### UNIT III - ARRAYS, FUNCTIONSAND STRINGS

**10 Hours**

Arrays: Characteristics –One-dimensional and Two-dimensional arrays – Functions: Declaration & Definition of function –Built in function – User defined function –Types of functions – Call by value &reference – Strings: Formatting strings – String handling functions.

### UNIT IV - POINTERS, STRUCTURES & UNION

**9 Hours**

Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays –Structures: Features– Operations on Structures – Array of structures – Unions.

### UNIT V - FILES & PRE-PROCESSOR DIRECTIVES

**9 Hours**

Introduction to Files – Stream and File Types – File operations (Open, close, read, write) – Command line arguments – Pre-processor Directives: Macro Expansion, File Inclusion, Conditional Compilation.

## LIST OF EXPERIMENTS

30

1. Programs to process data types, operators and expression evaluation. (any 1)
  - a. To find area of rectangle/circle/square.
  - b. To find the simple interest and compound interest.
2. Programs using decision and looping statements. (any 2)
  - a. To find the maximum number among 3 given numbers.
  - b. To check whether given year is leap year or not.
  - c. To display the Fibonacci series.
  - d. To find the factorial of a number.
3. Programs using Arrays
  - a. To search for particular number among N numbers. (1D array)
  - b. To compute matrix addition. (2 D array)
4. Programs using Functions and Strings (any 2)
  - a. To swap two numbers using call by reference.
  - b. To find the cube of a number.
  - c. To manipulate strings using string functions.
  - d. To check whether the string is palindrome or not.
5. Programs using Pointer, Structure & Union
  - a. To perform arithmetic operations using pointers.
  - b. To display the information of N students using Structure.
  - c. To display the employee details using Union.
6. Programs using Files (any 1)
  - a. To read the contents of a text file.
  - b. To copy the contents from one file into another.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain about computer organization and problem solving techniques	Understand
CO2: Write programs for the given scenario using appropriate programming Constructs	Apply
CO3: Develop programs using arrays, functions & strings for the given Scenario	Apply
CO4: Implement programs for given application using pointers, structures& unions	Apply
CO5: Write programs using files & preprocessor directives for simple problems	Apply

**Text Book(s):**

- T1. Ashok N. Kamthane, Amit.N. Kamthane, "Programming in C", Third Edition, Pearson Education, 2015.

**Reference Book(s):**

- R 1. Ajay Mittal, "Programming in C-A Practical Approach", Third Edition, Pearson Education, 2010.
- R 2. Yashavant P. Kanetkar, "Let Us C", Sixteenth Edition, BPB Publications, 2018
- R 3. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second edition, Oxford University Press, 2013

**Web References:**

1. <http://www.cprogramming.com/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	2	-	-	-	-	-
CO2	3	2	1	2	2	-	-	-	2	-	-	-	-	-
CO3	3	2	1	2	2	-	-	-	2	-	-	-	-	-
CO4	3	2	1	2	2	-	-	-	2	-	-	-	-	-
CO5	3	2	1	2	2	-	-	-	2	-	-	-	-	-

High-3; Medium-2; Low-1



<b>Course Code: 19CECN3201</b>		<b>Course Title: COMPUTER AIDED BUILDING DRAWING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 4</b>	<b>Credits: 2</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Engineering Drawing for Civil Engineering

### **Course Objectives**

The course is intended to:

- Understand the principles of planning for various buildings by incorporating building bye laws and develop the skills of drawing the different components of buildings using CAD software.

### **List of Exercises**

1. Introduction to CAD commands and drawing of simple objects.
2. Drawing of plan, elevation and section of types of foundations. (Wall foundation, Column footing – Stepped, Combined and Trapezoidal)
3. Drawing of plan, elevation of dog legged staircase and bifurcated staircase.
4. Drawing of section of King post & Queen Post wooden truss.
5. Drawing of plan, elevation & section of simple buildings.
6. Drawing of plan, elevation & section of one BHK residential building with RCC flat roof – single storey – load bearing structure
7. Drawing of plan, elevation & section of one BHK residential building with RCC flat roof – single storey – framed structure
8. Drawing of plan, elevation & section of two BHK residential building with RCC flat roof – single storey – load bearing structure
9. Drawing of plan, elevation & section of two BHK residential building with RCC flat roof – single storey – framed structure
10. Drawing of plan, elevation & section of Commercial building.
11. Drawing of perspective view of a single storied building.
12. Drawing of perspective view of a two storied building.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Draw plan, elevation and section of wall foundations and column footings (stepped, combined and trapezoidal) using CAD software	Apply
CO.2 Draw plan, elevation of dog legged and bifurcated staircase using CAD software.	Apply
CO.3 Draw the king post and Queen post wooden trusses using CAD software.	Apply
CO.4 Draw plan, elevation and sectional view of residential buildings using CAD software.	Apply
CO.5 Draw the perspective view of buildings using CAD software.	Apply

#### Reference Book(s):

- R 1. Rangawala, "A text book of Civil Engineering Drawing (including computer aided  
R 2. N. Kumaraswamy & A. Kameswara Rao, "Building Planning and Drawing", Charotar publishers, 8<sup>th</sup> edition, 2015.  
R 3. B.P. Verma, "Civil Engineering Drawing & House Planning", Khanna publishers, 12<sup>th</sup>  
R 4. 19CECN3201- Computer Aided Building Drawing Laboratory Manual - MCET

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	3	-	-	1	2	2	-	2	3	-
CO2	1	-	-	3	3	-	-	1	2	2	-	2	3	-
CO3	1	-	-	3	3	-	-	1	2	2	-	2	3	-
CO4	1	-	-	3	3	-	-	1	2	2	-	2	3	-
CO5	1	-	-	3	3	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19PSHG6001</b>		<b>Course Title: WELLNESS FOR STUDENTS (Common to all B.E/B.Tech Programmes) (2021 Batch onwards)</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0 :2</b>	<b>Credits: 1</b>	<b>Total Contact Hours: 30</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

1. Set SMART goals for academic, career and life
2. Apply time management techniques
3. Articulate the importance of wellness for success in life.
4. Understand the dimensions of wellbeing and relevant practices

#### **UNIT I – GOAL SETTING**

Understanding Vision and mission statements - Writing personal mission statements – ‘Focus’ as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

#### **UNIT II – TIME MANAGEMENT - TOOLS AND TECHNIQUES**

Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying ‘NO’ – Managing procrastination

#### **UNIT III – PRACTICES FOR PHYSICAL WELLNESS**

Concept of wellness – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods.

**Simplified Physical Exercises.** Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

#### **UNIT IV – PRACTICES FOR MENTAL WELLNESS**

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.

Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas

## UNIT V – PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Set well-articulated goals for academics, career, and personal aspirations	Apply
CO.2 Apply time management techniques to complete planned tasks on time	Apply
CO.3 Explain the concept of wellness and its importance to be successful in career and life	Apply
CO.4 Explain the dimensions of wellness and practices that can promote wellness	Apply
CO.5 Demonstrate the practices that can promote wellness	Valuing

### Text Book(s):

T 1. Reading material, workbook and journal prepared by PS team of the college

### Reference Book(s):

R.1 Stephen R Covey, "First things first", Simon & Schuster Uk, Aug 1997.

R.2 Sean Covey, "Seven habits of highly effective teenagers", Simon & Schuster Uk, 2004.

R.3 Vethathiri Maharishi Institute for Spiritual and Intuition Education, Aliyar, "Value education for harmonious life (Manavalakalai Yoga)", Vethathiri Publications, Erode, I Ed. (2010).

R.4 Dr. R. Nagarathna, Dr.H.R. Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.

R.5 Tony Buzan, Harper Collins, "The Power of Physical Intelligence English)".

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	1	1	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	1	1	-	1	-	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code:</b> <b>19CHMG6201</b>	<b>Course Title: ENVIRONMENTAL SCIENCES</b> (Common to all B.E/B.Tech Programmes)		
<b>Course Category: Mandatory Non-Credit Course</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>1: 0: 0</b>	<b>Credits: 0</b>	<b>Total Contact Hours:15</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

1. Create awareness for conservation and equitable use of natural resources.
2. Impart knowledge on measures for prevention of pollution and disaster management.
3. Facilitate the understanding of environmental legislations in India.
4. Familiarize the environmental issues relevant to human health.
5. Know the innovative measures for day to day environmental issues.

#### **UNIT I - NATURAL RESOURCES**

**2 Hours**

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

#### **UNIT II - ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT**

**2 Hours**

Role of an individual in prevention of pollution; Disaster management : floods, earthquake, cyclone and landslides.

#### **UNIT III - ENVIRONMENTAL ETHICS AND LEGISLATIONS**

**2 Hours**

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

#### **UNIT IV - ENVIRONMENTAL ISSUES AND PUBLIC AWARENESS**

**2 Hours**

Public awareness - Environment and human health

#### **UNIT V - ENVIRONMENTAL ACTIVITIES**

**2 Hours**

##### **(a) Awareness Activities:**

- i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
- ii) Slogan making event
- iii) Poster making event.

**(b) Actual Activities:**

- i) Plantation
- ii) Cleanliness drive
- iii) Drive for segregation of waste
- iv) To know about the different varieties of plants
- v) Shutting down the fans and ACs of the campus for an hour or so

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Describe the role of individual in conservation of water resources and equitable use of natural resources for sustainability.	Understand
CO.2 Explain the role of individual in prevention of pollution and disaster management.	Understand
CO.3 Illustrate the importance of environmental legislations in India and the issues involved in its enforcement.	Understand
CO.4 Explain the general environmental issues relevant to human health.	Understand
CO.5 Demonstrate innovative measures for day to day environmental issues such as waste disposal and deforestation.	Understand

**Text Book(s):**

- T 1. Benny Joseph, "Environmental Studies", Tata McGraw Hill, New Delhi, 2006.
- T 2. Mackenzie Davis and Susan Masten, "Principles of environmental engineering and science", Mc-Graw Hill, 3<sup>rd</sup> Edition, 2014.

**Reference Book(s):**

- R 1. Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.
- R 2. Cunningham, W.P.Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	3	3	-	-	-	-	2	3	-
CO2	2	1	-	-	-	3	3	-	-	-	-	2	3	-
CO3	2	1	-	-	-	3	3	-	-	-	-	2	3	-
CO4	2	1	-	-	-	3	3	-	-	-	-	2	3	-
CO5	2	1	-	-	-	3	3	-	-	-	-	2	3	-

High-3; Medium-2;Low-1

**NON-LETTER GRADES**

Marks Scored	Performance Level
70 & above	Good
30 – 69	Average
< 30	Fair

<b>Course Code: 19PSHG6003</b>		<b>Course Title:HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week) 1: 0 :0</b>	<b>Credit: 1</b>	<b>Total Contact Hours: 15</b>	<b>Max Marks:100</b>

### Pre-requisites

➤ NIL

### Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

**CO.1** மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை, நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள், திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

**CO.2** இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

### தமிழர் மரபு

#### அலகு 1 - மொழி மற்றும் இலக்கியம்

3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

#### அலகு 2 - மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை

3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

#### அலகு 3 - நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்

3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

**அலகு 4 - தமிழர்களின் திணைக் கோட்பாடுகள்****3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக் கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

**அலகு 5 - இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு****3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுய மரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப் படிக்கல்- தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

**TOTAL : 15 PERIODS**

Course Outcomes		Cognitive Level
மாணவர்கள் இப்பாடத்தை கற்றபின்		
CO.1	மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)



## TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:  
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19PSHG6003</b>		<b>Course Title:HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week) 1: 0 :0</b>	<b>Credit: 1</b>	<b>Total Contact Hours: 15</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinaï Concept.
2. Understand the Contribution of Tamils to Indian National Movement and Indian Culture.

## **HERITAGE OF TAMILS**

### **UNIT I LANGUAGE AND LITERATURE**

**3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

### **UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS****3**

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS****3**

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE****3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL : 15 PERIODS**

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.	Understand
CO.2 Understand the Contribution of Tamils to Indian National Movement and Indian Culture.	Understand

## TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:  
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

### **SEMESTER III**

<b>Course Code: 19MABN1301</b>		<b>Course Title: TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS</b>	
<b>Course Category: Basic Science</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours: 60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Matrices and Calculus
- Ordinary Differential Equation and Complex variables

#### **Course Objectives**

The course is intended to:

- Determine the solution of first and higher order partial differential equations.
- Compute the Fourier series expansion
- Solve one dimensional wave equation.
- Solve one dimensional and two-dimensional heat flow equation.
- Calculate the Fourier transformation for a periodic function

#### **UNIT I - PARTIAL DIFFERENTIAL EQUATIONS**

**9+3 Hours**

Formation of partial differential equations — Solutions of standard types of first order partial differential equations — Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

#### **UNIT II - FOURIER SERIES**

**9+3 Hours**

Dirichlet's conditions — General Fourier series — Odd and even functions — Half range sine series — Half range cosine series — Parseval's identity — Complex form of Fourier series — Harmonic analysis.

#### **UNIT III - SOLUTION OF ONE-DIMENSIONAL WAVE EQUATION**

**9+3 Hours**

Method of separation of variables - Classification of second order linear partial differential equations, Solutions of one-dimensional wave equation by Fourier series method.

#### **UNIT IV - SOLUTION OF ONE AND TWO-DIMENSIONAL HEAT FLOW EQUATION**

**9+3 Hours**

One dimensional equation of heat conduction - Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded), Solution by Fourier series method.

#### **UNIT V - FOURIER TRANSFORMS**

**9+3 Hours**

Fourier transform pair — Fourier sine and cosine transforms — Properties — Transforms of simple functions — Convolution theorem — Parseval's identity.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Determine the solution of first and higher order partial differential equations.	Apply
CO.2 Compute the Fourier series expansion	Apply
CO.3 Solve one dimensional wave equation.	Apply
CO.4 Solve one dimensional and two-dimensional heat flow equation.	Apply
CO.5 Calculate the Fourier transformation for a periodic function	Apply

#### Text Book(s):

- T 1. Erwin kreyzig, Advanced Engineering Mathematics, 10<sup>th</sup> edition, John Wiley& Sons, 2015.
- T 2. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
- T 3. Ramana B.V., higher Engineering Mathematics, Tata McGraw-Hill, New Delhi, 11<sup>th</sup>Reprint, 2010.

#### Reference Book(s):

- R 1. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
- R 2. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publication, Reprint, 2008.
- R 3. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36<sup>th</sup> Edition, 2010.

#### Web References:

1. [http://nptel.ac.in/courses/122107037/19\\_2](http://nptel.ac.in/courses/122107037/19_2)  
<http://nptel.ac.in/video.php?subjectId=108106075>  
<https://nptel.ac.in/courses/111103021/>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN1301</b>		<b>Course Title: CONSTRUCTION MATERIALS AND PRACTICES</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- Acquire basic knowledge on various building materials used in construction.
- Discuss the importance of metals, timber and other materials.
- Study the specifications, details and sequence of sub structure construction activities.
- List the concepts and techniques used in super structure construction.
- Identify the equipment required in various levels of construction.

### **UNIT I - BASIC CONSTRUCTION MATERIALS**

**9 Hours**

Stones –Bricks – Classification – Manufacturing of Clay Bricks –Bricks for Special Use – Cement Concrete blocks – Considerations for use – Lime – Types – Properties and Uses – Cement: Manufacture – Types – Characteristics – Properties – Fly ash. Aggregates – Characteristics – Types – Mortar: Classification – Preparation – Selection.

### **UNIT II - METALS, TIMBER AND OTHER MATERIALS**

**9 Hours**

Steel – Types – Manufacturing process– Tests – Structural steel – Rebar – Alloy steels – Aluminium – Properties and Uses – Timber – Types –Characteristics – Seasoning – Defects – Timber products – Paints – Types– Glass – Characteristics – Selection – Ceramics – Composite materials – Geo-synthetics – properties and applications.

### **UNIT III - SUB STRUCTURE CONSTRUCTION PRACTICES**

**9 Hours**

Specifications, details and sequence of activities - Site Clearance - Marking - Earthwork - Excavation – Dewatering - Building foundations – Types of foundations - Plinth beam – Filling in foundation trenches– Anti-termite treatment – Damp-proofing and Waterproofing – Sand filling in basement.

### **UNIT IV - SUPER STRUCTURE CONSTRUCTION PRACTICES**

**9 Hours**

Masonry – Formwork - Scaffolding - Roofs and roof covering - Flooring - types of flooring - Joints in Concrete - Staircase: Types and Construction – Plastering – Plastering methods - Pointing – Types - Painting – Preparation and Process – Defects.

### **UNIT V - CONSTRUCTION EQUIPMENTS**

**9 Hours**

Earthwork equipments- tractors, motor graders, scraper, front end loader, earth mover - Concreting equipments - batching, mixing, transportation, concreting and compaction - Equipment for material handling and erection of structures - Dewatering and pumping equipments.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Identify the building materials used for construction based on its properties, characteristics, classification and manufacturing methods, also explain the selection and preparation process of mortar.	Understand
CO.2 Elucidate the manufacturing process, properties and tests to be performed for metals, timber and composite materials for various civil engineering applications.	Understand
CO.3 Explain the specifications, details and sequence of sub structure construction activities of civil engineering projects.	Understand
CO.4 Identify appropriate scaffoldings for super structure construction activities as well as various super structure construction processes.	Understand
CO.5 Identify and illustrate the construction equipment for various applications in construction project.	Understand

#### Text Book(s):

- T 1. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, "Building Construction", LaxmiPublications Pvt. Ltd., 2016
- T 2. Bindra and Arora, "Building Materials and Construction", DhanpatRai& Sons, NewDelhi, 2015
- T 3. Varghese. P.C, "Building Materials", 2<sup>nd</sup>Revised edition (2015)PHI Learning Pvt. Ltd, New Delhi.

#### Reference Book(s):

- R 1. Roy Chudley, Roger Greeno, Advanced Construction Technology, Pearson Prentice Hall, 2006.
- R 2. Rangwala S.C., "Engineering Materials" Charotar Publishing House, Anand, India, 2014
- R 3. P.C. Varghese, "Building Construction", PHI Learning Private Limited, New Delhi, 2010.
- R 4. M.S. Shetty, "Concrete Technology Theory and Practice", S. Chand and Company Ltd., 2008.

#### Web References:

- [www.understandconstruction.com](http://www.understandconstruction.com)
- [www.engineeringcivil.com](http://www.engineeringcivil.com)

#### Course Articulation Matrix\*

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1



<b>Course Code: 19CECN1302</b>		<b>Course Title: TRANSPORTATION ENGINEERING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- Understand the concept of highway alignment.
- Comprehend the geometrics of highway.
- Gain knowledge on the various pavement materials and its properties.
- Understand the design procedure of the flexible and rigid pavement according to the IRC codes, specifications and methods.
- Comprehend the elements of highway construction.

### **UNIT I - HIGHWAY ALIGNMENT**

**9 Hours**

Different Modes of Transportation; Highway Development in India; Highway Alignment, Survey- Horizontal Profile, Vertical Profile, Factors Controlling the alignment, Survey for route location, and Detailed Project Report

### **UNIT II - GEOMETRIC DESIGN OF HIGHWAYS**

**9 Hours**

Cross sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vertical curves, summit and valley curves. introduction to Elements of Traffic Engineering

### **UNIT III - PAVEMENT MATERIALS**

**9 Hours**

Properties and testing of Sub grade soil, aggregates, bituminous binders

### **UNIT IV - PAVEMENT DESIGN**

**9 Hours**

Types of Pavements, Design factors, Design of bituminous paving mixes; Design of Flexible Pavement by CBR method (IRC : 37- Latest revision), Design of rigid pavement, Westerguard theory, load and temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2015)

### **UNIT V - ELEMENTS OF HIGHWAY CONSTRUCTION**

**9 Hours**

Embankment, subgrade, subbase and base courses, bituminous surface courses, concrete pavements, soil stabilization; Drainage; Evaluation and Maintenance of highways.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the concepts of highway planning as well as highway alignment for transportation infrastructural projects.	Understand
CO.2 Elucidate the geometrics of highway and calculate the super elevation, sight distance and widening of curves.	Apply
CO.3 Illustrate the various pavement materials for highway construction projects.	Understand
CO.4 Design the flexible and rigid pavement according to the IRC codes.	Apply
CO.5 Illustrate the various elements of highway construction as per the standards.	Understand

#### Text Book(s)

- T 1. Khanna, S. K. and Justo, C.E.G., Highway Engineering, Nem Chand & Bros, 10th Edition 2015
- T 2. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Eighth edition, 2013
- T 3. Subhash C Saxena, Textbook of Highway and Traffic Engineering., CBS Publishers, 2014

#### Reference Book(s):

- R 1. C. Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press (India) Private Limited, Hyderabad, 2015
- R 2. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2005
- R 3. IRC: 37- Latest revision, "Tentative Guidelines for the design of Flexible Pavements" Indian Roads Congress, New Delhi
- R 4. IRC:58-2015 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision) (with CD)

#### Web References:

- <https://www.vidyarthiplus.com/vp/attachment.php?aid=10395>
- <https://www.scribd.com/doc/119865487/Pavement-Engineering>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1.

<b>Course Code: 19CECN1303</b>		<b>Course Title: SURVEYING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>4: 0: 0</b>	<b>Credits: 4</b>	<b>Total Contact Hours: 60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- NIL

#### **Course Objectives**

The course is intended to:

- Study the Conventional surveying techniques [Chain, Compass and Plane table], Levelling, Theodolite Surveying, Tacheometric Surveying, Curves and Modern Surveying.

#### **UNIT I - BASICS OF SURVEYING**

**12 Hours**

Definition - Principles – Classification. Introduction to Chain, Compass, Plane table – Errors and corrections in Chain/Tape, Compass – bearing, meridian – Open and closed traverse – Closing errors

#### **UNIT II - LEVELLING**

**12 Hours**

Principles and theory of levelling - Types of levels, levelling staff and their types - Effect of curvature and refraction - Longitudinal, cross-sectional and reciprocal levelling - Reducing levels by rise and fall and height of collimation methods and check. Definition - Contour interval and horizontal equivalent - Characteristics - Uses of contour maps - Computation of area and volume from contour map

#### **UNIT III - THEODOLITE SURVEYING**

**12 Hours**

Theodolite - types, features and fundamental axes - Adjustments; horizontal angles - Vertical angles - Heights and distances of inaccessible points - Methods of traversing - Problems on omitted measurements – Gale's Traversing method for closing error correction.

#### **UNIT IV - TACHEOMETRIC SURVEYING**

**12 Hours**

Methods - Determination of constants of the tacheometer - Use of anallactic lens - Distance and elevation formulae for inclined sights with vertical and normal holding staff - Movable hair method - principles of tangential tacheometry - Problems in tacheometry - Subtense bar method.

#### **UNIT V - CURVES AND MODERN SURVEYING**

**12 Hours**

Elements of simple curve - Location of tangent points - Setting out of simple curve by offset and Rankine's methods. Vertical curves – Types – grades. Total Station – Electronic Theodolite – Laser alignment instrument – Global Positioning System. Introduction to remote sensing (RS) and Geographical Information System (GIS).

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO.1	Explain the concepts of surveying for linear and angular measurements through conventional techniques to arrive solutions to basic surveying problems.	Understand
CO.2	Illustrate the levelling methods, calculate reduce levels for the give area as well as compute the area and volume from contour map.	Apply
CO.3	Explain the concepts of theodolite surveying to arrive solutions to find omitted measurements and closing error correction in traverse.	Apply
CO.4	Calculate the elevation and distance using tacheometric principles.	Apply
CO.5	Calculate the important parameters of curves for setting out of alignments in transport planning as well as explain the principles of modern surveying techniques.	Apply

### Text Book(s)

- T 1. Punmia B C, "Surveying" - vol. 1, vol. 2 and vol 3, Laxmi Publications (P) Ltd., New Delhi, 2016.
- T 2. Agor. R, "A Text Book of Surveying and Levelling", Khanna Publishers, 2009.
- T 3. Duggal R K, "Surveying", Vol I & II, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.

### Reference Book(s):

- R 1. Kanetkar T P, "Surveying and Levelling", Part I and II, Pune Vidyarthi Griha Prakashan, 2006.
- R 2. Bannister A and Raymond S, "Surveying", 7<sup>th</sup> Edition, Addison Wesley Longman Ltd, England, 1998.
- R 3. Gopi. S, Sathikumar. R, Madhu. N, "Advanced Surveying", Dorling Kindersley (India) Pvt. Ltd., 2008.
- R 4. Chandra. A.M., "Surveying", New Age International Private Ltd Publishers, 2015.

### Web References:

1. <http://www.aboutcivil.org/surveying-levelling%20II.html>
2. <http://civil.engineering.webservices.utoronto.ca/Assets/Civil+Engineering+Digital+Assets/>
3. <http://www.nptel.ac.in/courses/105107122/>
4. [http://www.vssut.ac.in/lecture\\_notes/lecture1428642587.pdf](http://www.vssut.ac.in/lecture_notes/lecture1428642587.pdf)
5. [www.scribd.com/doc/63716977/Surveying-1-Lecture-Notes](http://www.scribd.com/doc/63716977/Surveying-1-Lecture-Notes)

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1.

<b>Course Code: 19CESN1301</b>		<b>Course Title: SOLID MECHANICS</b>	
<b>Course Category: Engineering Science</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Engineering Mechanics

#### **Course Objectives**

The course is intended to:

- Learn the concept of slope and deflection in determinate beams
- Understand the stresses in oblique plane and to study continuous beams.
- Study the energy theorems.
- Gain knowledge on columns and cylinders.
- Acquire the knowledge on shafts and springs

#### **UNIT I – DEFLECTION OF STATICALLY DETERMINATE BEAMS**

**9+3 Hours**

Deflection and slope of cantilever, simply supported and overhanging beams – Double integration method, Macaulay's method, Moment area method and Conjugate beam method.

#### **UNIT II – PRINCIPAL STRESSES AND STATICALLY INDETERMINATE**

**9+3 Hours**

##### **BEAMS**

Biaxial state of stress – Stress at a point – Stress on inclined plane – Principal stresses and principal planes – Mohr's circle of stresses. Theorem of three Moments – Analysis of continuous beam (up to two spans)-Shear force and B.M diagrams for continuous beams.

#### **UNIT III – ENERGY PRINCIPLES**

**9+3 Hours**

Strain energy and Strain energy density - Strain energy in axial load, flexure, Shear and Torsion - Strain energy and complimentary energy - Castigliano's and Engesser's Energy theorems - Principle of virtual work - Application of Energy theorem for computing deflection - Simple beams, plane trusses and simple rigid plane frames - Maxwell's reciprocal theorem-Williot Mohr diagram.

#### **UNIT IV – COLUMNS AND CYLINDERS**

**9+3 Hours**

Type of columns, eccentrically loaded short columns, combined bending and direct stresses, crushing load – middle third rule – Euler's theory – Limitations of Euler's theory - critical loads for prismatic columns with different end conditions; Rankine's formula - Thin cylinders - Circumferential stress, longitudinal stress, volumetric strain under internal pressure – Thick cylinders.

#### **UNIT V – TORSION OF SHAFTS AND SPRINGS**

**9+3 Hours**

Elastic theory of torsion - Stresses and deformation in circular solid and hollow shafts - Combined bending moment and torsion of shafts - Strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft – Shaft in series and parallel - Design of shafts - Closed coiled and open coiled helical springs subjected to axial load, leaf springs, deflection of springs.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 Compute slope and deflection for different types of beams using appropriate method.	Apply
CO2 Calculate the stresses in oblique plane and to draw the shear force and bending moment for continuous beam for various support conditions.	Apply
CO3 Apply energy theorems to compute the deflection for beams, trusses and frames	Apply
CO4 Calculate the critical load for various end conditions of columns as well as the stresses in thin and thick cylinders.	Apply
CO5 Calculate the design parameters of shaft and springs for various applications.	Apply

#### Text Book(s)

- T 1. R.K. Rajput, "Strength of Materials", Sixth Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2015.
- T 2. R.K. Bansal, "A Text Book of Strength of Materials", Sixth Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.
- T 3. Egor P Popov, Engineering Mechanics of Solids, Second Edition, Prentice Hall of India, New Delhi, 2005.

#### Reference Book(s):

- R.1 Timoshenko. S.P. and Young D.H., "Elements of Strength of Materials", 5<sup>th</sup> edition (SI Units), Affiliated East-West Press Ltd., New Delhi, 2012
- R.2 Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf and David F. Mazurek "Mechanics of Materials", Seventh Edition, McGraw Hill Education, New York, 2015.
- R.3 R.C. Hibbeler, "Mechanics of Materials", Ninth Edition, Pearson-Prentice Hall, New Delhi, 2014.

#### Web References:

- <http://nptel.ac.in/courses/105106116>
- <http://web.mit.edu/emech/dontindex-build/>
- <http://www.aboutcivil.org/solid-mechanics.html>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1.

<b>Course Code: 19CECN3301</b>		<b>Course Title: SURVEYING PRACTICE LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

- Impart the field knowledge of surveying measurements and a broad overview of surveying instruments and their applications.

#### **List of Experiments:**

1. Study of Instruments – chains, compass, plane table and dumpy levels.
2. Determination of the area of a closed traverse after eliminating the closing error using Compass Surveying
3. Determination of RL of different points on the earth surface using dumpy level
4. Verifying the accuracy of levelling using method of Check Levelling
5. To plot the LS & CS of a given length of road using Profile levelling.
6. Determination of horizontal angles by Method of repetition and reiteration.
7. Determination of elevation of an object whose base is inaccessible by Single Plane method
8. Determination of elevation of an object whose base is inaccessible by Double Plane method
9. Determination of gradients between given points by stadia method
10. Set out a simple circular curve by Rankine's method.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Survey the given plot using chain and compass to determine the area through linear and angular measurements.	Apply
CO.2 Record the levels using various methods of levelling to calculate the reduced levels of given points and plot the level profile as well as contour maps.	Apply
CO.3 Determine the elevation of an object by single and double plane methods.	Apply
CO.4 Set out the simple curves using Rankines method.	Apply
CO.5 Demonstrate and determine the measurements with the help of modern surveying instruments for real time applications.	Apply

**Reference(s):**

- R 1. Punmia B C, "Surveying" - vol. 1, vol. 2 and vol 3, Laxmi Publications (P) Ltd., New Delhi, 2016.
- R 2. Agor. R, "A Text Book of Surveying and Levelling", Khanna Publishers, 2009.
- R 3. Duggal R K, "Surveying", Vol I & II, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
- R 4. Surveying Practice Laboratory Manual, Department of Civil Engineering, MCET, Pollachi.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	2	-

High-3; Medium-2; Low-1



<b>Course Code: 19CECN3302</b>		<b>Course Title: MATERIALS LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- Provide an understanding of the basic properties of construction materials and presents current field and laboratory standards and testing requirements for these materials.

### **List of Exercises**

1. Determination of modulus of elasticity for a given metal specimen
2. Determine the properties of bricks
3. Determine the properties of cement
4. Determine the properties of coarse aggregates
5. Determination of torsional strength and modulus of rigidity for a given metal specimen.
6. Verification of Maxwell reciprocal theorem
7. Determination of hardness and impact strength
8. Determination of spring constant on a given spring specimen
9. Determination of slope and deflection of a beam by moment area theorems
10. Determination of Flexural Rigidity (EI) for a given specimens
11. Determination of shear strength of metals (Double Shear test).
12. Determination of buckling load for a given end condition of a column.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Determine the important mechanical properties of materials.	Apply
CO.2 Demonstrate the different theorems of beam as well as column members.	Apply
CO.3 Calculate the hardness of various metals.	Apply
CO.4 Calculate the impact strength of various metals.	Apply
CO.5 Determine the Flexural Rigidity (EI), shear strength of a beam and buckling load for a given end condition of a column.	Apply

**Reference Book(s):**

- R 1. Bansal, R.K., "A Text Book of Strength of Materials", Laxmi Publications (P) Ltd., New Delhi 2010.
- R 2. Timoshenko. S.P. and Young D.H., "Elements of Strength of Materials", 5<sup>th</sup> edition (SI Units), Affiliated East-West Press Ltd., New Delhi, 2012.
- R 3. 19CELN3302 - Materials Laboratory Manual

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	2	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19PSHG6004</b>		<b>Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week) 1: 0 :0</b>	<b>Credit: 1</b>	<b>Total Contact Hours: 15</b>	<b>Max Marks:100</b>

### Pre-requisites

➤ NIL

### Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

- CO.1** நெசவு மற்றும் பாணைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.
- CO.2** அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

### தமிழரும் தொழில்நுட்பமும்

#### அலகு 1 - நெசவு மற்றும் பாணைத் தொழில்நுட்பம்

3

சங்க காலத்தில் நெசவுத் தொழில் - பாணைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கிறல் குறியீடுகள்

#### அலகு 2 - வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்

3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ஷ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

#### அலகு 3 - உற்பத்தித் தொழில்நுட்பம்

3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத் துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

**அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்****3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன் வளம் - முத்து மற்றும் முத்துக் குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

**அலகு 5 - அறிவியல் தமிழ் மற்றும் கணினித் தமிழ்****3**

அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய்தல் - தமிழ் மென் பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக் கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

**TOTAL : 15 PERIODS**

Course Outcomes	Cognitive Level
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 நெசவு மற்றும் பாணைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

**TEXT - CUM REFERENCE BOOKS**

- 1 தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருறை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

<b>Course Code: 19PSHG6004</b>		<b>Course Title:TAMILS AND TECHNOLOGY (Common to all B.E/B.TechProgrammes)</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week)</b> <b>1: 0 :0</b>	<b>Credit: 1</b>	<b>Total Contact Hours: 15</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

### **TAMILS AND TECHNOLOGY**

#### **UNIT I WEAVING AND CERAMIC TECHNOLOGY**

**3**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

#### **UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY**

**3**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

#### **UNIT III MANUFACTURING TECHNOLOGY**

**3**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY****3**

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING****3**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL : 15 PERIODS**

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.	Understand
CO.2 Understand the Scientific Tamil & Tamil Computing.	Understand

## TEXT - CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே.பிள்ளை  
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

## Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1



## SEMESTER IV

<b>Course Code: 19MABG1401</b>		<b>Course Title: PROBABILITY AND STATISTICS</b> (Common to EE,EC,AU,CS,ME,IT & CE)	
<b>Course Category: Basic Science</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> 3: 1: 0	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Calculate expectations and variances of random variables
- Apply the concepts of standard distributions to solve practical problems
- Calculate the correlation and regression for two variables
- Test the samples based on hypothesis
- Analyse the samples based on variance

### **UNIT I - PROBABILITY AND RANDOM VARIABLES**

**9+3 Hours**

Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions- Properties - Moments- Moment generating functions and their properties.

### **UNIT II - STANDARD DISTRIBUTIONS**

**9+3 Hours**

Binomial- Poisson- Uniform –Exponential- Normal Distributions and their properties-Functions of a random variable.

### **UNIT III - TWO DIMENSIONAL RANDOM VARIABLES**

**9+3 Hours**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Transformation of random variables.

### **UNIT IV - TESTING OF HYPOTHESES**

**9+3 Hours**

Sampling Distributions- Testing of hypotheses for mean, variance, proportions and differences using Normal, t, Chi-Square and F distributions – Tests for independence of attributes and Goodness of fit.

### **UNIT V - DESIGN OF EXPERIMENTS**

**9+3 Hours**

Analysis of Variance (ANOVA)- One way Classification – Completely Randomized Design (CRD) – Two-way Classification – Randomized Block Design (RBD) – Latin square

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Calculate expectations and variances of random variables	Apply
CO.2 Apply the concepts of standard distributions to solve practical problems	Apply
CO.3 Calculate the correlation and regression for two variables	Apply
CO.4 Test the samples based on hypothesis	Apply
CO.5 Analyse the samples based on variance	Apply

**Text Book(s):**

- T 1. Veerajan T, "Probability, Statistics and Random process", 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2013.
- T 2. Dr.J.Ravichandran, "Probability and Statistics for Engineers", 1<sup>st</sup> Edition, Wiley India Pvt.Ltd.2010.

**Reference Book(s):**

- R 1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", 9<sup>th</sup> Edition Pearson Education, Asia, 2016.
- R 2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", 3<sup>rd</sup> Edition, Tata McGraw Hill edition, 2009.
- R 3. Morris DeGroot, Mark Schervish, "Probability and Statistics", Pearson Educational Ltd, 4<sup>th</sup> Edition, 2014.
- R 4. Johnson and C.B. Gupta, "Probability and Statistics for Engineers", 9<sup>th</sup> Edition, Pearson Education, Asia, 2016.

**Web References:**

1. <https://onlinecourses.nptel.ac.in/111105041/>
2. <https://nptel.ac.in/downloads/111105041/>
3. <https://nptel.ac.in/courses/111105090/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO2	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO3	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO4	3	2	1	1	-	-	1	1	-	1	-	1	-	-
CO5	3	2	1	1	-	-	1	1	-	1	-	1	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN1401</b>		<b>Course Title: HYDRAULICS ENGINEERING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

- Introduce the concepts of static pressure, buoyant force and metacentric height.
- Know the flow properties through velocity potential function and stream function and
- apply the Bernoulli's theorem for pipe flow.
- Understand the major and minor losses in pipe flow.
- Study the principles of most economical channel section.
- Impart knowledge on the performance of pumps and turbines.

#### **UNIT I - FLUID PROPERTIES AND FLUID STATICS**

**12 Hours**

Fluid – definition, distinction between solid and fluid – Units and dimensions – Properties of fluid. Fluid statics – concepts of fluid static pressure, absolute and gauge pressure – Pressure measurements using manometers and pressure gauges – Forces on planes – centre of pressure – Buoyancy – Metacentric height - Floatation.

#### **UNIT II - FLUID KINEMATICS AND DYNAMICS**

**12 Hours**

**Fluid kinematics:** Flow visualization – Lines of flow – Types of flow- Velocity field and acceleration – Continuity (one dimensional and three-dimensional form)- stream function – velocity potential function – flow net

**Fluid dynamics:** Euler's equation along a streamline – Bernoulli's equation – Applications – Venturimeter, orificemeter. Linear momentum equation and its applications. Boundary layer concept- displacement, energy and momentum thickness.

#### **UNIT III - FLOW THROUGH PIPES**

**12 Hours**

Laminar flow through circular pipes(Hagen Poiseuille's equation)- Hydraulic and energy gradient – flow through pipes – Darcy Weisbach equation – friction factor – Moody's diagram – Major and minor losses of flow in pipes – Pipes in series and in parallel.

#### **UNIT IV - FLOW THROUGH OPEN CHANNELS**

**12 Hours**

Definition - Differences between pipe flow and open channel flow –Types open channels - Types of Flow – Properties of open channel - Fundamental equations - Velocity distribution in open channel – Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force.

**UNIT V - PUMPS AND TURBINES****12 Hours**

Centrifugal pump – components – working principle – priming of centrifugal pump – specific speed- reciprocating pump – components – working principles – single and double acting reciprocating pump – discharge through a pump- work done – pump efficiency – negative slip. Turbines – classification – impulse and reaction turbines – head and efficiencies of hydraulic turbines – components and functions of Pelton wheel turbine, Francis turbine, Kaplan turbine – Velocity triangle – specific speed.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Determine the fluid properties and its behaviour in static conditions.	Understand
CO.2 Apply the conservation laws for fluids in fluid kinematics and dynamics.	Apply
CO.3 Estimate losses in pipelines and analysis of pipes connected in series and parallel.	Apply
CO.4 Describe the basics of open channel flows, analysis of uniform flow with specific energy concept and estimate the most economical channel section.	Apply
CO.5 Explain the working principle of pumps and turbines, and estimate their performance.	Apply

**Text Book(s):**

- T 1. R.K. Rajput, "A text book of fluid mechanics", S. Chand Publishing, 2019
- T 2. Subramanya, K., "Flow in open channels", Tata McGraw Hill Publishing Company Ltd, New Delhi (2015)
- T 3. Som S., Biswas G., and Chakraborty S., "Introduction to fluid mechanics and fluid machines", Tata McGraw Hill Education private Ltd., New Delhi, 2011.
- T 4. R.K. Rajput, "A text book of hydraulic machines", S. Chand Publishing, 2019.

**Reference Book(s):**

- R 1. Chow VenTe, "Open Channel hydraulics", Tata McGraw Hill Book company Ltd, New Delhi (2009)
- R 2. Modi, P.N., and Seth, S.M., "Hydraulics and Fluid Mechanics", Standard book house, New Delhi (2019)
- R 3. Srivastava, R., "Flow through open channels", Oxford University Press, New Delhi (2007)
- R 4. Chanson, H., "The Hydraulics of open channel flow: An Introduction", Elsevier (2013)
- R 5. Frank M White, "Fluid mechanics", Tata McGraw Hill, New Delhi, 2008.
- R 6. John F Douglas, Janusz M, Gasiorek and John A. Swaffield. "Fluid mechanics", Fourth edition, Pearson education limited, New Delhi, 2001.

**Web References:**

- 1. <http://nptel.ac.in/courses/105103095>
- 2. <http://www.vidhyarthiplus.com/vp/Thread-ME2204-Fluid-Mechanics-and-Machinery->
- 3. <http://www.et.byu.edu/~2014/che374/lectureNotes/lectureNotes.html>

4. <http://www.annaunivupdates.com/2015/01/ce6403-applied-hydraulic-engineering-ahe->
5. <http://nptel.ac.in/courses/105106114/>
6. [http://web.itu.edu.tr/~bulu/hydraulics\\_files/lecture\\_notes\\_05.pdf](http://web.itu.edu.tr/~bulu/hydraulics_files/lecture_notes_05.pdf)

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2;Low-1

<b>Course Code: 19CECN1402</b>		<b>Course Title: CONCRETE TECHNOLOGY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Construction Materials and Practices
- Materials Laboratory

#### **Course Objectives**

The course is intended to:

- Understand the theoretical concept of concrete materials which includes Cement, Aggregate and Water.
- Study the different types of admixtures.
- Study the concrete mix design.
- Study the behavior of concrete at its fresh and hardened state.
- Know the different types of special concrete and its applications.

#### **UNIT I - CONCRETE CONSTITUENTS**

**9 Hours**

Composition of cement - Hydration of cement - Structure of hydrated cement - Aggregate - Classification - Testing - Methods of combining aggregates - Grading requirements as per BIS - Quality of water.

#### **UNIT II - ADMIXTURES**

**9 Hours**

Chemical admixture - Accelerators, Retarders, Plasticisers, Super plasticisers, Water proofers - Effects on fresh and hardened properties - Mineral admixture - Fly ash, Silica fume, Ground granulated blast furnace slag, Metakaoline - Effects on fresh and hardened properties.

#### **UNIT III - CONCRETE MIX PROPORTIONING**

**9 Hours**

Basic considerations - Principles of mix proportioning – Quality control - Methods of mix proportioning - BIS and ACI mix design procedure - Mix design examples - Correction for moisture content and bulking.

#### **UNIT IV - PROPERTIES OF CONCRETE**

**9 Hours**

Fresh concrete properties - Workability and factors affecting it - Segregation - Bleeding - Hardened concrete properties - Factors affecting strength - curing - methods of curing - Dimensional stability - Creep, Shrinkage, Permeability - Tests on permeability - RCPT, Half cell - Non Destructive Testing - Rebound hammer test, Ultrasonic pulse velocity method.

#### **UNIT V - SPECIAL CONCRETES**

**9 Hours**

Light weight concrete - High strength concrete - High performance concrete - Fibre reinforced concrete - Ferrocement - Polymer Concrete - Ready mix concrete - Shotcrete - Self compacting concrete - their production, properties and application.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the properties of the constituent materials of concrete.	Understand
CO.2 Explain the effect of admixtures on fresh and hard state of concrete.	Understand
CO.3 Calculate the mix proportions of concrete as per BIS and ACI standards	Apply
CO.4 Explain the properties and perform various test on fresh and hardened concrete	Understand
CO.5 Explain the properties of special concrete, their real time applications.	Understand

**Text Book(s):**

- T 1. Shetty. M.S, "Concrete Technology", S. Chand and Company Ltd., New Delhi, 2010.  
T 2. Gambhir. M.L, "Concrete Technology", Tata Mc-Graw Hill Company, New Delhi, 2013.

**Reference Book(s):**

- R 1. Santhakumar. A.R, "Concrete Technology", Oxford university press, New Delhi, 2007.  
R 2. Neville A.M "Properties of Concrete", Pearson Education Asia Pvt Ltd., New Delhi, 2012.  
R 3. Povindar K. Mehta, Paulo J. M. Monteiro, "Concrete: Microstructure, Properties, and Materials", Mc-Graw Hill Company, 2011.

**Web References:**

1. <http://nptel.ac.in/courses/105102012/>  
2. <http://freevidelectures.com/Course/3357/Concrete-Technology/1>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	2	3	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2;Low-1

<b>Course Code: 19CECN1403</b>		<b>Course Title: STRUCTURAL ANALYSIS</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Solid Mechanics

### **Course Objectives**

The course is intended to:

- Gain knowledge on Consistent deformation and flexibility matrix method.
- Understand the Moment distribution and stiffness matrix method.
- Know the Influence line diagrams.
- Know the Arches and cables.
- Understand the Plastic analysis

#### **UNIT I - CONSISTENT DEFORMATION AND FLEXIBILITY MATRIX METHOD**

**9+3 Hours**

Analysis of statically indeterminate structures by the method of consistent deformations- analysis of rigid frames - Analysis of statically indeterminate trusses by the method of consistent deformations - Flexibility Matrix method Concept of flexibility matrix - analysis of continuous beams - plane frames and pin jointed plane trusses.

#### **UNIT II - MOMENT DISTRIBUTION AND STIFFNESS MATRIX METHODS**

**9+3 Hours**

Analysis of Statically indeterminate Structures; Distribution and carryover of moments - Stiffness and carry over factors - Analysis of continuous beams - Plane rigid frames with and without sway. Stiffness Matrix method Stiffness matrix for beam element - analysis of continuous beams - plane frames & pin jointed plane trusses.

#### **UNIT III - INFLUENCE LINES FOR MOVING LOAD**

**9+3 Hours**

System of moving loads- Equivalent UDL – Influence lines for reactions, shear force and bending moment in statically determinate beams for concentrated and uniformly distributed moving loads – Influence lines for member forces in statically determinate pin-jointed plane frames – Influence lines for three hinged arches.

#### **UNIT IV - ARCHES AND CABLE STRUCTURES**

**9+3 Hours**

Arches as structural forms - Examples of arch structures – Types of arches – Analysis of three hinged, two hinged and fixed arches - Settlement and temperature effects. Cables, Suspension bridges and Space frames: Suspension cables – Cables with two and three hinged stiffening girders.



**UNIT V - PLASTIC ANALYSIS****9+3 Hours**

True and idealized stress - strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage - Plastic moment of resistance — Plastic modulus — Shape factor — Load factor — Concept of plastic hinge and collapse mechanism - Static and kinematic methods - Upper bound, lower bound and uniqueness theorems - Plastic analysis of determinate and indeterminate beams, single bay single storied portal frames.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Analyse the statically indeterminate structures using consistent deformation and flexibility matrix methods to plot SFD and BFD.	Analyse
CO.2 Analyse the statically indeterminate structures using moment distribution and stiffness matrix methods to plot SFD and BMD.	Analyse
CO.3 Analyse the effect of moving loads acting on the beams, arches and frames using influence line diagrams.	Analyse
CO.4 Calculate the internal forces, moments and displacement for various types of arches and cables.	Apply
CO.5 Explain the concepts of plastic analysis and calculate the plastic moments for determinate and indeterminate structures.	Apply

**Text Book(s):**

- T 1. Vaidyanadhan, R and Perumal, "Comprehensive Structural Analysis - Vol. 1 & Vol. 2", P, Laxmi Publications, New Delhi, 2008
- T 2. B. C. Punmia, Ashok Kumar Jain, Arun K. Jain, "Theory of Structures", Laxmi Publications Pvt. Ltd, 2003.
- T 3. S.S. Bhavikatti, Structural Analysis, Vol I & II, Vikas Publishing House Pvt. Ltd, 2011.

**Reference Book(s):**

- R 1. Wang, C.K., Intermediate Structural Analysis, McGraw Hill, 2017
- R 2. Vazirani, V.N. and Ratwani, M.M., Analysis of Structures Vol-1, Vol-2, Khanna Publishers, 2009
- R 3. Ramamrutham, S. and Narayan, R., Theory of Structures, Dhanpat Rai Publishing Co (P) Ltd, 2020

**Web References:**

- <https://nptel.ac.in/courses/105101085/>
- <https://nptel.ac.in/courses/105105109/>
- <http://www.iste.co.uk/book.php?id=1367>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN3401</b>		<b>Course Title: HYDRAULICS ENGINEERING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Provide hands-on experience of the application of flow measuring devices and performance characteristics of pumps and turbines.

#### **List of Exercises**

1. Determination of metacentric height of a floating body
2. Classification of flow based on Reynolds number
3. Verification of Bernoulli's theorem
4. Measurement of flow using venturi meter and orifice meter
5. Measurement of flow through orifice
6. Determination of friction factor of various pipe materials
7. Determination of losses of different pipe fittings
8. Measurement of flow through notches
9. Measure the performance of centrifugal pump
10. Measure the performance of reciprocating pump
11. Measure the performance of Kaplan turbine
12. Measure the performance of Pelton Wheel turbine

#### **Experiments beyond syllabus**

1. Measure the efficiency of a multistage centrifugal pump
2. Measure the performance of Francis turbine
3. Measure the efficiency of a submersible pump

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Differentiate between laminar, transition and turbulent flow using Reynolds apparatus.	Apply
CO.2 Verify the Bernoulli s Theorem using the given apparatus.	Apply
CO.3 Determine the major and minor losses for pipes made of different materials.	Apply

CO.4 Measure the flow through pipes and open channel.	Apply
CO.5 Calculate the efficiency and draw the characteristic curves of the hydraulic machines.	Apply

**Reference Book(s):**

- R 1. R.K. Rajput., "A textbook of hydraulic machines", S. Chand Publishing, New Delhi, 2019.
- R 2. Bansal, R.K., "Fluid mechanics and hydraulic machines", Laxmi Publications Ltd, New Delhi, 2010.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN3402</b>		<b>Course Title: CONCRETE AND TRANSPORTATION ENGINEERING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Construction Materials and Practices
- Transportation Engineering

The course is intended to:

- To gain hands on experience of the various tests to be conducted for fresh and hardened concrete as well as highway materials.

#### **List of Exercises**

1. Preparation of concrete mix design using IS code of practice.
2. Determination of workability of fresh concrete.
3. Determination of compressive, split tensile and flexural strength on hardened concrete.
4. Determination of modulus of elasticity of concrete.
5. Determination of strength & quality of concrete using NDT.
6. Determination of workability of self-compacting concrete.
7. Determination of specific gravity of bitumen.
8. Determination of softening point of bitumen.
9. Determination of ductility test on bitumen.
10. Determination of flash and fire point of bitumen.
11. Determination of binder content of bitumen using binder recovery extraction test.
12. Determination of optimum bitumen content using Marshall Stability test.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Calculate the concrete mix proportions as per IS method for different types of concrete.	Apply
CO.2 Demonstrate and determine the various fresh concrete properties as per IS standards	Apply
CO.3 Demonstrate and determine the various hardened concrete properties as per IS standards.	Apply
CO.4 Demonstrate and determine the basic properties of bitumen for highway projects.	Apply
CO.5 Determine optimum bitumen content as per IS standards.	Apply

**Reference Book(s):**

- R 1. M. S. Shetty & A K Jain, "Concrete Technology: Theory and practice", S. Chand publishers, 2018.
- R 2. S.K.Khanna and C.E.G Justo, "Highway Engineering" Nem Chand & Brothers publishers, 2015.
- R 3. Concrete and transportation engineering laboratory manual, MCET, Pollachi

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19PSHG6002</b>		<b>Course Title: Universal Human Values 2: Understanding Harmony</b>	
<b>Course Category: Humanities</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week) 2:1: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Induction Program (UHV 1)

### **Course Objectives**

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
4. Development of commitment and courage to act
5. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

### **UNIT I - INTRODUCTION TO VALUE EDUCATION**

**9 Hours**

Need for the Value Education; Self -exploration as the process for value education; Continuous Happiness and Prosperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities; Happiness and Prosperity: current scenario; Method to fulfill the Basic human aspirations

### **UNIT II - HARMONY IN HUMAN BEING**

**9 Hours**

Human being as a co-existence of self ('I') and the material 'Body'; needs of Self ('I') and 'Body'; The Body as an instrument of 'I'; Harmony in the self ('I'); Harmony of the self ('I') with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

### **UNIT III - HARMONY IN THE FAMILY AND SOCIETY**

**9 Hours**

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation ;Understanding harmony in the society (society being an extension of family); Vision for the universal human order.

### **UNIT IV - HARMONY IN THE NATURE**

**9 Hours**

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

**UNIT V - HARMONY ON PROFESSIONAL ETHICS****9 Hours**

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basic for Humanistic Education, Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case study: holistic technologies, management models and production systems; Strategy for transition towards value-based life and profession

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO.2 Appraise physical, mental and social wellbeing of self and practice techniques to promote wellbeing.	Responding
CO.3 Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO.4 Respect nature and its existence for survival and sustainable of all life forms and hence practice conservation of nature	Valuing
CO.5 Appreciate ethical behaviour as a result of value system in personal and professional situations	Receiving

**Text Book(s):**

T 3. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

**Reference Book(s):**

- R 1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.  
 R 2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.  
 R 3. The story of stuff, Annie Leonard, Free Press, New York 2010.

**Web References:**

1. <https://aktu.ac.in/hvpe/ResourceVideo.aspx>
2. <http://hvpenotes.blogspot.com/>
3. <https://nptel.ac.in/courses/109/104/109104068/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEPN6401</b>		<b>Course Title: MINI-PROJECT</b>	
<b>Course Category: Project</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0:0: 4</b>	<b>Credits:2</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### Pre-requisites

➤ Nil

### Course Objectives

The course is intended to:

- Know how to prepare the layout of the buildings, which includes architectural drawing by using building by-laws.
- Provide opportunity for the students to demonstrate their independence, individuality and originality to plan and organize projects within a specified time frame by way of applying, and implementing the principles/techniques that they have learnt through the courses.

The student should plan a residential building by applying principles of planning, local building bye laws, vastu and draw the section as well as elevation. The mini project work shall be carried out individually by the student. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Comprehend local building bye-laws and provisions of National Building Code in respect of building and town planning.	Apply
CO.2 Explore building drawing as a way of discovering and developing ideas for designing residential, commercial and public buildings.	Apply
CO.3 Prepare working drawings, foundation plans and other executable drawings with proper details for residential buildings.	Apply
CO.4 Organize and present the findings effectively through written and oral mode with the aid of multimedia tools	Apply



### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	3	-	3	3	-	-	3	-	3
CO2	3	3	-	3	3	-	3	-	3	3	-	3	-	3
CO3	3	3	-	3	3	-	3	-	3	3	-	3	-	3
CO4	3	3	-	-	3	-	3	-	3	3	-	3	-	3

High-3; Medium-2;Low-1

## V SEMESTER

<b>Course Code: 19CESN1501</b>		<b>Course Title: GEOLOGY AND SOIL MECHANICS</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- Understand the nature and origin of soil, petrology and structural geology in relevance to civil engineering applications.
- Understand the soil properties, classification of soil and soil compaction.
- Understand the concept of effective stress, permeability of soil and flownets.
- Understand the stress distribution and consolidation of soil.
- Understand the importance of shear strength of soil.

### **UNIT I – INTRODUCTION TO GEOLOGY**

**9 + 3 Hours**

Geology in Civil Engineering – Weathering of Rocks – Classification of rocks – Engineering properties of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering.

### **UNIT II – SOIL PROPERTIES, CLASSIFICATION AND COMPACTION**

**9 + 3 Hours**

Types of soil – Basic soil properties – Three phase system – Sieve Analysis including Hydrometer Analysis – Determination of consistency limits and their significance to the field behaviour of Soil – Unified Soil Classification System & IS Soil Classification system – Plasticity Charts

Soil compaction – Concept of OMC and dry density– Factors affecting compaction – Field compaction methods.

### **UNIT III – EFFECTIVE STRESS AND PERMEABILITY**

**9 + 3 Hours**

Soil water – Various forms – Capillary rise – Effective stress concepts in soil – Total, neutral and effective stress distribution in soil – Pressure diagrams.

Permeability – Darcy's Law – factors affecting permeability – Determination of Permeability– Liquefaction and Quicksand Condition – Seepage – Introduction to flow nets – properties and uses – Application to simple problems.

**UNIT IV – STRESS DISTRIBUTION AND CONSOLIDATION****9 + 3 Hours**

Stress distribution in soil media – Boussinesq's theory (Point Load, UDL and Line Load) – Use of Newmark influence charts – Westergaard's equation for point load–pressure bulb.

Consolidation – Definition – Concepts of coefficient of compressibility –Terzaghi's theory of one-dimensional consolidation – Coefficient of volume change and compression index – e-log p curves – Determination of coefficient of consolidation by curve fitting methods – Calculation of Consolidation settlement – Pre-consolidation pressure.

**UNIT V – SHEAR STRENGTH****9 + 3 Hours**

Shear strength of cohesive and cohesion less soils – Mohr–Coulomb theory – shear strength parameters and their measurements – Direct shear, Triaxial compression, Unconfined Compression and Vane shear tests – Types of shear tests based on drainage and their applicability – Factors influencing shear strength – pore pressure parameters.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1 Explain the different types of minerals, rocks, structure of rocks and geological investigations needed for construction of civil engineering structures	Understand
CO2 Classify soils with respect to their properties, calculate soil parameters through phase diagram and calculate optimum moisture content of soil through application of compaction process.	Apply
CO3 Explain the effects of water in the soil and solve complex problems related to seepage of water in soil.	Apply
CO4 Explain the stress distribution in soil, consolidation process and solve problems related to stress distribution and consolidation settlement for design of foundation.	Apply
CO5 Classify the shear test based on drainage conditions, calculate shear strength parameters as well as draw shear strength envelopes for cohesive and non-cohesive soil.	Apply

**Text Book(s):**

- T 1. Murthy V.N.S., "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors, New Delhi,
- T 2. Venkatramaiah. C, "Geotechnical Engineering", New Age International (P) Ltd. Publishers, New Delhi, 2019.
- T 3. Dr. Arora. K.R, "Soil Mechanics and Foundation Engineering (Geotechnical Engineering)", Standard Publishers Distributors, Nai Sarak, New Delhi, 2020.
- T 4. Parbin Singh "Engineering and General Geology" S.K Kataria & Sons, October 2013.

**Reference Book(s):**

- R 1. Varghese P.C., "Foundation Engineering", PHI Learning Private Limited, New Delhi, 2012.

- R 2. GopalRanjan and Rao A.S.R., “Basic and Applied Soil Mechanics”, New Age International Publishers, New Delhi, 2020.
- R 3. Dr. B.C Punmia, Er. Ashok K Jain, Dr. Arun K Jain., “Soil Mechanics and Foundations”, Laxmi Publications, 17th Edition, 2018.
- R 4. N. Chenna Kesavulu, “Textbook of Engineering Geology”, Laxmi Publication, January 2018.

**IS Code Book:**

1. IS: 2720– Part 1 to Part 40

**Web References:**

3. <http://nptel.ac.in/courses/105103097/>
4. <http://home.iitk.ac.in/~pkbd/A%20preview%20of%20soil%20Behaviour.pdf>
5. <https://www.aboutcivil.org/soil-mechanics-html>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN1502</b>		<b>Course Title: DESIGN OF RC STRUCTURES</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Structural Analysis

### **Course Objectives**

The course is intended to:

- Learn to design Reinforced Concrete beam.
- Learn to design Reinforced Concrete slabs and staircase
- Learn to design Reinforced Concrete columns.
- Learn to design Reinforced Concrete footings.
- Learn to design Reinforced Concrete water tanks

#### **Unit I-INTRODUCTION AND DESIGN OF BEAMS**

**9+3 Hours**

Objective of RC design - Code of practices and specifications-Properties of concrete and reinforcing steel - Design methodologies - Limit state method of design for singly and doubly reinforced rectangular and flanged sections - Design for shear, torsion, bond and anchorage of reinforcement

#### **Unit II- DESIGN OF SLABS AND STAIRCASE**

**9+3 Hours**

Design of One-way, two-way and flat slabs - Types of staircases - Design of dog-legged staircase.

#### **Unit III - DESIGN OF COLUMNS**

**9+3 Hours**

Design of columns for axial load with uniaxial bending-Design of short columns under axial compression, axial compression with uni-axial and bi-axial bending-Design of slender columns.

#### **Unit IV - DESIGN OF FOOTINGS**

**9+3 Hours**

Types of footings and foundation - Design of isolated and combined footings - Design of Raft foundation.

#### **Unit V -DESIGN OF WATER TANKS**

**9+3 Hours**

Types of water tanks - Design of ground and underground tanks (square, rectangular and circular)

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Identify and compute the stress strain behavior of steel and concrete, as well as analyse and design reinforced concrete beams as per BIS codal provisions.	Apply
CO.2 Analyse and design different types of RC slabs and dog-legged staircase as per BIS codal provisions.	Create
CO.3 Analyse and design the columns for various loading conditions as per BIS codal provisions.	Create
CO.4 Analyse and design different types of footings for load bearing as well as framed structure as per BIS codal provisions.	Create
CO.5 Analyse and design water tanks as per BIS codal provisions.	Create

**Text Book(s):**

- T 1. S. Unnikrishna Pillai and Devdas Menon, Reinforced concrete design, Tata McGraw Hill Publication., 2019
- T 2. P.C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt.Ltd., New Delhi, 2013
- T 3. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, RCC Designs (Reinforced Concrete Structures), Laxmi Publications Pvt. Ltd., New Delhi, 2019

**Reference Book(s):**

- R 1. M.L. Gambhir, Design of Reinforced Concrete structures, Prentice Hall of India Private limited, New Delhi, 2012
- R 2. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014

**Web References:**

- 1. <https://nptel.ac.in/courses/105/105/105105104/>
- 2. <https://nptel.ac.in/courses/105/105/105105105/>

**IS Code Book**

- 1. IS 456:2000 Plain and Reinforced Concrete - Code of Practice.
- 2. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
- 3. IS 875(1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
- 4. IS 3370(Part 1-4): 1965 Code of Practice for Concrete Structures for the Storage of Liquids

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	2	-	3
CO2	3	3	3	-	-	-	-	-	-	-	-	2	-	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	-	3
CO4	3	3	3	-	-	-	-	-	-	-	-	2	-	3
CO5	3	3	3	-	-	-	-	-	-	-	-	2	-	3

High-3; Medium-2; Low-1

<b>Course Code: 19CECN1503</b>		<b>Course Title: ENVIRONMENTAL ENGINEERING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>4: 0: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Hydraulics Engineering

### **Course Objectives**

The course is intended to:

- Study the public water supply schemes and sources of water.
- Study the quality and distribution of water.
- Understand the concept of water treatment.
- Study the quantity, collection and conveyance of wastewater.
- Understand the sewage treatment process.

### **UNIT I - PUBLIC WATER SUPPLY SCHEMES AND SOURCES OF WATER**

**12 Hours**

Necessary and objectives of water supply schemes. Quantity of water and its requirements - continuous and intermittent supply - Rate of demand and variations - effect on design period - population growth and forecast. Sources of water - infiltration galleries - storage reservoirs - storage capacity by mass curve methods. Types of wells - tests for yield of a well

### **UNIT II - QUALITY AND DISTRIBUTION OF WATER**

**12 Hours**

Definitions - quality of water - portable water, pure water, mineral water, etc. Physical, chemical, biological impurities in water- quality standards of water. Transportation of water - types of conduits - Hydraulics of pipe flow - design-materials of pressure pipes and pipe corrosion. Laying and testing of pipelines. Pumps - types, selection of pumps. Distribution of water - requirements of good distribution system - method of distribution - layout - pressure in the distribution system - Hardy cross method

### **UNIT III - TREATMENT OF WATER**

**12 Hours**

Water treatment - screening, plain sedimentation - coagulation sedimentation - filtration - disinfection - water softening - removal of colour, odour and taste - Removal of iron and manganese- Fluoridation and defluoridation(Only theoretical concepts will be covered, no design)



**UNIT IV - QUANTITY, COLLECTION AND CONVEYANCE OF WASTEWATER****12 Hours**

Necessity and objectives of sanitary engineering projects - Definitions - Design period - Systems of sewerage - quantity of sewage - Fluctuation in the flow pattern- Estimation of storm runoff - Dry and Wet weather flow - Hydraulics of sewers - Self cleansing velocities - Full/partial flow conditions - Sewer appurtenances - Materials of sewers - sewer joints - sewer laying - sewer cleaning and maintenance

**UNIT V - QUALITY OF SEWAGE AND TREATMENT****12 Hours**

Characteristics and composition of sewage - physical and chemical analysis - DO, BOD, COD and their significance - Objectives and basic principles of sewage treatment - primary treatment - screens - grit chamber - settling tank - principles of sedimentation. Principles and Functions of Aeration, Activated Sludge Process and Trickling filter, Other treatment methods - Oxidation ditches, UASB - Waste Stabilization Ponds  
(Only theoretical concepts will be covered, no design)

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the concept of water supply system, sources of water, calculate population forecast by different approaches and estimate the storage capacity of reservoir as well as tube well.	Apply
CO.2 Explain the quality standards of water, type of conduits, laying and testing of pipelines, selection of pumps and concepts of water distribution system as well as construction of distribution of networks through Hardy cross methods.	Apply
CO.3 Elucidate the fundamental scientific processes underlying for design of water treatment processes.	Understand
CO.4 Explain the quantity, collection and conveyance of wastewater as well as estimate the dimensions of sewer and self-cleaning velocity of sewers.	Apply
CO.5 Elucidate the fundamental scientific processes underlying for design of waste water treatment processes.	Understand

**Textbook(s):**

- T1. Garg, S.K., Environmental Engineering Vol. I and Vol.II, Khanna Publishers, NewDelhi, 2019.
- T2. Mark J Hammer, Mark J. Hammer Jr., Water and wastewater technology, Prentice Hall of India, 2012.

**Reference Book(s):**

- R.1 Birdie, G.S., Water supply and sanitary engineering, Dhanpat Rai and Sons, 2018.

- R.2 Shah, C.S., Water supply and sanitation, Galgotia publishing company, New Delhi, 2016.
- R.3 Manual on wastewater and treatment CPHEEC, Ministry of urban affairs and employment, Govt of India., New Delhi, 2013.

**Web References:**

1. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-85-water-and-wastewater-treatment-engineering-spring-2006/lecture-notes/>
2. <http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code:19CECN3501</b>		<b>Course Title: SOIL MECHANICS LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

- attain adequate knowledge in assessing both index and engineering properties of soils, through hands on experience.

#### **List of Experiment**

1. Determination of Water content and Specific Gravity of Soil Solids.
2. Determination of Grain Size distribution using Sieve Analysis and Hydrometer Analysis.
3. Determination of Liquid Limit, Plastic Limit and Shrinkage Limit using Casagrande Apparatus.
4. Determination of Field Density by Sand replacement method and core cutter method.
5. Determination of Moisture-density relationship using Standard Proctor compaction Test.
6. Determination of Relative density of Cohesion less soil.
7. Determination of soil permeability by Constant head and falling head methods.
8. Determination of Coefficient of Consolidation using One Dimensional Consolidation Test.
9. Determination of Shear strength using Direct Shear Test in Cohesion less soil.
10. Determination of Shear strength parameters by Unconfined compression test in cohesive soil.
11. Determination of Shear strength using Laboratory vane shear test in cohesive soil.
12. Determination of Shear strength and stiffness parameters of soil using Tri-axial compression test in cohesion-less soil (Demonstration only).
13. Determination of Soil strength by CBR test for roads and pavements.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the soil sample procedure for various soil tests as per the IS: 2720 (Part 1) – 1983 specifications.	Apply
CO.2 Demonstrate the tests and determine the index properties of soils for soil classification.	Apply
CO.3 Determine the Insitu density and compaction characteristics of soils for pavement design.	Apply
CO.4 Determine the compressibility and permeability to Analyse the seepage characteristics of soils.	Apply
CO.5 Demonstrate and determine the shear strength parameters of soil and plot shear strength envelopes.	Apply

**Reference Book(s):**

- R 1. Soil Mechanics Laboratory Manual, Department of Civil Engineering, MCET,
- R 2. Soil Mechanics Laboratory Manual, Braja M. Das, 8th Edition, Oxford University
- R 3. Soil Mechanics Laboratory Manual, Michael E Kalinski, 2nd Edition.
- R 4. I.S Code of Practice (2720) Relevant parts.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code:19CECN3502</b>		<b>Course Title: ENVIRONMENTAL ENGINEERING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- learn how the common environmental experiments relating to water and wastewater quality are performed.

#### **List of Experiments**

1. Determination of pH and Electrical Conductivity
2. Determination of Dissolved solids, Suspended Solids, Volatile Solids (VS), and Turbidity
3. Determination of Sulphates
4. Determination of Chlorides
5. Determination of Dissolved Oxygen
6. Determination of Chemical Oxygen Demand
7. Determination of Acidity
8. Determination of Alkalinity
9. Determination of Total Hardness
10. Determination of Available chlorine in Bleaching powder
11. Determination of Residual Chlorine, Chloride and Fluoride
12. Determination of Optimum amount of Coagulant
13. Determination of Biological Oxygen Demand (Demonstration)

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Determine physical and chemical characteristics of water.	Apply
CO.2 Determine physical and chemical characteristics of wastewater.	Apply
CO.3 Determine the optimum dosage of coagulant.	Apply
CO.4 Determine break-point chlorination.	Apply
CO.5 Demonstrate the method to estimate biological oxygen demand.	Apply

#### Reference Book(s):

- R 1. Environmental engineering Laboratory manual of Civil Engineering Department, MCET, Pollachi.
- R 2. Csuros Maria, Environmental sampling and analysis for technicians, Lab Manual, 1<sup>st</sup> edition, CRC Press, 1997.

#### Web References:

1. [http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk\\_labs/Environmental\\_Engineering\\_1/index.html](http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/index.html)
2. <https://vlab.amrita.edu/?sub=2&brch=193&sim=1548&cnt=6>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO2	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO3	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO4	1	-	-	3	-	-	-	1	2	2	-	2	3	-
CO5	1	-	-	3	-	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19PSHG6501</b>	<b>Course Title: EMPLOYABILITY SKILLS 1: TEAMNESS AND INTERPERSONAL SKILLS</b> (Common to all B.E/B.Tech Programmes)		
<b>Course Category: Humanities</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week): 0: 0: 2</b>	<b>Credit :1</b>	<b>Total Contact Hours: 30</b>	<b>Total Marks: 100</b>

**Pre-requisites:**

➤ **NIL**

**Course objectives:**

The course is intended to

1. Enrich effective communicative attributes as part of the skills and Facilitate presentation and public speaking skills.
2. Handle negativities and explore the true self.
3. Inculcate interpersonal skills and to groom as a professional.
4. Educate the importance of Nonverbal skill set to attain perfection
5. Build teamness and its ethics to facilitate corporate working

**UNIT I: EFFECTIVE COMMUNICATION & PRESENTATION SKILLS**

**6 Hours**

Barriers of Communication -Fear Of English -Handling Social Factors - Handling Psychological Factors -Handling Practical Problems -Do's & Don'ts - Effective Presentation - Presentation - Importance of Presentation Slide orientation - Introduction in a presentation - Styles of a slide - Slide Templates- Font ,color, Background -Graph Diagrammatic representation - Delivery of presentation - Body Language & Gestures - Verbal Attributes - Communication -Handling stammers and breaks - Handling fear of stage - Maintaining Confidence - Content delivery methods- Do's and Don'ts in a presentation- Tips to handle it-Effective Conclusion

**UNIT II: POSITIVE ATTITUDE & HANDLING REJECTIONS**

**6 Hours**

A,B,C's Of Attitude -Influencing Factors -Individual Factors -Character Comparison - Strategies to Handle ourselves-Benefits of Positive Attitude - Do's& Don'ts - Handling Rejections - Identifying Negativities -Nuances of handling it -Necessary changes -To do List -Creating One's self -Self Qualifiers

**UNIT III - INTERPERSONAL SKILLS**

**6 hours**

Life skills -Core IP Skills -Importance of IP Skills -Tips to improve IP Skills-Necessity of IP Skills

**UNIT IV - BODY LANGUAGE, DRESSING & GROOMING****6 Hours**

Unconscious Physical moments - Metrics of Body Language - Good Posture -Head Motion -Facial Expression - Eye contact -Gestures -Dressing -Grooming & Outlook - Necessity of good Body Language

**UNIT V - TEAM ETHICS****6 Hours**

Team Ethics-Necessity of Team Work- Teams Everywhere - Benefits of team culture - Reason for team failure -Conflicts -Handling Conflicts -Being a team player -Work difference from college

**COURSE OUTCOMES:**

Course Outcomes	Cognitive Level
CO.1 Demonstrate effective communicative attributes as part of their skills and facilitate presentation & public speaking skills	Apply
CO.2 Identify and explore the true self and handle negatives.	Apply
CO.3 Develop interpersonal skills and to groom as a professional.	Apply
CO.4 Explain the importance of Nonverbal skill set to attain perfection.	Understand
CO.5 Build teamness and its ethics to facilitate corporate working.	Apply

**Textbook(s):**

T 1. John C Maxwell, " The 17 Indisputable Laws of Teamwork: Embrace Them and Empower Your Team", Harper Collins Leadership Publishers, 2013

**Reference Books**

- R 1. Patrick Lencioni, " The Five Dysfunctions of a Team: A Leadership Fable" Jossey Bass Publishers, 2006
- R 2. Malcolm Gladwell, "Talking to Strangers: What We Should Know about the People We Don't Know" Penguin Publishers, 2019
- R 3. Harvey Segler, " Body Language: Discovering & Understanding the Psychological secrets behind reading & Benefiting from Body Language" Kindle Edition, 2016

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	1	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	2	1	-	-	1	-	-

High -3, Medium - 2, Low-1



## VI SEMESTER

<b>Course Code: 19CECN1601</b>		<b>Course Title: FOUNDATION ENGINEERING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Geology and Soil Mechanics

### **Course Objectives**

The course is intended to:

- Gain knowledge on Site investigation methods for selection of suitable foundation.
- Gain Knowledge on Bearing capacity of soil and design of footings.
- Gain Knowledge on Load carrying capacity and settlement of pile foundation.
- Gain Knowledge on Earth pressure in retaining walls.
- Gain Knowledge on Stability of slopes.

### **UNIT I - SUBSURFACE EXPLORATION AND SITE INVESTIGATION 9 + 3 Hours**

Objectives - Methods of exploration - Boring - Depth of boring - Spacing of bore hole - In-situ penetration tests - SPT - SCPT - Geophysical methods- Electrical Resistivity Method- Seismic Refraction Method- Soil Sampling techniques -Sample Disturbance - Rock sampling- RQD- Core Recovery Ratio-Bore log.

### **UNIT II - SHALLOW FOUNDATION 9 + 3 Hours**

Types of Shallow Foundation – function – requirements - Location and depth of foundation – bearing capacity of Soils – factors affecting bearing capacity - Terzaghi and IS bearing capacity theories - Plate load test and its limitations- Allowable bearing pressure - Contact Pressure – proportioning of footings - design of footings (Rectangular, combined and strap footing)- Settlement and types.

### **UNIT III - DEEP FOUNDATION 9 + 3 Hours**

Types of piles and their function - Factors influencing the selection of pile - Estimating Load Carrying capacity of piles by Static formula and Dynamic formulae - Pile load test - Negative skin friction - Use of Under reamed piles in Expansive Soils-Group capacity - Pile group efficiency by Feld's rule, Converse Labarra formula - Group Capacity- Settlement of pile groups.

### **UNIT IV - LATERAL EARTH PRESSURE AND RETAINING WALLS 9 + 3 Hours**

Earth Pressure at rest - Active and Passive states - Rankine's theory for cohesionless and cohesive soil - Coloumb's wedge theory- Determination of Earth Pressure by Analytical methods - Culmann's Graphical method- Types of retaining walls - Design principles of Gravity and Cantilever retaining walls.

## UNIT V - STABILITY OF SLOPES

9 + 3 Hours

Types of Slope Failure - Different factors of Safety- Stability analysis of Infinite and Finite Slopes- Swedish Circle Method -  $\phi=0$  analysis and  $c=0$  analysis - Friction circle Method - Taylor's stability number- Stability Charts- Slope Protection measures.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the various site investigation methods to select the suitable foundation.	Understand
CO.2 Explain the bearing capacity of soil, calculate the bearing capacity of soil using appropriate procedure and estimate the size of shallow foundation.	Apply
CO.3 Determine the load carrying capacity of pile foundation and efficiency of pile group.	Apply
CO.4. Derive the lateral earth pressure theories and calculate the earth pressure for different backfill conditions.	Apply
CO.5 Derive the equation for slope stability of C and C- $\phi$ soils and calculate the stability number.	Apply

### Textbook(s):

- T 1. Murthy V.N.S., "Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering", CBS Publishers and Distributors, New
- T 2. Venkatramaiah. C, "Geotechnical Engineering", New Age International (P) Ltd. Publishers, New Delhi, 2019.
- T 3. Dr. Arora. K.R, "Soil Mechanics and Foundation Engineering (Geotechnical Engineering)", Standard Publishers Distributors, Nai Sarak, New Delhi, 2019.

### Reference Book(s):

- R 3. Varghese P.C., "Foundation Engineering", PHI Learning Private Limited, New Delhi, 2012.
- R 4. Gopal Ranjan and Rao A.S.R., "Basic and Applied Soil Mechanics", New Age International Publishers, New Delhi, 2020.
- R 5. Dr. B.C Punmia, Er. Ashok K Jain, Dr. Arun K Jain., "Soil Mechanics and Foundations", Laxmi Publications, 17<sup>th</sup> Edition, 2018.

### IS Code Book:

- 1. IS: 2720- Part 1 to Part 40

### Web References:

- 1. <http://nptel.ac.in/courses/105103097/>
- 2. <http://home.iitk.ac.in/~pkbd/A%20preview%20of%20soil%20Behaviour.pdf>
- 3. <https://www.aboutcivil.org/soil-mechanics-html>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN1602</b>		<b>Course Title: DESIGN OF STEEL STRUCTURES</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 1: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Mechanics of Solids

### **Course Objectives**

The course is intended to:

- Gain knowledge on design of steel structure connections.
- Gain knowledge on design of tension member.
- Gain knowledge on design of Compression member.
- Gain knowledge on design of Flexure member.
- Gain knowledge on design of Roof trusses.

### **UNIT I - INTRODUCTION**

**9+3 Hours**

Steel structures- types - Properties of steel - Design philosophies - Analysis and Design Methods - Structural steel sections - Types of connections - Design of bolted and welded connections - Axial and Eccentric connections

### **UNIT II - TENSION MEMBERS**

**9+3 Hours**

Classification of Tension members - Net area - Net effective sections - Concept of shear lag - Design strength of simple and compound members - Use of lug angles - Design of tension splices.

### **UNIT III - COMPRESSION MEMBERS**

**9+3 Hours**

Classification of Compression members - Effective length of compression members - Slenderness ratio - Design strength of simple and compound members - Design of laced and battened columns - Design of column bases and column splicing.

### **UNIT IV - FLEXURAL MEMBERS**

**9+3 Hours**

Effective span of beams - Design strength in bending - Laterally supported and unsupported beams - Intermediate and bearing stiffeners- Flange web splices - Effective length for lateral torsional buckling - Web crippling and buckling.

### **UNIT V -ROOF TRUSSES**

**9+3 Hours**

Components of industrial structures - load specifications-calculation of dead, live and wind loads - Types of roof trusses - Design of purlins - need for bracings-design of bracings- Introduction to gantry girder.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Calculate the forces acting on bolted and welded connections to ensure efficiency of joints	Apply
CO.2 Design of tension members for various steel structures as per IS codal provisions.	Create
CO.3 Design of steel columns and column bases as per IS standards.	Create
CO.4 Design of laterally supported and unsupported beams under different loading conditions as per IS codal provisions.	Create
CO.5 Calculate the loads acting on roofs, design purlins as per IS standards as well as explain the design principles of gantry girder.	Create

**Textbook(s):**

T1. N. Subramanian, Design of Steel Structures, Oxford University Press 2015.

T2. S.S.Bhavakatti, Design of Steel Structures, IK publications, New Delhi, Third Edition 2017.

**Reference Book(s):**

R 1. S. K. Duggal, Limit State Design of Steel Structures, Tata, Mc Graw Hill Education Pvt Ltd, New Delhi, 2014.

R 2. Punmia B.C., Ashok Kumar Jain & Arun Kumar Jain, "Design of Steel Structures", Vol. I and II, Arihant Publications, Mumbai, 2015.

R 3. Dayaratnam P., "Design of Steel Structures", A.H. Wheeler & Co. Ltd., Allahabad, 2012.

**IS Code Book**

1. IS 800 - 2007, General Construction in Steel - Code of Practice, BIS, New Delhi
2. IS 875 (part 3) - 2015, Wind loads on Buildings and Structures, BIS, New Delhi
3. IS 808: 1989 - Steel Tables

**Web References:**

1. [http://www.steel-insdag.org/TM\\_Contents.asp](http://www.steel-insdag.org/TM_Contents.asp)

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	3	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN3601</b>		<b>Course Title: BUILDING DRAWING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Engineering Drawing for Civil Engineers
- Design of RC Structures

### **Course Objectives**

The course is intended to:

- provide an understanding of plotting reinforcement details of various building components as well as other structures.

### **List of Experiments**

1. Explain the requirements of a building along with minimum dimension as per NBC, requirement
2. Draft the section for foundation for load bearing structure
3. Draft the section for foundation and column of framed structure
4. Draft the Cross Section and Longitudinal Section of RCC roof slab (one way), and beam
5. Draft the Cross Section and Longitudinal Section of RCC roof slab (two way), and beam
6. Preparation of Cross Section and Longitudinal Section for Beam - column joints
7. Draft the Plan, Section, and elevation of dog legged staircase,
8. Draft the Plan, Section, and elevation of bifurcated staircase,
9. Draft the Plan, Section, and elevation of septic tank,
10. Draft the Plan, Section, and elevation Rainwater Harvesting Structure.
11. Prepare a scheme layout of a residential building section (G+1) for a load bearing Structure
12. Prepare a scheme layout of a residential building section (G+1) for a framed structure.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Draw the reinforcement details of basic components of buildings as per IS codal provisions.	Apply
CO.2 Draw the reinforcement details of staircases as per IS codal provisions.	Apply
CO.3 Design the septic tank and plot the plan, section and elevation.	Create
CO.4 Explain the NBC requirements for planning a residential building.	Understand
CO.5 Draw the plan, section and elevation of a residential building (G+1) for load bearing and framed structures.	Apply

**Reference Book(s):**

- R 1. Computer Aided Building Drawing Manual, Department of Civil Engineering, MCET, Pollachi
- R 2. Civil Engineering Drawing and House Planning, B. P. Verma, Khanna Publishers, New Delhi, 2010.
- R 3. Illustrated Design of Reinforced Concrete Buildings, V. L. Shah and S. R. Karve, Assorted Editorial; 8<sup>th</sup> edition, 2017.
- R 4. IS 456-2000 (Reaffirmed 2016), Plain and Reinforced Concrete code of practice (Fourth Revision), Bureau of Indian Standards.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	3	-	-	-	-	-	-	-	2	3	-
CO2	3	-	-	3	-	-	-	-	-	-	-	2	3	-
CO3	3	-	3	3	-	-	-	-	-	-	-	2	3	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	-	-	3	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1

<b>Course Code: 19CECN3602</b>		<b>Course Title: COMPUTER AIDED DESIGN AND DRAFTING LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Design of RC structures

### **Course Objectives**

The course is intended to:

- Provide students with a solid background on the computer aided design and drafting of building elements.
- Acquire the knowledge of designing components of buildings, retaining walls, water tanks and steel structures using software.

### **List of Exercises**

1. Design simply supported, cantilever and continuous beams
2. Design short and long columns
3. Design isolated and combined footing
4. Design retaining walls
5. Design underground and elevated water tanks
6. Design two storey RC space frame
7. Design steel beams for flexure
8. Design steel roof truss
9. Design gantry girder
10. Design bridge deck slab



Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Design and illustrate the reinforcement detailing of various structural elements such as beams, columns, footing as well as the framed structures by a software.	Create
CO.2 Design and draw the structural detailing of RCC water tanks using a software	Create
CO.3 Design and demonstrate the structural detailing of RCC Retaining wall by a software	Create
CO.4 Design and draw the structural drawing of steel beams and trusses by a software	Create
CO.5 Design and detail the sectional view of bridge deck slab and gantry girder using a software	Create

#### Reference Book(s):

- R 1. Computer Aided Design and Drafting Laboratory manual of Civil Engineering Department, MCET, Pollachi.
- R 2. S. Unnikrishna Pillai and Devdas Menon, Reinforced concrete design, Tata Mc-Graw Hill Publication., 2019

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	3	3	-	-	1	2	2	-	2	-	3
CO2	1	-	-	3	3	-	-	1	2	2	-	2	-	3
CO3	1	-	-	3	3	-	-	1	2	2	-	2	-	3
CO4	1	-	-	3	3	-	-	1	2	2	-	2	-	3
CO5	1	-	-	3	3	-	-	1	2	2	-	2	-	3

High-3; Medium-2;Low-1

<b>Course Code: 19PSHG6601</b>	<b>Course Title: EMPLOYABILITY SKILLS 2: CAMPUS TO CORPORATE</b>		
<b>Course Category: Humanities</b>	<b>Course Level: Introductory</b>		
<b>L: T:P (Hours/Week): 0:0:2</b>	<b>Credit :1</b>	<b>Total Contact Hours: 30</b>	<b>Total Marks: 100</b>

**Pre-requisites:**

➤ **NIL**

**Course objectives:**

The course is intended to:

1. Understand emotions and necessity to handle it to evolve as an effective social animal
2. Build effective resumes to project the positives to be employable
3. Facilitate working in a collaborative work environment and to engage in healthy agreements for building person's professional facet
4. Formulate the growth attribute to outperform, initiate and grow in professional arena
5. Explain time management and impart leadership skills.

**UNIT I: EMOTIONAL INTELLIGENCE**

**6 Hours**

Nature of Emotions - Importance of EI - EQ vs IQ - Behavioral difference between EQ & IQ - Acquiring Emotional Intelligence - Benefits of high EI - Steps to develop EI - Role of EI in Interviews

**UNIT II: RESUME PREPARATION**

**6 Hours**

Importance of Resume - Good Resume - Planning Resume -Organizing Resume -Spell check - Benefits of good resume - Resume Writing

**UNIT III: GROUP DISCUSSION**

**6 Hours**

Purpose of GD -Prerequisites of GD - Benefits of GD-Features of GD-Do's & Don'ts in GD-Accept Criticism & Feedback - Accepting Suggestions - GD Phrases - Effective Introduction& Conclusion - Preferred Etiquette of GD.

**UNIT IV: INTERVIEW ETIQUETTE(NETIQUETTE)**

**6 Hours**

Definition of Interview - Types of Interview - Prior interview - Know the Company -Employer's perspective in interview - Non-Verbal etiquette - Dressing - Verbal Communication in Interview - Facing Rejection in Interview - Do's & Don'ts in an Interview - Common Interview Questions - Handling Stress Questions - Handling Telephonic Interviews.

**UNIT V: LEADERSHIP SKILLS& TIME MANAGEMENT****6 Hours**

**Leadership** - Leadership Traits - Leadership styles - Types of Leaders - Qualities of a leader  
-Developing Perspectives

**Time Management** - Necessity of Time Management - Types of time -Estimation of time -  
Process of Time management - Efficient utilization of Time - Time wasting culprits - Tips to  
manage time - Goal setting in Time Management

Course Outcomes	Cognitive Level
CO.1 Understand the emotions and necessity to handle them	Understand
CO.2 Build effective resumes to project the positives to be employable	Apply
CO.3 Facilitate collaborative work environment and to engage in healthy agreements for building person's professional facet	Understand
CO.4 Formulate the growth attribute to outperform, initiate and grow in professional arena	Apply
CO.5 Explain time management and impart leadership skills	Understand

**Textbook(s):**

- T 1. Thea Kelley, "Get That Job! The Quick and Complete Guide to a Winning Interview " Plover crest Press, 2017

**Reference Books**

- R 1. Daniel Goleman, " Emotional Intelligence Reader's Guide", BANTAM PUBLISHERS, 1997
- R 2. Daniel Goleman, Richard Boyatzis & Annie McKee, " Primal Leadership: Unleashing the Power of Emotional Intelligence" Harvard Business Review Press; Anniversary edition, 2013
- R 3. Stephen R Covey, " The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change" Simon & Schuster; Anniversary edition, 2013

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	-	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	1	-	-	1	1	-	-

High -3, Medium - 2, Low-1

<b>Course Code: 19CEPN6601</b>		<b>Course Title: INNOVATIVE AND CREATIVE PROJECT</b>	
<b>Course Category: Project</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0:0: 4</b>	<b>Credits:2</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to

- Gain knowledge on problem identification and to formulate the methodology to arrive a suitable solution.
- Enhance students' skills pertaining to scientific and technical report writing and presentation.

The student should carry out the literature survey, identification of the problem, development of the methodology and execution of their project in the civil engineering discipline. The project work can be allotted to either an individual student or a group of students comprising of not more than three. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Analyze and compile information from various resources relevant to the specific area of project to be undertaken and relate with societal and global issues.	Analyse
CO.2 Analyze regional, national and international scenarios and compose the problem statements and the objectives of the project towards a sustainable development.	Analyse
CO.3 Formulate project methodology integrating clear fundamentals, theories and standards governing the project as well as project planning.	Analyse
CO.4 Apply relevant engineering principles and theories to design, built, operate, simulate and analyze the development of a system or concept.	Create
CO.5 Plan and manage time effectively as a team or individually.	Apply
CO.6 Organize and present technical and scientific findings effectively through written and oral mode with the aid of multimedia tools and appropriate code of ethics.	Analyse

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	3	-	-	-	-	-	3	3	-
CO2	3	3	-	-	-	-	3	-	-	-	-		3	-
CO3	3	-	-	-	-	-	-	-	-	-	3		3	3
CO4	3	3	3	3	3	-	-	-	-	-	-		3	3
CO5	-	-	-	-	3	-	-	-	3	-	-		3	-
CO6	-	-	-	-	3			3	-	3	-	-	3	-

High -3, Medium - 2, Low-1

## **VII SEMESTER**

<b>Course Code: 19CECN1701</b>		<b>Course Title: WATER RESOURCES AND IRRIGATION ENGINEERING</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week) 4: 0: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Hydraulics Engineering

### **Course Objectives**

The course is intended to:

- Understand the fundamentals of water resources engineering.
- Know about the principles of irrigation.
- Comprehend the methods of irrigation water management.
- Familiarize with the concepts of canal head works and cross drainage works.
- Facilitate the understanding of storage reservoirs.

### **UNIT I - WATER RESOURCES ENGINEERING AND MANAGEMENT**

**12 Hours**

Water resources survey - Water resources of India and Tamil Nadu - Description of water resources planning - Economics of water resources planning, physical and socio-economic data - National Water Policy - Interlinking of rivers – Consumptive and non-consumptive use of water- Conjunctive use of surface and groundwater.

### **UNIT II – PRINCIPLES OF IRRIGATION**

**12 Hours**

Irrigation – Need, mode and Influence of irrigation – Crop and crop seasons – Consumptive use of water – Duty - Factors affecting duty - Relationship between Duty, Delta, Base period - Irrigation efficiencies - Irrigation scheduling – Planning and Development of irrigation projects.

### **UNIT III – METHODS OF IRRIGATION**

**12 Hours**

Tubewell irrigation - Lift irrigation – Flooding methods – Irrigation methods - Surface and Sub-Surface - Micro Irrigation – Drip and Sprinkler Irrigation - Merits and demerits

**UNIT IV – CANAL IRRIGATION****12 Hours**

Classification of canals - Alignment of canals - Silt theories - Water logging - Canal losses - Weirs - Canal Head works - Canal regulators - Canal drops – Trapezoidal and Siphon well drop - Cross drainage works - Lining and maintenance of canals.

**UNIT V – RESERVOIR PLANNING AND MANAGEMENT****12 Hours**

Reservoirs & dams - Single and multipurpose - Multi objective - Factors to be considered in selection of site for a dam - Fixation of storage capacity - Strategies for reservoir operation - Sedimentation of reservoirs - Design flood and its estimation - Flood control & mitigation methods - Levees and flood walls - Channel improvement - Flood warning.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the fundamentals of water resources planning and the national water policy.	Understand
CO.2 Describe the importance of irrigation, its scheduling and estimation of their efficiencies.	Understand
CO.3 Explain the methods of irrigation adopted in the field.	Understand
CO.4 Elucidate the various aspects of canal irrigation including canal head works and cross drainage works.	Understand
CO.5 Estimate the storage capacity of reservoirs and describe the strategies for flood control measures.	Apply

**Text Book(s):**

- T1. Asawa. G.L, "Irrigation and water resources engineering", New Age International Publishers.1<sup>st</sup> Edition, reprint 2012.
- T2. Singh, G., "Irrigation engineering", Standard Book House, 2018.
- T3. Sharma, S.K., "Irrigation engineering and hydraulic structures", S. Chand Publishers, New Delhi, 2017.

**Reference Book(s):**

- R.1 Basak, N.N, "Irrigation Engineering", Tata McGraw-Hill Publishing Co, Edition:2011-2012
- R.2 Garg, S.K., "Irrigation Engineering", Khanna Publishers, 2006
- R.3 H.M., Ragunath, "Irrigation Engineering", Wiley India Pvt Ltd., 2011

**Web References:**

- 1. <http://nptel.ac.in/downloads/105105110/>
- 2. <http://www.civilenggforall.com/2015/09/irrigation-and-water-resources-engineering-gl-asawa-free-download-pdf-civilenggforall.html>
- 3. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-731-water-resource-systems-fall-2006/lecture-notes/>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2; Low-1



<b>Course Code: 19CECN1702</b>		<b>Course Title: CONSTRUCTION PROJECT MANAGEMENT</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>4: 0: 0</b>	<b>Credits:4</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Understand the concepts of project formulation in construction projects.
- Know the different stages of construction planning.
- Learn the different scheduling procedures and techniques required for project planning in construction projects.
- Study different cost control measures to be adopted in construction projects.
- Understand the purpose of resource levelling in construction projects.

#### **UNIT I – CONSTRUCTION PROJECT FORMULATION**

**12 Hours**

Construction participants – Roles and responsibilities of client, construction management consultants, architect – Engineering associates and contractors – Different types of construction projects – Project life cycle – Phases in project life cycle – Pre – feasibility report and clearance – Techno economic feasibility report – Detailed project report

#### **UNIT II – CONSTRUCTION PLANNING**

**12 Hours**

Basic concepts in the development of construction plans – Choice of technology and construction method – Importance of planning in construction project – Different periods of planning – Pretender data collection – Charts for labour, staff, material and plant requirements – BOQ and cost estimates – Types of contract – Contract procedures – Contract agreement – Principal clauses and conditions.

#### **UNIT III – SCHEDULING PROCEDURES AND TECHNIQUES**

**12 Hours**

Construction schedules – CPM – Activities, their duration and interdependence – Construction of network diagram – forward and backward pass – critical path – float – PERT – three-time aspects and their identification based on statistical data and Beta distribution – Probability of achieving desired time targets for projects.

#### **UNIT IV – CONSTRUCTION PROJECT CONTROL**

**12 Hours**

Inventory control – Types and tools – EOQ model – Direct cost and indirect cost and their relation to project duration – Time cost trade off – Quality and safety concerns in construction – Total quality control – Quality control by statistical methods – Sampling by attributes and variables.

## UNIT V – RESOURCE ALLOCATION

12 Hours

Resource aggregation diagrams as per early start and late start – smoothing by activity start time manipulation – Levelling of resources according to constraints – priorities of activities – sort rules – Minimum project duration subject to resource constraint.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the phases of project life cycle with the roles and responsibilities of construction participants.	Understand
CO.2 Explain the basic concepts of construction planning and explain the different types of contracts.	Understand
CO.3 Calculate the project duration using different network techniques.	Apply
CO.4 Explain the quality and safety concerns in construction projects and compute the minimum project duration using time cost trade off.	Apply
CO.5 Compute the resources with different constraints and illustrate the resource levelling in construction projects.	Apply

### Text Book(s):

T1. Chitkara. K.K, “Construction Project Management: planning, Scheduling and control”, Tata McGraw Hill Publishing Company, New Delhi, 4th edition, 2019

T2. Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pittsburgh, 2000.

### Reference Book(s):

R1. Kumar Neeraj Jha, “Construction Project Management: Theory and Practice”, second edition, Pearson Education India, 2015

R2. B.C Punmia and K.K Khandelwal “Project Planning and Control with PERT and CPM”, Laxmi Publications Private Limited, 2016

R3. Srinath L S, “PERT/CPM Principles and Applications”, Affiliated East West Press (P) Ltd, 2002.

### Web References:

1. <http://nptel.ac.in/courses/105103093/>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	3	2	-	3
CO2	2	1	-	-	-	-	-	-	-	-	3	2	-	3
CO3	3	2	-	-	-	-	-	-	-	-	3	2	-	3
CO4	3	2	-	-	-	-	-	-	-	-	3	2	-	3
CO5	3	2	-	-	-	-	-	-	-	-	3	2	-	3

High–3; Medium–2; Low–1

<b>Course Code: 19CECN3701</b>		<b>Course Title: QUANTITY SURVEYING AND ESTIMATION LABORATORY</b>	
<b>Course Category: Professional Core</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 4</b>	<b>Credits:2</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Building Drawing Laboratory

#### **Course Objectives**

The course is intended to:

- Know the quantities and to learn how to calculate the cost abstract for the given load bearing structure.
- Learn to estimate the quantities and cost abstract for the given framed structure.
- Learn to estimate the quantities and cost abstract for irrigation and environmental structures.
- Know how to calculate the volume of earthwork and cost abstract for bituminous and concrete roads.
- know how to calculate the rent for different types of buildings.

#### **List of Exercises**

1. Introduction to building components with detailed drawing.
2. Determine the rate for Damp proof course, RCC and plain concrete for various mix proportions with reference to the current schedule of rate.
3. Estimation of quantities for the given simple load bearing structures and give the cost abstract statement.
4. Estimation of quantities for the given G+1 framed structures and give the cost abstract statement.
5. Estimation of quantities for the given simple industrial building and give the cost abstract statement.
6. Estimation of quantities for the given retaining wall and give the cost abstract statement.
7. Estimation of quantities for the given culvert and give the cost abstract statement.
8. Estimation of quantities for the given septic tank and soak pit and give the cost abstract statement.
9. Estimation of quantities for bituminous and cement concrete roads and give the cost abstract statement.
10. Estimate the quantities and calculate the rate for shuttering and form work for the given the building.
11. Determination of rent for different types of building.
12. Preparation of plan and costing using software for duplex residential building.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Estimate the quantities and cost abstract for the given load bearing structure.	Apply
CO.2 Estimate the quantities and cost abstract for the given framed structure.	Apply
CO.3 Estimate the quantities and cost abstract for irrigation and environmental structures.	Apply
CO.4 Estimate the volume of earthwork and cost abstract for bituminous and concrete roads.	Apply
CO.5 Calculate the rent for different types of buildings.	Apply

#### Reference Book(s):

- R1. Quantity Surveying and Estimation Lab Manual, Department of Civil Engineering, MCET, Pollachi
- R2. Dutta, B.N., "Estimating and Costing in Civil Engineering", UBS Publishers & Distributors Pvt. Ltd., 28th Edition, 2016.
- R3. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S. Chand & Company Ltd, 2012.
- R4. Chakraborti. M., "Estimating, Costing, Specification and Valuation in Civil Engineering", 24th edition 2012 (Reprint 2013).
- R5. Schedule of Rate for the current year, Section I – Civil Engineering Section, Coimbatore Corporation.
- R6. Schedule of Rate for the current year, Section II – Road Works, Coimbatore
- R7. Methods of Measurement of Building and Civil Engineering works, Bureau of Indian Standards.
- R8. IS 1200 (Part-1 to 28), Methods of Measurement of Building and Civil Engineering works, Bureau of Indian Standards.

#### Web References:

1. <https://nptel.ac.in/courses/105/103/105103093/>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	1	2	2	-	2	3	-
CO2	3	2	-	-	-	-	-	1	2	2	-	2	3	-
CO3	3	2	-	-	-	-	-	1	2	2	-	2	3	-
CO4	3	2	-	-	-	-	-	1	2	2	-	2	3	-
CO5	3	2	-	-	-	-	-	1	2	2	-	2	3	-

High-3; Medium-2; Low-1

## VIII SEMESTER

<b>Course Code: 19CEPN6801</b>		<b>Course Title: PROJECT</b>	
<b>Course Category: Project</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 16</b>	<b>Credits:8</b>	<b>Total Contact Hours: 240</b>	<b>Max Marks:200</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Impart and improve the manual design capability of the student as well as using civil engineering software.

This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection etc. The design problem can be allotted to either an individual student or a group of students comprising of not more than three. The students will be guided by internal and external supervisors (if any). The external supervisor will be appointed by head of the department after consultation with Industry-Institute interaction cell. The progress of the project is evaluated based on a minimum of three reviews by the project review committee. At the end of the semester after completing the work to the satisfaction of the supervisor and review committee, course the student should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Apply the principles of planning to plan different types of structures considering futuristic need of an area with reference to different codes	Create
CO.2 Evaluate load calculation and load transfer phenomena of the structure.	Analyse

CO.3	Analysis the different component of structure based on SFD and BMD	Analyse
CO.4	Design the elements of a building manually and design software as per codal provisions	Create
CO.5	Develop structural drawings with all necessary measurements and details of the structure to be constructed.	Create
CO.6	Organize and present technical and scientific findings effectively through written and oral mode with the aid of multimedia tools and appropriate code of ethics.	Analyse

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	3	3	3	3	3	-	-	-	3	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	3	-	-	-	-	3	-	-	-	-	-	3
CO5	3	-	-	3	3	-	-	-	3	-	3	-	-	3
CO6	3	-	-	-	3	-	-	3	-	3	-	-	-	-

High-3; Medium-2; Low-1

## **STRUCTURAL ENGINEERING ELECTIVES**

<b>Course Code: 19CEEN1002</b>		<b>Course Title: ADVANCED CONCRETE STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Design of RC Structures

### **Course Objectives**

The course is intended to:

- Study the design concepts of Retaining walls for different backfill conditions.
- Study the design concepts of Flat-bottomed elevated square and circular water tanks along with staging.
- Study the design concepts of Solid slab bridge and box culvert.
- Study the design concepts of Portal frames by substitute frame method.
- Study the design concepts of Prestressed concrete.

### **UNIT I –DESIGN OF RETAINING WALLS**

**9 Hours**

Design of cantilever and counter fort retaining walls.

### **UNIT II – DESIGN OF ELEVATED WATER TANKS**

**9 Hours**

Types of elevated water tanks– Design of flat–bottomed elevated water tanks (square and circular)

### **UNIT III – DESIGN OF RCC BRIDGES**

**9 Hours**

Introduction, Classification of bridges – IRC Loadings – Effective width of load dispersion – Design of solid slab Bridge – Box culverts.

### **UNIT IV – DESIGN OF PORTAL FRAMES**

**9 Hours**

Portal frames – Analysis of portal frames – substitute frame method – cantilever method – portal method (concept only) – Design of single bay portal frame by substitute frame method.

### **UNIT V – INTRODUCTION TO PRESTRESSED CONCRETE ELEMENTS**

**9 Hours**

Introduction– Principles of prestressing–types and methods of prestressing–Need for high strength materials– Losses in prestress–long term and short–term deflection– anchorage zone

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Design the retaining walls for various backfill conditions as per IS codal provisions.	Create
CO.2 Design the flat bottomed circular and square elevated water tanks with staging as per IS codal provisions.	Create
CO.3 Design the solid slab bridge and box culverts as per IRC standards.	Create
CO.4 Analyse the portal frame using substitute frame method and design a single bay portal frame.	Create
CO.5 Explain the basic concepts in prestressing and calculate the losses and deflections in the prestressed concrete.	Apply

#### **Text Book(s):**

- T1. Gambhir, M.L., "Reinforced Concrete Structures", PHI Learning Private Ltd., New Delhi, 2012.
- T2. Unnikrishna Pillai S. and DevdasMenon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 3<sup>rd</sup> Edition, New Delhi, 2019.
- T3. Krishna Raju N, "Prestressed Concrete", Tata McGraw Hill Company, 6<sup>th</sup> Edition, New Delhi, 2018.

#### **Reference Book(s):**

- R.1 Punmia, B.C., Ashok. K. Jain and Arun. K. Jain, "Reinforced Concrete Structures" Vol. II, Laxmi Publications, 5<sup>th</sup> Edition New Delhi, 2019.
- R.2 Varghese, P. C., Limit State Design of Reinforced Concrete, 2<sup>nd</sup> Edition, PHI Learning Private Ltd., New Delhi, 2013.
- R.3 Subramanian N, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.

#### **IS Code Books**

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978
3. IS 875(1–5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
4. IRC 6 – 2014, Standard Specification and Code of practice for road bridges.
5. IRC 21 – 2000, standard specifications and Code of practice for Road bridges.
6. IRC 112 –2011, Code of Practice for Concrete Road Bridges.
7. IS 3370(Part 1–4): 1965 Code of Practice for Concrete Structures for the Storage of Liquids.
8. IS 1343–2012 Code of Practice for Prestressed Concrete.

#### **Web References:**

1. <https://nptel.ac.in/courses/105/105/105105104/>
2. <http://www.ce.memphis.edu/4135/PDF/Notes/Chapter1–0%20.pdf>
3. <https://nptel.ac.in/courses/105/105/105105165/>



### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High-3; Medium-2;Low-1

<b>Course Code: 19CEEN1008</b>		<b>Course Title: MAINTENANCE AND REHABILITATION OF STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Construction Materials and Practices
- Concrete Technology

#### **Course Objectives**

The course is intended to:

- Understand the different types of maintenance and repair strategies.
- Understand the characterization of concrete under different environments.
- Know the different repair materials and repair techniques.
- Learn the various parameters for rehabilitation and retrofitting of structures.
- Understand the various demolition methods and its preventive measures adopted in buildings.

#### **UNIT I – MAINTENANCE AND REPAIR STRATEGIES**

**9 Hours**

Maintenance – repair and rehabilitation, facets of maintenance, importance of maintenance – Various aspects of inspection – Assessment procedure for evaluating a damaged structure – Causes of deterioration.

#### **UNIT II – QUALITY CONTROL**

**9 Hours**

Quality assurance for concrete construction – Concrete properties – strength, permeability, thermal properties and cracking – Effects due to climate, temperature, chemicals, corrosion – Design and construction errors – Effects of cover thickness and cracking.

#### **Unit III – REPAIR MATERIALS AND TECHNIQUES**

**9 Hours**

Special concretes and mortar – Concrete chemicals, Special elements for accelerated strength gain – Expansive cement – Polymer concrete – Sulphur infiltrated concrete – Ferro cement – Fibre reinforced concrete – Rust eliminators and polymers coating for rebars – Foamed concrete – Mortar and dry pack – Vacuum concrete – Guniting and shotcrete – Epoxy injection – Mortar repair for cracks.

#### **UNIT IV – REHABILITATION AND RETROFITTING OF STRUCTURES**

**9 Hours**

Strengthening of super structures, sub structures – Increasing the load carrying capacity of footing – Repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure – Shoring and underpinning – Methods of corrosion protection – Corrosion inhibitors – Corrosion resistant steels – Coatings and cathodic protection.

**UNIT V – DEMOLITION TECHNIQUES****9 Hours**

Introduction – planning, precautions and protective measures in demolition works –Sequences of operations – Demolition of structural elements – Engineered demolition techniques for dilapidated structures – Case studies.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the different types of maintenance and various aspects of inspection.	Understand
CO.2 Explain the serviceable and durable characterization of concrete under thermal and corrosive environment.	Understand
CO.3 Describe the properties of various repair materials and its method of application in building.	Understand
CO.4 Elucidate the various aspects in strengthening of buildings and the various corrosion protection methods adopted in building.	Understand
CO.5 Describe the planning and precautionary measures during demolition works and the sequence involved in demolition of building.	Understand

**Textbook(s):**

- T 1. Dr.R.P.Rethaliya, “Maintenance and Rehabilitation of Structures”, Atul Prakashan publications, 2019
- T 2. Dayarathnam. P and Rao. R, “Maintenance and Durability of Concrete Structures”, University Press, India 2015

**Reference Book(s):**

- R 1. Gambhir. M.L, “Concrete Technology”, Tata Mc–Graw Hill Company, New Delhi, 2013.
- R 2. Gupta B.L. and Amit Gupta, “Maintenance and Repair of Civil Structures”, Standard Publishers Distributors, 2009
- R 3. CPWD and Indian Building Concepts, Hand Book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.

**Web References:**

1. [http://fmcet.in/CIVIL/CE2071\\_uw.pdf](http://fmcet.in/CIVIL/CE2071_uw.pdf)
2. <https://theconstructor.org/concrete/repair-rehabilitation-concrete-structure-failure->
3. <https://nptel.ac.in/courses/105/106/105106202/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2; Low–1

<b>Course Code: 19CEEN1011</b>		<b>Course Title: PREFABRICATED STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Design of RC Structures

### **Course Objectives**

The course is intended to:

- Know the Importance of prefabrication
- Learn the Components of prefabricated structures
- Know the design principles of prefabrication
- Learn Joints in structural members
- Design of prefabricated structure for abnormal loads

### **UNIT I – INTRODUCTION TO PREFABRICATION**

**9 Hours**

Prefabrication– Need of prefabrication – Comparison with monolithic construction – Advantages and Disadvantages – Methods of prefabrication – Types of precast systems – Materials – Modular coordination – Standardization– Systems – Production – Transportation – Erection.

### **UNIT II – PREFABRICATED COMPONENTS**

**9 Hours**

Planning for components of prefabrication structures– Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs, Wall panels – Columns – Shear walls– Provisions for non–structural fastenings

### **UNIT III – DESIGN PRINCIPLES**

**9 Hours**

Disuniting of structures – Design of cross section with the efficiency of material used – Problems in design due to joint flexibility – Allowance for joint deformation.

### **UNIT IV –JOINTS IN STRUCTURAL MEMBERS**

**9 Hours**

Joints for different structural connections – Dimensions and detailing – Design of expansion joints–Jointing Materials.

### **UNIT V – DESIGN FOR ABNORMAL LOADS**

**9 Hours**

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., – Importance of avoidance of progressive collapse.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Describe the principles of prefabrication as well as production and erection techniques.	Understand
CO.2 Explain the behaviour and construction methods of prefabricated structural components.	Understand
CO.3 Illustrate the design principles for prefabricated sections based on efficiency of members used.	Understand
CO.4 Classify joints for different structural connections in prefabricated system.	Understand
CO.5 Illustrate the importance of avoidance of progressive collapse using Indian codal provisions for prefabricated concrete.	Understand

**Text book(s):**

- T1. K.M. Elliott, "Precast concrete structures", CRC Press, Second edition, 2019.
- T2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.
- T3. L. Makk, "Prefabricated Concrete for Industrial and Public Structures", Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
- T4. Gorostiza C.Z., Hendrikson C. and Rehak D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 2012.

**Reference Book(s):**

- R 1. Building Materials and Components, CBRI, India, 1990.
- R 2. Koncz T., Manual of Precast Concrete Construction, Vols. I, II and III, Bauverlag, GMBH, 1976.
- R 3. Glover C.W, "Structural Precast Concrete", Asia Publishing House, 1965
- R 4. M. Levitt, "Precast Concrete Material, Manufacture, Properties and Usage" CRC Press, Second Edition, 2019.
- R 5. Structural Design Manual, "Precast Concrete Connection Details", Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1012</b>		<b>Course Title: PRESTRESSED CONCRETE STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Design of RC Structures

### **Course Objectives**

The course is intended to:

- Understand the concept of pre-stressing.
- Understand the design of pre-stress members for flexure and shear.
- Understand the deflection and design of anchorage zones.
- Understand the design of tension and compression member.
- Understand the design of composite members.

### **UNIT I – Introduction**

**9 Hours**

Principles of Pre–stressing – Classification and types – Advantages over reinforced concrete – Materials– high strength concrete and high tensile steel – Methods of Pre–stressing – Freyssinet, Magnel Blaton, Lee Mc Call and Killick anchorage systems – Analysis of sections for stresses by stress concept, strength concept and load balancing concept – Losses of pre–stress

### **UNIT II – Design for Flexure and Shear**

**9 Hours**

Basic assumptions – Permissible stresses in steel and concrete – Design of sections of Type I and Type II post tensioned and pre tensioned beams – Check for strength – Layout of cables in post–tensioned beams – Location of wires in pre–tensioned beams – Design for shear

### **UNIT III – Deflection and Design of Anchorage Zone**

**9 Hours**

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long–term deflections due to creep and shrinkage – Check for serviceability limit state of deflection– Determination of anchorage zone stresses in post – tensioned beams by Magnel's method, Guyon's method and I.S code – Design of anchorage zone reinforcement

### **UNIT IV – Design of Tension and Compression Members**

**9 Hours**

Design of tension members –pre–stressed trusses– application in the design of pre–stressed pipes and pre–stressed concrete cylindrical water tanks – Design of compression members with and without flexure –its application in the design piles and flag masts.

### **UNIT V – Design of Composite Members**

**9 Hours**

Composite beams – design, longitudinal shear transfer, ultimate strength – applications – Partial pre–stressing – advantages and applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the concepts of pre-stressing in concrete structures, identify the materials for pre-stressing and estimate losses of pre-stressing	Apply
CO.2 Design pre-tensioned and post tensioned girders for flexure and shear.	Create
CO.3 Calculate the short term and long-term deflections of pre-stressed members and design the anchorage zone for post-tensioned members.	Create
CO.4 Design pre-stressed pipes and water tanks.	Create
CO.5 Analyze and design of composite members.	Create

**Text Book(s):**

- T 1. Krishna Raju N., "Prestressed concrete", 6th Edition, Tata McGraw Hill Company, New Delhi, 2018
- T 2. Pandit. G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2012.

**Reference Book(s):**

- R 1. Dayaratnam. P., "Prestressed Concrete Structures", Oxford and IBH, 2013.
- R 2. Karuna Moy Ghosh, "Prestressed Concrete: Analysis and Design Practice Of Members", PHI Learning Pvt. Ltd., 2014.
- R 3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", 3rd Edition, Wiley India Pvt. Ltd., New Delhi, 2013.

**IS Code Book**

- IS 1343 – 2012: Code of practice for Pre–stressed concrete
- IS 784 – 2001: Code of practice for Pre–stressed concrete pipes
- IS 3370 – 1999: Code of practice for concrete structures for the storage of liquids

**Web References:**

- <http://www.nptel.ac.in/courses/105106118/>
- <http://www.nptel.ac.in/courses/105106118/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	2	3	-

High–3; Medium–2; Low–1

<b>Course Code: 19CEEN1019</b>		<b>Course Title: SEISMIC DESIGN OF STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Solid Mechanics
- Geology and Soil Mechanics

#### **Course Objectives**

The course is intended to:

- Study the Theory of vibration and single degree of freedom.
- Study the Multiple degree of freedom.
- Study the Elements of seismology
- Know the Design principles of seismic design
- Study about the Retrofitting of buildings

#### **UNIT I – THEORY OF VIBRATIONS**

**9 Hours**

Difference between static loading and dynamic loading – Degree of freedom – Single degree of freedom system – Formulation of Equations of motion for single degree of freedom (SDOF) system – Newtons Second Law – D'Alemberts principles – Effect of damping – Free and forced vibration of damped and undamped structures – Response to harmonic and periodic forces.

#### **UNIT II – MULTIPLE DEGREE OF FREEDOM SYSTEM**

**9 Hours**

Two degree of freedom system – Modes of vibrations – Formulation of equations of motion for multi –degree of freedom (MDOF) system – Eigen values and Eigen vectors – Response to free and forced vibrations – Damped and undamped MDOF system – Modal superposition methods.

#### **UNIT III – ELEMENTS OF SEISMOLOGY**

**9 Hours**

Elements of engineering seismology – Causes of earthquakes – Seismic waves – Magnitude – Intensity and Energy release – Indian seismology – Earthquake history – Catastrophes – Failures – Liquefaction – Lessons learnt from past earthquakes – Seismic zone map of India – Estimation of Earthquake Parameters, Microzonation – Strong ground motion characteristics

#### **UNIT IV –SEISMIC DESIGN OF BUILDINGS**

**9 Hours**

Introduction to methods of seismic analysis – Equivalent static analysis – IS code provisions – Design horizontal seismic coefficient – Design base shear distribution – Seismic resistant design of – Ductile detailing of reinforcements in RC buildings – Behavior masonry structures – Behaviour of tall building under seismic and wind conditions.



## UNIT V –REPAIRS AND RETROFITTING

9 Hours

Code of practices for repairs and retrofitting – Retrofitting of RC buildings and structural elements –Techniques of retrofitting – Improving structural integrity of masonry buildings – Tuned Mass Dampers –Retrofitting by seismic isolation – Case studies

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the fundamentals of vibrations and develop equation of motion for single degree of freedom systems.	Apply
CO.2 Explain the modes of vibration in two degree and multi degree of freedom and develop equations for MDOF system.	Apply
CO.3 Illustrate the elements of seismology to explain the ground motion characteristics.	Understand
CO.4 Identify the effects of earthquake on different types of structures and apply suitable IS codal provisions for seismic design of buildings.	Apply
CO.5 Explain the various techniques for retrofitting of structures.	Understand

### Textbook(s):

- T 1. Pankaj Agarwal and Manish Shrikhande, Earthquake resistant design of structures, Prentice–Hall India Pvt. Ltd., 2012
- T 2. Duggal S.K, “Earthquake resistant design of structures”, Oxford University Press, NewDelhi, 2015.
- T 3. Damodarasamy S.R, and Kavitha S, “Basics of Structural Dynamics and Aseismic Design”, PHI Learning Pvt. Ltd, New Delhi. 2009

### Reference Book(s):

- R 1. George G Penelis and Andreas J Kappos –“Earthquake Resistant Concrete Structures”
- R 2. Chopra Anil.K., “Dynamics of Structures – Theory and Applications to Earthquake Engineering”, 5th Edition, Pearson Education, 2017.
- R 3. Park, R & Paulay, "Design of Reinforced Concrete Structure Elements", John Wiley & sons, 2009

### IS Code Book

- 1. IS 1893 – 2002, Criteria for Earthquake Resistant Design of Structures
- 2. IS 4326 – 1993, Earthquake Resistant Design and Construction of Buildings – Code of Practice
- 3. IS 13920 – 1993, Ductile Detailing of Reinforced Concrete Structures to Seismic Forces –Code of Practice
- 4. IS 13935 – 1993, Repair and Seismic Strengthening of Buildings – Guidelines

### Web References:

- 1. <https://nptel.ac.in/courses/105102016/>
- 2. <https://nptel.ac.in/courses/105101004/>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1020</b>		<b>Course Title: SMART MATERIALS AND STRUCTURES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Study the various types of smart materials used in the engineering application.
- Acquire the fundamental knowledge of sensors and its application.
- Learn the basic aspects, types and application of measuring techniques
- Study basics of actuators and its application in engineering
- Know the importance of data acquisition and signal processing.

#### **Unit I – PROPERTIES OF MATERIALS**

**9 Hours**

Introduction to Smart Materials and Structures –Piezoelectric Materials, Properties – Shape memory alloy, constitutive modelling, application – Vibration Control – Embedded actuators.

#### **Unit II – SENSING TECHNOLOGY**

**9 Hours**

Type of sensors – Physical measurement – Piezo Electric Strain – Transducers – Fiber Optic Techniques– Chemical and bio–Chemical sensing in Structural Assessment – Spectroscopes – Fiber Optic Chemical Sensing Systems – Distributed measurement.

#### **Unit III – MEASURING TECHNIQUES**

**9 Hours**

Measuring Techniques – Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells –Temperature Compensation – Strain Rosettes.

#### **Unit IV – ACTUATOR TECHNIQUES**

**9 Hours**

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro rheological Fluids– Electromagnetic actuation – Role of actuators and Actuator Materials.

#### **Unit V – SIGNAL PROCESSING AND CONTROL SYSTEMS**

**9 Hours**

Data Acquisition and Processing – Signal Processing and Control for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non–Linear.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the properties and applications of piezoelectric materials, vibration control and embedded actuators.	Understand
CO.2 Illustrate the sensing techniques for structural assessment.	Understand
CO.3 Explain the measuring techniques for health monitoring of structures.	Understand
CO.4 Illustrate the principles of actuator for various applications in construction industry.	Understand
CO.5 Explain the basic concepts of signal processing and control system for civil engineering applications.	Understand

**Textbook(s):**

- T1. Srinivasan, A. V. and Michael McFarland, D., "Smart Structures: Analysis and Design" Cambridge University Press, 2009.
- T2. Michelle Addington and Daniel L. Schodek, "Smart Materials and Technologies: For the Architecture and Design Professions", Routledge 2004.

**Reference Book(s):**

- R.1 Mel.M Schwartz, Encyclopedia of Smart Materials, John Wiley and Sons, inc 2002.
- R.2 A. J. Moulson and J. M. Herbert, Electro ceramics: Materials, Properties, Application, 2<sup>nd</sup> Edition John Wiley & Sons, Chichester, West Susses, New York, 2003

**Web References:**

1. <https://nptel.ac.in/courses/112/104/112104251/>
2. <https://nptel.ac.in/courses/112/104/112104173/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1024</b>		<b>Course Title: EXPERIMENTAL TECHNIQUES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Mastery</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- To impart knowledge on basic concepts of measurements and related instruments.
- To offer theoretical knowledge and hands on training in the usage of strain gauge, load cell, LVDT and data acquisition systems.
- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.
- To impart students' knowledge on working principle of non-destructive testing techniques and its usage in real time conditions. Explain the procedure for investigation by model analysis.
- To expose students the theory and principles involved in model analysis.

#### **Unit I –FORCE AND STRAIN MEASUREMENTS**

**9 Hours**

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long term monitoring – vibrating wire sensors– Fibre optic sensors.

#### **Unit II –VIBRATION MEASUREMENTS**

**8 Hours**

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – wind tunnels – Flow meters – Venturimeter – Digital data Acquisition systems.

#### **Unit III –DISTRESS MEASUREMENTS AND CONTROL**

**10 Hours**

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

#### **Unit IV –NON DESTRUCTIVE TESTING METHODS**

**9 Hours**

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR , Ground penetrating radar (GPR).

**Unit V – MODEL ANALYSIS****9 Hours**

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems – Usage of influence lines in model studies

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1 Usage of strain gauge, load cell, LVDT and data acquisition systems.	Understand
CO2 Analyze the structure by non-destructive testing methods and model analysis.	Understand
CO3 Employ load cell, sensitive dial gauges and LVDT for different application areas and interpret the results	Apply
CO4 Acquire load-deflection and load-strain behaviour using data acquisition systems.	Apply
CO5 Describe the importance of model analysis in predicting structural behaviour of large scale structures.	Understand

**Text Book(s):**

T1. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2015.

T2. Rangan C S et al., 'Instrumentation – Devices and Systems', Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 2017

**Reference Book(s):**

R1. U.C. Jindal, Experimental Stress Analysis, Pearson Publication, Noida, 2012.

R2. Ravisankar.K.and Chellappan.A., "Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures", SERC, Chennai, 2007.

R3. Gandhi.M.V and Thompson.B.S, "Smart Materials and Structures", Chapman and Hall, NewYork, 1992.

**Web References:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_me02/preview](https://onlinecourses.nptel.ac.in/noc20_me02/preview)
2. <https://nptel.ac.in/courses/112106198/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	-

High-3; Medium-2;Low-1

## **ENVIRONMENTAL ENGINEERING ELECTIVES**

<b>Course Code: 19CEEN1003</b>		<b>Course Title: AIR POLLUTION MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Understand the sources and effects of air pollution
- Understand the Dispersion of Pollutants
- Understand the Air pollution control
- Understand the Air quality management
- Understand the Noise pollution

### **UNIT I – SOURCES AND EFFECTS OF AIR POLLUTANTS**

**9 Hours**

Sources and classification of air pollution – Effects of air pollution on human beings, materials, vegetation, animals – Global warming– Ozone layer depletion, Sampling and Analysis – Basic principles of sampling – Source and ambient sampling – Stack sampling

### **UNIT II – DISPERSION OF POLLUTANTS**

**9 Hours**

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Inversion, Introduction to air quality modeling.

### **UNIT III – AIR POLLUTION CONTROL**

**9 Hours**

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment – gaseous pollutant control by adsorption, absorption, condensation, combustion – Biofiltration (Only theory and working of equipments only)

### **UNIT IV – AIR QUALITY MANAGEMENT**

**9 Hours**

Air quality standards – Air quality monitoring – Preventive measures – Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement– National Ambient Air quality standards – Air quality management in India

### **UNIT V – NOISE POLLUTION**

**9 Hours**

Sources of noise pollution – Effects – Assessment– Standards – Control methods (at the source and transmission) – Prevention– Protection of exposed people

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Classify and identify the sources of air pollutants and predict the effects of air pollutant on human health and environment.	Understand
CO.2 Explain and relate the significance of various air pollution dispersion models.	Understand
CO.3 Explain the methods available for controlling of air pollution from point, line and area sources.	Understand
CO.4 Elucidate the air quality and relate with air pollution regulation.	Understand
CO.5 Explain sources, effects and control of noise pollution.	Understand

#### Text Book(s):

- T1. Anjaneyulu, Y., Air Pollution: Prevention and Control Technologies, B.S. Publications, 2<sup>nd</sup> edition, 2020.
- T2. Rao, C.S. Environmental Pollution Control Engineering, New Age International publishers, Third Edition, 2018.
- T3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 2017.
- T4. Garg, S.K., "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2019.

#### Reference Book(s):

- R 1. Heumann, W.L., "Industrial Air Pollution Control Systems", McGraw Hill, New York, 1997.
- R 2. Mahajan, S.P., "Pollution Control in Process Industries", Tata Mc-Graw Hill Publishing Company, New Delhi, 2017.
- R 3. Peavy, S.W., Rowe, D.R. and Tchobanoglous, G. "Environmental Engineering", Tata Mc-Graw Hill, New Delhi, 2017.

#### Web References:

- [https://metnet.imd.gov.in/imdetp/lecture\\_notes/course11/LN\\_11\\_61\\_Air%20Pollution%20Measurment.pdf](https://metnet.imd.gov.in/imdetp/lecture_notes/course11/LN_11_61_Air%20Pollution%20Measurment.pdf)
- [https://web.iitd.ac.in/~arunku/files/CVL212\\_Y18/Airpollutioneffects.pdf](https://web.iitd.ac.in/~arunku/files/CVL212_Y18/Airpollutioneffects.pdf)

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1007</b>		<b>Course Title: INDUSTRIAL WASTE MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Environmental Engineering

#### **Course Objectives**

The course is intended to:

- Learn Industrial pollution prevention.
- Learn Industrial wastewater treatment.
- Learn Zero liquid discharge concepts.
- Learn Sludge and hazardous waste management.
- Learn Wastewater treatment process of selected industries.

#### **UNIT I – INDUSTRIAL POLLUTION PREVENTION**

**9 Hours**

Industrial scenario in India – Uses of water by Industry – sources, generation rates and characteristics of Industrial wastewaters – Toxicity of Industrial Effluents and Bioassay Tests – Environmental Impacts of Industrial Wastewaters – Regulatory requirements for Industrial wastewaters– Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Waste Minimization Strategies – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay back period.

#### **UNIT II – INDUSTRIAL WASTEWATER TREATMENT**

**9 Hours**

Physico–Chemical Treatment Processes – Equalisation, Neutralisation, Oil Separation, Flotation – Precipitation, Aerobic and Anaerobic Biological Treatment Processes – Sequencing batch reactors, membrane bioreactors, Advanced oxidation and Tertiary Treatment processes for removal of dissolved organics and inorganics– Ozonation, photocatalysis, Evaporation and membrane Technologies

#### **UNIT III – ZERO LIQUID DISCHARGE**

**9 Hours**

Individual and Common Effluent Treatment Plants – Zero Effluent Discharge Systems and Management of RO Rejects, Quality requirements for wastewater reuse – Industrial reuse, Disposal on water and land.

#### **UNIT IV – SLUDGE AND HAZARDOUS WASTE MANAGEMENT**

**9 Hours**

Residuals of Industrial Wastewater treatment – Quantification and Characteristics of Sludge – Thickening, Digestion, Conditioning, Dewatering and Disposal of Sludge – Solidification – Incineration – Secured Landfills – Hazardous waste management.

#### **UNIT V – CASE STUDIES**

**9 Hours**

Industrial manufacturing process description, Wastewater characteristics, Pollution Prevention Options and Treatment Flow sheets for selected Industries – Tanneries– Textiles– Pulp and Paper – Metal finishing – Sugar and Distilleries.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the significance of industrial pollution prevention in today life.	Understand
CO.2 Explain the industrial wastewater treatment processes such as physical, chemical and biological treatment for effective removal of pollutants.	Understand
CO.3 Illustrate the concept of zero effluent discharge and quality requirements for disposal of effluent on land and water bodies.	Understand
CO.4 Explain the concepts of sludge and hazardous waste management techniques.	Understand
CO.5 Illustrate the wastewater treatment process of selected industries through.	Understand

**Textbook(s):**

- T 1. S.C. Bhatia, Handbook of Industrial Pollution and Control, Volume I & II, CBS Publishers, New Delhi, 2003.
- T 2. Mahajan, S.P. Pollution Control in Process Industries, Tata McGraw Hill Publishing Co., New Delhi, 2017.

**Reference Book(s):**

- R 1. Eckenfelder, W.W., „Industrial Water Pollution Control" , Mc–Graw Hill, 2000.
- R 2. Frank Woodard, „ Industrial waste treatment Handbook" , Butterworth Heinemann, New Delhi, 2005.
- R 3. Wang L.K., Yung–Tse Hung, Howard H.Lo and Constantine Yapijakis, „Handbook of Industrial and Hazardous Wastes Treatment" , Marcel Dekker, Inc., USA, 2004.

**Web References:**

1. <http://nptel.ac.in/courses/105106119/36>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2; Low–1

<b>Course Code: 19CEEN1009</b>		<b>Course Title: MUNICIPAL SOLID WASTE MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Environmental Engineering

#### **Course Objectives**

The course is intended to:

- Learn the Sources and characteristics of municipal solid wastes.
- Learn on-site storage and processing of municipal solid waste.
- Learn about the collection and transfer of MSW.
- Learn the offsite processing of MSW.
- Learn the disposal methods of MSW.

#### **UNIT I – SOURCES AND CHARACTERISTICS**

**9 Hours**

Sources and types of municipal solid wastes–waste generation rates–factors affecting generation, characteristics–methods of sampling and characterization; Effects of improper disposal of solid wastes–Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – I solid waste (M&H) rules – integrated solid waste management–Public awareness; Role of NGO" s– Public Private participation

#### **Unit II – ON-SITE STORAGE AND PROCESSING**

**9 Hours**

On–site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and environmental aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling of plastic waste –Construction and Demolishing waste

#### **Unit III – COLLECTION AND TRANSFER**

**9 Hours**

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

#### **Unit IV – OFF–SITE PROCESSING**

**9 Hours**

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and bio-methanation; Thermal processing options – case studies under Indian conditions.

#### **Unit V – DISPOSAL**

**9 Hours**

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 capping –Biomining.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the sources, types and composition of solid wastes as well as elements of integrated solid waste management plan.	Understand
CO.2 Illustrate the on-site storage and processing of municipal solid waste for Indian conditions.	Understand
CO.3 Select the appropriate method for solid waste collection, and transportation of waste and solve simple problems in transfer of solid wastes.	Apply
CO.4 Illustrate the off-site processing of municipal solid waste for waste recovery under Indian conditions.	Understand
CO.5 Explain the appropriate methods for municipal solid waste disposal.	Understand

**Textbook(s):**

- T 1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018
- T 2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management – Science and Engineering, Butterworth–Heinemann, 2016

**Reference Book(s):**

- R 1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc–Graw Hill India, First edition, 2015.
- R 2. CPHEEO, "Manual on Municipal Solid waste management, Vol I, II and III, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2016.
- R 3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering – A Global Perspective, 3rd Edition, Cengage Learning, 2017.
- R 4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc–Graw Hill International edition, New York, 2010.
- R 5. John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group, 2014.
- R 6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010

**Web References:**

1. <https://nptel.ac.in/courses/120/108/120108005/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2; Low–1

<b>Course Code: 19CEEN1025</b>		<b>Course Title: ENVIRONMENTAL IMPACT AND RISK ASSESSMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
- To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

#### **Unit I – INTRODCUTION**

**9 Hours**

Impacts of Development on Environment –Sustainable Development and Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types EIA in project cycle –EIA Notification and Legal Framework in India– Selection & Registration Criteria for EIA Consultants Stakeholders and their Role in EIA.

#### **Unit II - ENVIRONMENTAL ASSESSMENT**

**9 Hours**

Screening and Scoping in EIA – Drafting of Terms of Reference -Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives.

#### **Unit III - SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION**

**9 Hours**

Social impact assessment – Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.

#### **Unit IV - ENVIRONMENTAL MANAGEMENT PLAN**

**9 Hours**

EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and

monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

#### **Unit V - ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT 9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication – Emergency Preparedness Plans –Design of risk management programs.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the concepts of EIA and types if EIA for various assessment process.	Understand
CO.2 Apply suitable EIA method to study the impacts of Ecosystems	Apply
CO.3 Apply suitable EIA methods to identify the social impacts	Apply
CO.4 Explain the concept of Environmental impact management plan	Understand
CO.5 Apply the various tools for identifying Environmental risk assessment and management.	Apply

#### **Text Book(s):**

- T1. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996
- T2. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999, Bimal Kanti Paul 2011.
- T3. Raghavan K. V. and Khan A A, Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.

#### **Reference Book(s):**

- R.1 Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
- R.2 World Bank –Source book on EIA
- R.3 Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York, 1996.
- R.4 Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	2	-	-	-	-	-	3	-	-	-	-	2	-	2
C02	3	-	-	-	-	-	3	-	-	-	-	2	-	2
C03	3	-	-	-	-	-	3	-	-	-	-	2	-	2
C04	2	-	-	-	-	-	3	-	-	-	-	2	-	3
C05	3	-	-	-	-	-	3	-	-	-	-	2	-	3

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1026</b>		<b>Course Title: CLIMATIC CHANGE AND ADAPTION</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students

#### **Unit I - EARTH'S CLIMATE SYSTEM**

**9 Hours**

Global, Regional and Local climates, Ocean Circulation, weather parameters - Role of ozone in environment - ozone layer - ozone depleting gases - Green House Effect, Radiative effects of Greenhouse Gases - Green House Gases and Global Warming – Carbon Cycle.

#### **Unit II - IMPACTS OF CLIMATE CHANGE**

**9 Hours**

Impacts of Climate Change on various sectors – Agriculture, Forestry, and ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

#### **Unit III - OBSERVED CHANGES AND ITS CAUSES**

**9 Hours**

Climate change and Carbon credits- CDM- Initiatives in India-Kyoto Protocol Intergovernmental Panel on Climate change- Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India.

#### **Unit IV - CLIMATE CHANGE AND MITIGATION MEASURES**

**9 Hours**

Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding Key Mitigation Technologies and Practices – Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.



## Unit V - NATIONAL ACTION PLAN ON CLIMATE CHANGE

9 Hours

National and State Action Plan on Climate Change, Significance on Sustainable development of Natural resources – National Water Mission, Sustainable Agriculture Mission, Green India Mission, Coastal Conservation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the Earth's climate system	Understand
CO.2 Explain the impact of climatic change on different types of ecosystems	Understand
CO.3 Explain the protocol related to climate change and its causes	Understand
CO.4 Apply the mitigation measures to be adopted during climate change	Apply
CO.5 Explain the national action plan on climate change	Understand

### Text Book(s):

- T1. Jan C. van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, 2003.
- T2. Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 'Climate Change and Water'. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.
- T3. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007.

### Reference Book(s):

- R1. IPCC fourth assessment report - The AR4 synthesis report, 2007
- R2. IPCC fourth assessment report –Working Group I Report, "The physical Science Basis", 2007
- R3. IPCC fourth assessment report - Working Group II Report, "Impacts, Adaptation and Vulnerability", 2007
- R4. IPCC fourth assessment report – Working Group III Report" Mitigation of Climate Change", 2007

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO4	3	-	-	-	-	-	2	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	2	-	-	-	-	2	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1027</b>		<b>Course Title: DISASTER MITIGATION AND MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster Management
- To acquaint with the skills for planning and organizing disaster response

### **Unit I - INTRODUCTION**

**9 Hours**

Introduction to Disaster - Definition: Disaster, Hazard, Vulnerability, Resilience, Risks –Types of disasters – Earthquake, Landslide, Flood, Drought, Fire, Volcanic eruption, Tsunami, Avalanches and Pest infestation. Impacts including social, economic, political, environmental, health, psychosocial.

### **Unit II - CONSEQUENCES AND CONTROL OF DISASTERS**

**9 Hours**

Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

### **Unit III - DISASTER MANAGEMENT CYCLE AND FRAMEWORK**

**9 Hours**

Disaster Management: Capability-Vulnerability- risk- preparedness and mitigation- Disaster management cycle; Disaster Risk Reduction and Resilience; Disaster Management Act and Policy.

### **Unit IV - DISASTER MANAGEMENT IN INDIA**

**9 Hours**

Disaster Profile of India, Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005, Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management, Role of Government, Non-Government and Inter-Governmental Agencies.

### **Unit V - DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES**

**9 Hours**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the types of disasters and its various impacts	Understand
CO.2 Explain the consequences and control measures for various types of disasters	Understand
CO.3 Explain the cycle of disaster management and its framework	Understand
CO.4 Describe the various disasters profile in India and explain the policies on disasters management	Understand
CO.5 Explain the applications of disasters management with case studies.	Understand

**Text Book(s):**

T1. Damon P. Coppola, "Introduction to International Disaster management", Elsevier publication, 2015

T2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.

T3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011.

**Reference Book(s):**

R.1 Brassard, Caroline, Giles, David W., Howitt, Arnold M., "Natural Disaster Management in the Asia-Pacific", Policy and Governance.

R.2 Jack Pinkowski, "Disaster Management Handbook", CRC Press , January 22, 2008.

R.3 Disaster Management Guidelines, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	2	-	-	-	-	2	-	2

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1028</b>		<b>Course Title: SUSTAINABLE ENGINEERING AND TECHNOLOGY</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- impart knowledge about the concepts of sustainable engineering and its various impacts on environment, construction and resources.

#### **Unit I - INTRODUCTION TO SUSTAINABILITY**

**9 Hours**

Sustainability - Introduction, Need and concept of sustainability, Social environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM).

#### **Unit II - SUSTAINABLE ENGINEERING CONCEPTS**

**9 Hours**

Key concepts – Factor 4 and Factor 10. Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy.

#### **Unit III - GLOBAL ENVIRONMENTAL ISSUES**

**9 Hours**

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint.

#### **Unit IV - SUSTAINABLE HABITAT**

**9 Hours**

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainable cities, Sustainable transport.

#### **Unit V - SUSTAINABLE ENERGY SOURCES**

**9 Hours**

Basic concepts-Conventional and non- conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the various concepts of sustainability.	Understand
CO.2 Explain the goals of sustainability and the concept of circular economy	Understand
CO.3 Explain the sources of pollution and various environmental issues globally.	Understand
CO.4 Explain the basic concepts of sustainable habitat.	Understand
CO.5 Explain the basic concepts of conventional and non-conventional energy sources.	Understand

**Text Book(s):**

T1. Allen, D. T. and Shonnard, D. R., "Sustainability Engineering: Concepts, Design and Case Studies", Prentice Hall, 2011.

T2. Twidell, J. W. and Weir, A. D., "Renewable Energy Resources", Taylor & Francis Ltd, 2015.

**Reference Book(s):**

R.1 Bradley. A.S; Adebayo,A.O., Maria, P. "Engineering applications in sustainable design and development", Cengage learning, 2015.

R.2 ECBC Code 2007, "Bureau of Energy Efficiency", New Delhi Bureau of Energy Efficiency Publications

R.3 Ni bin Chang, "Systems Analysis for Sustainable Engineering: Theory and Applications", McGraw-Hill Professional, 2010.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	2	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	2	-	-	-	-	2	-	2

High-3; Medium-2; Low-1

## GEOTECHNICAL ENGINEERING ELECTIVES

<b>Course Code: 19CEEN1006</b>		<b>Course Title: GROUND IMPROVEMENT TECHNIQUES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Geology and Soil Mechanics
- Foundation Engineering

### **Course Objectives**

The course is intended to:

- Know the various problematic soils and understand the suitable techniques for ground improvement.
- Understand the dewatering techniques.
- Learn the methods of In-situ treatment of cohesionless and cohesive soil.
- Understand the concepts of earth reinforcement.
- Study the grouting techniques and stabilization in ground improvement.

### **UNIT I – PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES 9 Hours**

Different types of problematic soils – Role of ground improvement in foundation engineering– Methods of ground improvement– Geotechnical problems in alluvial, laterite and black cotton soils.

Selection of suitable ground improvement techniques based on soil condition.

### **UNIT II – DEWATERING 9 Hours**

Necessity of Dewatering – sumps and interceptor ditches – single and multi-stage well points – deep well – vacuum well points – Electro osmosis– Drains – criteria for choice for filler material around drains.

### **UNIT III – INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 9 Hours**

Insitu densification of Cohesion-less soils– Dynamic compaction–vibrofloatation– Sand Compaction piles– Deep compaction.

Consolidation– Preloading with sand drains– fabric drains, stone columns– Lime piles – installation techniques– relative merits of above methods and their limitations.

### **UNIT IV – EARTH REINFORCEMENT AND GEOTEXTILES 9 Hours**

Concept of Earth reinforcement – Application of reinforced Earth– Geotextiles–Types– role of geotextiles for filtration, drainage, Separation and Construction Works – Soil nailing– Rock Anchoring– Micro–piles.

### **UNIT V – GROUTING TECHNIQUES 9 Hours**

Objectives of Grouting– Types of Grout– Grouting Equipment's and machinery–Injection Methods– Grout Monitoring–Stabilization with cement, lime and chemicals – Stabilization of Expansive Soils.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the characteristics of problematic soil and identify the suitable techniques for ground improvement.	Understand
CO.2 Explain various dewatering techniques for ground improvement.	Understand
CO.3 Explain the different methods of In-situ treatment of cohesionless and cohesive soil.	Understand
CO.4 Explain the concepts of earth reinforcement and identify suitable material for various applications.	Understand
CO.5 Explain the grouting techniques and select appropriate stabilization methods for expansive soils.	Understand

**Text Book(s):**

- T 1. Purushothama Raj. P, Ground Improvement Techniques, Lakshmi Publications, 2nd Edition, 2016.
- T 2. Koerner, R.M. Construction and Geotechnical Methods in Foundation Engineering, McGraw Hill, 1994.
- T 3. Nihar Ranjan Patra, Ground Improvement Techniques, Vikas Publishing House, First Edition, 2012.
- T 4. Mittal.S, An Introduction to Ground Improvement Engineering, Medtech Publisher, First Edition, 2013.

**Reference Book(s):**

- R 1. Moseley, M.P and Kirsch. K., Ground Improvement, Spon Press, Taylor and Francis Group, London, 2nd Edition, 2004.
- R 2. Jones C.J.F.P. Earth Reinforcement and Soil Structure, Thomas Telford Publishing, 1996.
- R 3. Winterkorn, H.F. and Fang, H.Y. Foundation Engineering Hand Book. Van Nostrand Reinhold, 1994.
- R 4. Koerner, R.M., Designing with Geosynthetics (Sixth Edition), Xlibris Corporation, U.S.A, 2012.

**IS Code Books:**

- 1. IS Code 9759: 1981
- 2. IS Code 15284 (Part 1): 2003

**Web References:**

- 1. <http://nptel.ac.in/courses/105103097/>
- 2. <http://home.iitk.ac.in/>
- 3. <https://nptel.ac.in/courses/111103021/>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1029</b>		<b>Course Title: SUBSURFACE INVESTIGATION AND INSTRUMENTATION</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Soil Mechanics

### **Course Objective**

The course is intended to the conduct and preparation of soil exploration report based on laboratory, field exploration and testing techniques.

### **UNIT I - EXPLORATION TECHNIQUES**

**9 Hours**

Scope and objectives - planning an exploration program - location – spacing – depth of borings – stabilization of bore holes– soil profile – bore logs – data presentation – soil investigation and exploration reports. Methods of boring and drilling - non-displacement and displacement methods, drilling in difficult subsoil conditions - limitations of various drilling techniques - geophysical exploration and interpretation – seismic refraction and electrical resistivity methods – Magnetic and Gravity Methods.

### **UNITII - SOIL SAMPLING**

**9 Hours**

Type of samples – sample disturbance - design features affecting sample disturbance - sampling techniques - types of samplers - shallow penetration samplers - advanced sampling techniques - offshore sampling - preservation and handling of samples.

### **UNIT III - IN-SITU TESTING**

**9 Hours**

Field tests – importance - penetration testing – standard penetration test – static cone penetration test – dynamic cone penetration test – plate load test – field vane shear test – pressure meter test – field permeability test - procedure, limitations, correction and data interpretation.

### **UNIT IV - INSTRUMENTATION**

**9 Hours**

Instrumentation in soil engineering – pore pressure – ground water table – strain gauges – resistance and induction type – load cells – earth pressure cells – settlement and heave gauges – piezometers and slope indications – inclinometer.

### **UNIT V - SPECIAL STRUCTURES**

**9 Hours**

Challenges in special structures – bridges, airport runway, tunnels, transmission towers, offshore structures, underground structures – Design considerations – process of monitoring the investigation and construction activities – Report preparation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Understand the various methods of soil exploration techniques with different soil conditions.	Understand
CO.2 Demonstrate the soil sampling techniques with different soil samplers based on soil conditions.	Apply
CO.3 Elucidate the in-situ testing methods with different soil conditions.	Apply
CO.4 Explain the methods instrumentation	Apply
CO.5 Prepare the soil investigation and construction progress report for special structures	Understand

#### Text Book(s):

T1. Alam Singh and Chowdhary, G.R., "Soil Engineering in Theory and Practice, Volume-2, Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, New Delhi, 2006.

T2. Hunt, R.E., "Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.

T3. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, The McGraw-Hill companies, Inc., New York, 1995.

#### Reference Book(s):

R1. Hunt, R.E., "Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.

R2. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.

#### Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	1	3	2	3	1	3	-	-
CO2	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO3	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO4	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO5	1	1	-	1	1	1	1	3	2	3	1	3	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1030</b>	<b>Course Title: ENGINEERING BEHAVIOUR OF SOILS</b>		
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Engineering Geology

#### **Course Objective**

The course is intended to gain the knowledge of the basic mechanics which governs the physio chemical, engineering, swell and shrinkage behaviour of soil.

#### **UNIT I - SOIL DEPOSITS AND CLAY MINERALS 9 Hours**

Introduction – formation of soils – different soil deposits and their engineering properties – composition and structure of clay minerals – classification and identification – anion and cation exchange capacity of clays – specific surface area – bonding in clays.

#### **UNITII - PHYSIO CHEMICAL BEHAVIOUR OF SOILS 9 Hours**

Physio chemical behaviour of soils – diffused double layer theory – computation of double layer distance – dielectric constant – temperature on double layer – ion exchange – cation exchange capacity – cause, fixation and determination of cation exchange effect–exchangeable cations - types of soil water – water interactions - soil structure.

#### **UNIT III - SWELLING AND SHRINKAGE BEHAVIOUR OF SOILS 9 Hours**

Problems associated with swelling and shrinkage behaviour of soils – causes, consequences and mechanisms – factors influencing swell – shrink characteristics – swell potential – swell pressure – volume changes and engineering problems in the field - soil fabric and measurement – sensitivity, thixotrophy of soils – soil suction – identification of expansive clays.

#### **UNIT IV - ENGINEERING PROPERTIES OF SOILS 9 Hours**

Compressibility, shear strength and permeability behaviour of fine and coarse grained soils – mechanisms - factors influencing engineering properties – liquefaction potential – causes and consequences - soil suction – determination of suction potential – collapsible soil – its identification – effect on foundation.

#### **UNIT V - CONDUCTION PHENOMENA OF SOIL BEHAVIOUR 9 Hours**

Conduction in soils – hydraulic, electrical, chemical and thermal flows in soils – applications - coupled flows – Electro-kinetic process – thermo osmosis - electro osmosis – prediction of engineering behaviour of soils using index properties – empirical equations and their applicability.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Understand the various types of soil deposits and clay minerals.	Understand
CO.2 Examine the physio chemical behavior with different soil.	Understand
CO.3 Interpret the swell behavior with different soil.	Understand
CO.4 Compare the engineering properties with different soil.	Understand
CO.5 Describe the hydraulic, electrical, chemical and thermal flows in soils and its applications.	Understand

**Text Book(s):**

T 1. Mitchell, J. K., 1993. Fundamentals of soil Behaviour. Edition, John Wiley and sons, New York

T 2. Das, B.M., 1997. Advanced soil Mechanics. Taylor and Francis.

T 3. Gulhati, S. K. and Datta M. 2008. Geotechnical Engineering. Tata Mcgraw-Hill Company Ltd.

**Reference Book(s):**

R 1. Lambe, T.W. and Whitman, R.V., 1987. Soil Mechanics. John Wiley and Sons

R 2. Coduto, D. P. 2002. Geotechnical Engineering, Principles and Practices. Pearson Education International, New Jersey.

R 3. Yong, R.N. and Warkentin, B.P., Introduction to Soil Behaviour, Macmillan, Limited, London, 1979.

**Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	1	2	2	2	1	3	-	-
CO2	1	1	-	1	1	1	1	2	2	2	1	3	-	-
CO3	1	1	-	1	1	1	1	2	2	2	1	3	-	-
CO4	1	1	-	1	1	1	1	2	2	2	1	3	-	-
CO5	1	1	-	1	1	1	1	2	2	2	1	3	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1031</b>	<b>Course Title: SHALLOW FOUNDATIONS</b>		
<b>Course Category: Professional Elective</b>	<b>Course Level: Practice</b>		
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Soil Mechanics

#### **Course Objective**

The course is intended to

- understand the various aspects related to shallow foundations and its design in the field of Civil Engineering.

#### **UNIT I - TYPES AND SELECTION OF FOUNDATIOS**

**9 Hours**

Types of foundations – types of shallow foundation – design concept - general requirements - additional consideration - selection of type of foundation - hostile environment - structural integrity – economy, foundation drainage and water proofing.

#### **UNITII - BEARING CAPACITY**

**9 Hours**

Theories of bearing capacity – ultimate bearing capacity – factors affecting bearing capacity -evaluation of bearing capacity from in-situ tests – safe bearing capacity – bearing capacity of foundations in slope – effect of ground water table and eccentricity of foundations– codal provisions.

#### **UNIT III - SETTLEMENT AND ALLOWABLE BEARING PRESSURE**

**9 Hours**

Component of settlement - immediate, primary and secondary consolidation settlement-stress path method of settlement evaluation-layered soil - construction period correction - evaluation from in-situ tests – allowable settlement – allowable bearing pressure - codal provisions.

#### **UNIT IV - DESIGN OF FOUNDATIONS**

**9 Hours**

Analysis of foundation - isolated - strip - combined footings and mat foundations - conventional - elastic approach - soil structure interaction principles - application - numerical techniques - software applications

#### **UNIT V - FOUNDATION FOR SPECIAL CONDITIONS**

**9 Hours**

Structural design of shallow foundations – limit state method-codal provisions- special foundations - foundation design in relation to ground movements - foundation on compressible fills – foundation for tower-design of foundation for seismic forces - codal provisions.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Classify and Identify the suitable type of foundation based on soil condition.	Understand
CO.2 Estimate the safe bearing capacity from various methods.	Apply
CO.3 Describe the components of settlement and evaluate the settlement of for different soil conditions.	Apply
CO.4 Design of isolated, strip, combined and mat foundation.	Apply
CO.5 Illustrate the design of foundation for special conditions.	Apply

#### Text Book(s):

T 1. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw Hill, New York, 1996.

T 2. Das, B.M., 'Principles of Foundation Engineering, Design and Construction", Fourth Edition, PWS Publishing, 1999

T 3. Donald P. Coduto, "Foundation Design Principles and Practices" - Prentice Hall, Inc., Englewood Cliffs, New Jersey, 2001.

T 4. Nainan P. Kurian, "Design of Foundation Systems, Principles and Practices, Narosa Publishing House, Third Edition, 2006.

T 5. Muni Budhu, "Soil Mechanics and Foundation, John Wiley and Sons, INC 2000.

#### Reference Book(s):

R 1. Poulos, H.G., Davis, E.H., "Pile foundation analysis and design", John Wiley and Sons, New York, 1980

R 2. Cernica, J.N. "Geotechnical Engineering Foundation Design", John Wiley and Sons, Inc. 1995.

R 3. Tomlinson, M.J. "Foundation engineering", ELBS, Longman Group, U.K. Ltd., England 1995.

R 4. Winterkorn, H.F. and Fang, Y.F., "Foundation Engineering Handbook", Van Nostrand Reinhold, 1994.

R 5. Day, R.W., "Geotechnical and Foundation Engineering, Design and Construction, McGraw Hill 1999.

#### Course Articulation Matrix:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	1	3	2	3	1	3	-	-
CO2	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO3	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO4	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO5	2	1	-	2	1	1	1	3	2	3	1	3	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1032</b>	<b>Course Title: DEEP FOUNDATIONS</b>		
<b>Course Category: Professional Elective</b>	<b>Course Level: Practice</b>		
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Soil Mechanics

#### **Course Objective**

The course is intended to gain the knowledge in different types of deep foundations and to estimate the load carrying capacity on various soil conditions.

#### **UNIT I - CLASSIFICATIONS AND LOAD CAPACITY PILES**

**9 Hours**

Necessity of pile foundation – classification of piles – factors governing choice of type of pile – load transfer mechanism – piling equipments and methods – effect of pile installation on soil condition. Allowable load of piles and pile groups – static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – wave equation application – interpretation of field test and pile load test results – settlement of piles and pile group - codal provisions.

#### **UNITII - LATERAL AND UPLIFT LOAD EVALUATION OF PILES**

**9 Hours**

Piles under lateral loads – Broms method, elastic, p-y curve analyses – batter piles – response to moment – piles under uplift loads – under reamed piles – drilled shaft – lateral and pull out load tests – codal provision.

#### **UNIT III - STRUCTURAL DESIGN OF PILE AND PILE GROUPS**

**9 Hours**

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- reinforcement details of pile and pile caps – pile raft system – basic interactive analysis – pile subjected to vibration – codal provision.

#### **UNIT IV – SHEET PILES**

**9 Hours**

Sheet piles structures- cantilever sheet pile walls in granular and cohesive soils – anchored bulk head – free earth support method – fixed earth support method – lateral earth pressure on braced sheet piles.

#### **UNIT V - WELL FOUNDATIONS**

**9 Hours**

Well foundation - design and construction - bearing capacity, settlement and lateral resistance stability of well foundation - drilled shaft - construction procedures - design considerations - load carrying capacity and settlement analysis.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Classify the pile foundation and estimate the pile capacity and settlement of piles and pile group.	Apply
CO.2 Illustrate the analysis of lateral loads on pile foundations.	Apply
CO.3 Design of structural pile and pile cap.	Apply
CO.4 Evaluate the earth pressure on sheet piles.	Apply
CO.5 Describe the various components and forces acting on well foundation.	Apply

#### **Text Book(s):**

T 1. Bowles, J.E., "Foundation Analysis and Design", 5th Edition, McGraw Hill, New York, 1996.

T 2. Das, B.M., 'Principles of Foundation Engineering, Design and Construction", Fourth Edition, PWS Publishing, 1999

T 3. Donald P. Coduto, "Foundation Design Principles and Practices" - Prentice Hall, Inc., Englewood Cliffs, New Jersey, 2001.

T 4. Nainan P. Kurian, "Design of Foundation Systems, Principles and Practices, Narosa Publishing House, Third Edition, 2006.

T 5. Muni Budhu, "Soil Mechanics and Foundation, John Wiley and Sons, INC 2000.

#### **Reference Book(s):**

R 1. Poulos, H.G., Davis, E.H., "Pile foundation analysis and design", John Wiley and Sons, New York, 1980

R 2. Cernica, J.N. "Geotechnical Engineering Foundation Design", John Wiley and Sons, Inc. 1995.

R 3. Tomlinson, M.J. "Foundation engineering", ELBS, Longman Group, U.K. Ltd., England 1995.

R 4. Winterkorn, H.F. and Fang, Y.F., "Foundation Engineering Handbook", Van Nostrand Reinhold, 1994.

R 5. Day, R.W., "Geotechnical and Foundation Engineering, Design and Construction, McGraw Hill 1999.

#### **Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO2	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO3	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO4	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO5	2	1	-	2	2	1	1	3	2	3	1	3	-	-

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1033</b>		<b>Course Title: SOIL DYNAMICS AND MACHINE FOUNDATIONS</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Soil Mechanics
- Foundation Engineering

### **Course Objective**

The course is intended to

- understand the theory of vibrations and behavior of soils under dynamic loads so that to design foundations for various types of machines.

### **UNIT I - THEORY OF VIBRATION**

**9 Hours**

Introduction – nature of dynamic loads – fundamentals of vibration - vibrations of single and multi degree freedom system – free vibrations of spring – mass systems – forced vibrations – resonance - viscous damping - Principles of vibration measuring instruments - effect of transient and pulsating loads.

### **UNITII - DYNAMIC SOIL PROPERTIES**

**9 Hours**

Dynamic stress-strain characteristics – principles of measuring dynamic properties – laboratory techniques – field tests – factors affecting dynamic properties - typical values - dynamic bearing capacity – dynamic earth pressure.

### **UNIT III - MACHINE FOUNDATIONS**

**9 Hours**

Types of Machines and Foundations – General requirements – Design approach for machine foundation - Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures.

### **UNIT IV - DESIGN OF MACHINE FOUNDATIONS**

**9 Hours**

General requirements – evaluation of design parameters – analysis and design of block type and framed type machine foundations – modes of vibration of a rigid foundation – foundations for reciprocating machines, impact machines, two-cylinder vertical compressor, double-acting steam hammer – codal recommendations.

### **UNIT V - INFLUENCE OF VIBRATION AND REMEDIATION**

**9 Hours**

Mechanism of liquefaction – influencing factors- vibration isolation – types of isolation - active and passive isolation – methods of isolation – use of springs and damping materials – properties of isolating materials – vibration control of existing machine foundation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Illustrate the importance of learning soil dynamics and the theory behind vibrations.	Understand
CO.2 Understand the principles of measuring dynamic properties of soils and determine the properties.	Apply
CO.3 Describe about machine foundations inducing soil dynamics and its importance in the design criteria.	Apply
CO.4 Design of various types of machine foundation.	Apply
CO.5 Explain the influence of vibration and its remediation.	Apply

**Text Book(s):**

- T 1. Saran, S., 1999. Soil Dynamics and Machine Foundations. Galogotia Publications Pvt. Ltd, New Delhi.
- T 2. Prakash, S and Puri, V.K., Foundations for Machines, McGraw Hill, 1987. McGraw Hill Book Company, New York.
- T 3. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing, New Delhi, 2000

**Reference Book(s):**

- R 1. Barken, D. D., 1962. Dynamics of bases and foundations. McGraw Hill, New York.
- R 2. Krammer, S., 2003. Geotechnical Earthquake Engineering. Pearson Education Pvt. Ltd. New Delhi.
- R 3. Moore, P.J., "Analysis & Design of Foundations for Vibrations", Oxford & IBH, 2006.

**Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	1	3	2	3	1	3	-	-
CO2	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO3	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO4	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO5	2	1	-	2	2	1	1	3	2	3	1	3	-	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1034</b>	<b>Course Title: REINFORCED SOIL STRUCTURES</b>		
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L: T:P (Hours/Week) 3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Soil Mechanics
- Foundation Engineering

#### **Course Objective**

The course is intended to

- gain the knowledge in the concept of geosynthetics, reinforced materials and their behavior and their applications in different civil engineering design.

#### **UNIT I - PRINCIPLES AND MECHANISMS**

**9 Hours**

Historical background – initial and recent developments – principles – concepts and mechanisms of reinforced soil – factors affecting behaviour and performance of soil – reinforcement interactions.

#### **UNITII - REINFORCING MATERIALS**

**9 Hours**

Materials used in reinforced soil structures – fill materials, reinforcing materials, metal strips, and geosynthetics – bamboo – timber – facing elements – properties methods of testing – advantages and disadvantages – influence of environmental factors on the performance of geosynthetic materials.

#### **UNIT III - DESIGN PRINCIPLES**

**9 Hours**

Design aspects of reinforced soil – soil reinforcement function – separator, filtration, drainage, barrier function – design and applications of reinforced soil of various structures – retaining walls – foundations – embankments and slopes.

#### **UNIT IV - DESIGN FOR FUNCTIONS**

**9 Hours**

Geotextiles - requirement for design of separation – filtration – general behaviour - filtration behind retaining wall, under drains, erosion control and silt fence – drainage design – liners for liquid containment – geo membrane and geosynthetic clay liners.

#### **UNIT V - GEOSYNTHETICS AND APPLICATIONS**

**9 Hours**

Geosynthetics in roads – geosynthetics in landfills – barrier walls - soil nailing – soil-nail interaction – behaviour in seismic conditions - case studies of reinforced dams, embankments, pavements, railroads, foundations–

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Understand the concept and mechanism of reinforced soil structures and the factors affecting the performance.	Understand
CO.2 Identify the different materials used for reinforced soil structure and compare the properties of different materials.	Apply
CO.3 Explain the design principles of various reinforced soil structures	Apply
CO.4 Design the structures for geosynthetics applications like separation, filtration, reinforcement and barrier.	Apply
CO.5 Illustrate the applications of geosynthetics in roads, dams, embankments and pavements.	Apply

**Text Book(s):**

T 1. Sivakumar Babu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad, 2006.

T 2. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.

T 3. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.

**Reference Book(s):**

R 1. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.

R 2. Ramanathan Ayyar , T.S., Ramachandran Nair, C.G. and Balakrishna Nair, N., Comprehensive Reference Book on Coir Geotextile, Centre for Development for Coir Technology, 2002.

R 3. Muller, W.W. HDPE Geomembranes in Geotechnics, Springer, New York 2007.

**Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	1	1	1	1	3	2	3	1	3	-	-
CO2	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO3	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO4	2	1	-	2	2	1	1	3	2	3	1	3	-	-
CO5	2	1	-	2	2	1	1	3	2	3	1	3	-	-

High-3; Medium-2; Low-1

## **WATER RESOURCES ENGINEERING ELECTIVES**

<b>Course Code: 19CEEN1023</b>		<b>Course Title: HYDROLOGY</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Define the key drivers on water resources, hydrological processes and their integrated behavior in catchments.
- Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and hydrograph
- Explain the concept of hydrological extremes such as flood and drought and its management strategies
- Describe the importance of spatial analysis of rainfall and design water storage reservoirs
- Apply the concepts of groundwater for water resources management

### **UNIT I - PRECIPITATION AND ABSTRACTIONS**

**9 Hours**

Hydrological cycle - Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges - Spatial analysis of rainfall data using Thiessen and Isohyetal methods - Interception - Evaporation. Horton"s equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton"s equation - double ring infiltrometer, infiltration indices.

### **UNIT II – RUNOFF**

**9 Hours**

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical - Strange"s table and SCS methods – Stage discharge relationships flow measurements- Hydrograph – Unit Hydrograph – IUH

### **UNIT III – FLOOD AND DROUGHT**

**9 Hours**

Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Definitions of droughts Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP)

### **UNIT IV – RESERVOIRS**

**9 Hours**

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve

**UNIT V – GROUNDWATER MANAGEMENT****9 Hours**

Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Define the key drivers on water resources, hydrological processes and their integrated behavior in catchments.	Understand
CO.2 Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and hydrograph	Understand
CO.3 Explain the concept of hydrological extremes such as flood and drought and its management strategies	Understand
CO.4 Describe the importance of spatial analysis of rainfall and design water storage reservoirs	Understand
CO.5 Apply the concepts of groundwater for water resources management	Understand

**Text Book(s):**

- T 1. Subramanya, K. "Engineering Hydrology"- Tata McGraw Hill, 2010  
 T 2. Jayarami Reddy, P., "Hydrology", Tata McGraw Hill, 2008.

**Reference Book(s):**

- R 1. Garg. S. K., "Hydrology And Water Resources Engineering", Khanna Publishers-Delhi, 2010.  
 R 2. Ven Te Chow, Maidment, D.R. and Mays, L.W., "Applied Hydrology", McGraw Hill  
 R 3. International Book Company, 1998.  
 R 4. Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998.

**Web References:**

- <http://nptel.ac.in/downloads/105105110/>
- <http://www.civilenggforall.com/2015/09/irrigation-and-water-resources-engineering-gl-asawa-free-download-pdf-civilenggforall.html>
- <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-731-water-resource-systems-fall-2006/lecture-notes/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code:19CEEN1035</b>		<b>Course title: GROUNDWATER ENGINEERING</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits: 3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Course Objectives**

The course is intended to:

- Learn about the basics of groundwater hydrology
- Outline the objectives of groundwater hydraulics
- Understand the various types of wells, its construction and maintenance
- Know about the different method of evaluation of aquifer parameters
- Study the concepts involved in modelling and recharge of groundwater

### **Unit I – GROUNDWATER HYDROLOGY**

**9 Hours**

Introduction- Water bearing formations- geological formation of water supply-subsurface distribution of water – hydrological cycle – sources of groundwater – types of aquifers – aquifer parameters – groundwater development and potential in India

### **Unit II – GROUNDWATER HYDRAULICS**

**9 Hours**

Groundwater flow- Permeability – Transmissibility – Darcy's law and its limitations – Properties of aquifer materials – Radial flow towards a well in a confined and unconfined aquifer – Relation of well size to yield – unsteady flow conditions – determination of aquifer constants – Theis method – Jacob's method – Chow's method – Theis recovery method – Conditions to check for steady state – Well losses and well efficiency

### **Unit III – WELLS AND EXPLORATION**

**9 Hours**

Types of wells – water well design – drilling of tubewells – drilling methods – percussion drilling – rotary drilling – auger core drilling and water jet methods – construction of wells – collector wells and infiltration wells – construction of strainer type tube wells- types of strainers – Construction of cavity type tube wells – Construction of gravel packed wells – Construction of open wells - testing yield of tube wells

### **Unit IV – EVALUATION OF AQUIFER PARAMETERS**

**9 Hours**

Pumping test analysis – Recuperation test – well characteristics – well capacity – confined and unconfined aquifer – groundwater investigation – subsurface geophysical methods

### **Unit V – GROUNDWATER QUALITY AND CONSERVATION**

**9 hours**

Groundwater development – hydrological maps – groundwater quality standards – groundwater contamination – seawater intrusion – control measures – Groundwater recharge methods – Groundwater modelling

<b>Course Outcomes</b>	<b>Cognitive level</b>
<b>At the end of this course, students will be able to:</b>	
CO.1 Explain the basics of groundwater hydrology and movement of groundwater	Understand
CO.2 Describe the objectives of groundwater hydraulics and properties of aquifer materials	Understand
CO.3 Classify the various types of wells, and brief about its construction and maintenance	Understand
CO.4 Enumerate the different methods of evaluation of aquifer parameters	Understand
CO.5 Explain the concepts involved in modelling and recharge of groundwater	Understand

### **Text Books:**

T1. Todd, D.K., Mays, L.W., Groundwater Hydrology, John Wiley and Sons, New York, 2005.

T2. Raghunath, H.M., Groundwater Hydrology, Wiley Eastern Ltd., Third edition, New Age International, 2007.

T3. R.N. Saxena, Gupta, D.C., Elements and Hydrology and groundwater, PHI Learning private limited, 2017.

### **Reference Books:**

R1. Murthy, V.V.N., Land and water management engineering, Kalyani publishers, New Delhi, 1985.

R2. Delleur, J.W., The Handbook of groundwater engineering, CRC Press, Taylor and Francis Group, 2007.

### **Web References:**

1. <https://nptel.ac.in/courses/105105042>
2. <https://nptel.ac.in/courses/105101214>

### **Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1036</b>		<b>Course title: IRRIGATION MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits: 3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Course Objectives**

The course is intended to:

- Expose students to irrigation development in India
- Understand the various systems of irrigation and their performance indicators
- Learn the various aspects of main system management
- Inculcate the principles of participatory irrigation management
- Outline the policies related to irrigation

### **Unit I – IRRIGATION DEVELOPMENT IN INDIA**

**9 hours**

Importance of Irrigation in Agriculture - Historical evolution of irrigation in India – Irrigation development during pre-colonisation – Colonisation and post-colonization – Different types of Irrigation prevalent in India: Warabandi, Shejpali and South Indian systems - Focus of Irrigation in India – Command area development approach and farmers' participation.

### **Unit II – IRRIGATION SYSTEMS AND PERFORMANCE INDICATORS**

**9 hours**

Systems classification - Institutions for irrigation management–Diagnostic Analysis of Irrigation Systems -Rehabilitation and modernization – Performance indicators – Improving system performance – Conjunctive management – constraints faced.

### **Unit III – MAIN SYSTEM MANAGEMENT**

**9 hours**

Main system components – Reservoir allocation rule, Operating rule and optimization methods to improve main system performance - irrigation scheduling – Constraints.

### **Unit IV – COMMAND AREA DEVELOPMENT AND PARTICIPATORY IRRIGATION MANAGEMENT**

**9 hours**

Command area development principles – Participatory Irrigation Management and Irrigation management transfer – Case studies – Constraints.

### **Unit V – IRRIGATION POLICY**

**9 hours**

Present status of irrigation policy and institutions – Irrigation related conflicts – Institutional transformation needed – Constraints in effecting institutional transformation – Irrigation financing – Water pricing – Water market – Policy changes.

Course Outcomes	Cognitive level
At the end of this course, students will be able to:	
CO1. Explain about irrigation development in India	Understand
CO2. Describe the various systems of irrigation and their performance indicators	Understand
CO3. Explain the various aspects of irrigation scheduling and reservoir operation	Understand
CO4. Resolve the conflicts based on principles of participatory irrigation management	Understand
CO5. Enumerate the policies related to irrigation	Understand

### Text Books:

- T1. Rakesh Hooja, Management of Water for Agriculture: Irrigation, Water sheds and Drainage, Rawat Publications, New Delhi, 2006.  
T2. Kijne, J.W., Barker, R and Molden, D, Water Productivity in Agriculture; Limits and Opportunities for improved, CABI Publishing, Walling ford, U.K, 2003.

### Reference Books:

- R1. Giodano.M and Villbolth K.G, The Agricultural Ground Water Revolution - Opportunities and threats to development, CABI Publishing, Walling ford, U.K, 2007.

### Web References:

1. <https://nptel.ac.in/courses/105108081>
2. [http://www.irrigationtoolbox.com/NEH/Part652\\_NationalIrrigationGuide/ch9.pdf](http://www.irrigationtoolbox.com/NEH/Part652_NationalIrrigationGuide/ch9.pdf)

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code:19CEEN1037</b>		<b>Course title: IRRIGATION WATER QUALITY</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits: 3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Course Objectives**

The course is intended to:

- Understand the physical and chemical characteristics of irrigation water.
- Study the role of salinity in irrigation water
- Learn the various sources of pollution
- Understand the recycling and reuse techniques adopted in irrigation
- Discuss the water quality standards and models

### **Unit I – WATER QUALITY**

**9 hours**

Physical and chemical properties of water – Suspended and dissolved solids – EC and pH – major ions –. Water quality investigation – Sampling design - Samplers and automatic samplers - Data collection platforms – Field kits – Water quality data storage, analysis and inference – Software packages

### **Unit II – SALINITY**

**9 hours**

Water quality for irrigation – Salinity and permeability problem – Root zone salinity - Irrigation practices for poor quality water – Saline water irrigation – Future strategies

### **Unit III – WATER POLLUTION**

**9 hours**

Sources and Types of pollution – Organic and inorganic pollutants - BOD – DO relationships – impacts on water resources – NPS pollution and its control – Eutrophication control - Water treatment technologies - Constructed wetland.

### **Unit IV – RECYCLING AND REUSE OF WATER**

**9 hours**

Multiple uses of water – Reuse of water in agriculture – Low cost waste water treatment technologies - Economic and social dimensions - Packaged treatment units – Reverse osmosis and desalination in water reclamation.

### **Unit V – WATER QUALITY MANAGEMENT**

**9 hours**

Principles of water quality – Water quality classification – Water quality standards - Water quality indices – TMDL Concepts – Water quality models.

<b>Course Outcomes</b>	<b>Cognitive level</b>
<b>At the end of this course, students will be able to:</b>	
CO.1 Explain the physical and chemical characteristics of irrigation water.	Understand
CO.2 Enumerate the role of salinity in irrigation water	Understand
CO.3 Describe the various sources of pollution affecting irrigation water	Understand
CO.4 Explain the recycling and reuse techniques adopted in irrigation	Understand
CO.5 Develop the water quality models	Understand

### **Text Books:**

T1. George Tchobanoglous, Franklin Louis Burton, Metcalf & Eddy, H. David Stense, "Wastewater Engineering: Treatment and Reuse", McGraw-Hill, 2002.

T2. Vladimir Novonty, "Water Quality: Diffuse pollution and watershed Management", 2<sup>nd</sup> edition, John Wiley & Sons, 2003.

### **Reference Books:**

R1. Mackenzie L Davis, David A Cornwell, "Introduction to Environmental Engineering", McGraw- Hill 2006.

R2. Stum, M and Morgan, A., "Aquatic Chemistry", Plenum Publishing company, USA, 1985.

R3. Lloyd, J.W. and Heathcote, J.A., "Natural inorganic chemistry" in relation to groundwater resources, Oxford University Press, Oxford, 1988.

### **Web References:**

1. <https://archive.nptel.ac.in/courses/126/105/126105010/>
2. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1530>

### **Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1038</b>		<b>Course title: WATERSHED CONSERVATION AND MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits: 3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Course Objectives**

The course is intended to:

- Learn about the watershed concepts
- Understand the various soil conservation measures
- Become aware of the watershed harvesting techniques
- Develop a watershed management plan
- Understand the role of remote sensing and GIS in watershed conservation

### **Unit I – WATERSHED CONCEPTS**

**9 hours**

Watershed- Need for an integrated approach – Influencing factors; Geology – Soil – Morphological characteristics – Toposheet – Delineation – Codification – Prioritization of watershed

### **Unit II – SOIL CONSERVATION MEASURES**

**9 hours**

Types of erosion – Water and wind erosion; Causes, factors, effects and control – Soil conservation measure: Agronomical and mechanical – Estimation of soil loss – Sedimentation

### **Unit III – WATER HARVESTING AND CONSERVATION**

**9 hours**

Water harvesting techniques – Micro catchments – Design of small water harvesting structures – Farm ponds – Percolation Tanks – Yield of a catchment

### **Unit IV – WATERSHED MANAGEMENT**

**9 hours**

Watershed development plan – Entry point activities – Estimation – Watershed economics – Agroforestry – Grassland management – Wasteland management – Watershed approach in government programmes – Developing collaborative know how – People's participation – Evaluation of watershed management

### **Unit V – GIS FOR WATERSHED MANAGEMENT**

**9 hours**

Applications of Remote Sensing and Geographical Information System – Role of decision support system – Conceptual models and case studies

<b>Course Outcomes</b>	<b>Cognitive level</b>
<b>At the end of this course, students will be able to:</b>	
CO.1 Explain the concepts of watersheds	Understand
CO.2 Enumerate the causes, effects and control measures for soil conservation	Understand
CO.3 Design small watershed harvesting structures	Apply
CO.4 Prepare a management plan for a watershed	Apply
CO.5 Explain the role of remote sensing and GIS in watershed conservation	Understand

### **Text Books:**

- T1. Ghanashyam, D., Hydrology and Soil Conservation engineering, Prentice Hall of India Private Limited, New Delhi, 2000.
- T2. Glenn, O. S., Soil and Water Conservation Engineering, John Wiley and Sons, 1981.
- T3. Gurmail, S., A Manual on Soil and Water Conservation, ICAR Publication, New Delhi, 1982.
- T4. Suresh, R., Soil and Water Conservation Engineering, Standard Publication, New Delhi, 1982.
- T5. Vir Singh, Raj., Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.

### **Reference Books:**

- R1. Brooks, K. N., P. F. Ffolliott, H. M. Joseph, A. Magner. Hydrology and the Management of Watersheds. Fourth Edition, 2013.
- R2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, 1998.
- R3. Lal, Ruttan. Integrated Watershed Management in the Global Ecosystem. CRC Press, New York, 2000.
- R4. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, 1988.
- R5. Dhruva Narayana, G. Sastry, V. S. Patnaik, "Watershed Management", CSWCTRI, Dehradun, ICAR Publications, 1997.

### **Web References:**

1. <https://nptel.ac.in/courses/105101010>
2. <http://ecoursesonline.iasri.res.in/course/view.php?id=542>

### **Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN3001</b>		<b>Course Title: IRRIGATION AND ENVIRONMENTAL ENGINEERING DRAWING</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>0: 0: 3</b>	<b>Credits:1.5</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Course Objectives**

The course is intended to:

- understand the layout of Diversion Head works and its components
- study and draw the different aspects of design of hydraulic structures.
- understand and draw the aspects of canal drop, regulator and siphon aqueduct
- understand the layout of water and waste treatment plants
- understand the the flow controlling and flow diversion structures

### **List of Exercises**

#### **IRRIGATION ENGINEERING DRAWING**

1. Typical layout of Diversion Head works and its components
2. Tank surplus weir
3. Tank sluice with tower head
4. Canal drop (Notch Type)
5. Canal regulator
6. Siphon aqueduct

#### **ENVIRONMENTAL ENGINEERING DRAWING**

1. General layout of water and waste treatment plants
2. Sedimentation aided with coagulation
3. Slow sand filter
4. Rapid sand filter
5. Trickling filter
6. Septic tank

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Design the components of irrigation engineering structures.	Apply
CO.2 Design water and waste water treatment units.	Apply
CO.3 Draw the components of irrigation engineering structures, water, and waste water treatment units as per the specifications.	Apply
CO.4 Design the flow controlling structures	Apply
CO.5 Design the flow diversion structures.	Apply

**Text Book(s):**

- T 1. Garg, S.K, "Irrigation Engineering and Design of Structures", Khanna Publishers, 36<sup>th</sup> Edition, 2019.
- T 2. Sharma S.K, "Irrigation Engineering and Hydraulic Structures", S. Chand Publication, 2017
- T 3. S.R. Sahasrabudhe, "Irrigation Engineering & Hydraulic Structures", S.K. Kataria & Sons, 2013.
- T 4. Satyanarayana Murthy, "Irrigation Design and Drawing", Published by Mrs. L.Banumathi, Tuni, East Godavari District, A.P. 1998

**Reference Book(s):**

- R 1. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999
- R 2. Manual of Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 2013
- R 3. Hand book on Water Supply and Drainage, SP35, B.I.S., New Delhi, 1987
- R 4. Peary, H.S., Rowe, D.R., and Tchobanoglous, G., "Environmental Engineering", McGraw-Hill Book Co., New Delhi, 7<sup>th</sup> Edition.
- R 5. Metcalf & Eddy, "Wastewater Engineering (Treatment and Reuse)", 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2017. (Kindle edition – 2021)

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1040</b>		<b>Course Title: REMOTE SENSING &amp; GIS APPLICATIONS IN WATER RESOURCES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L: T: P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits: 3</b>	<b>Total Contact Hours: 45</b>	<b>Maximum Marks: 100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

- Learn the basic concepts of Remote Sensing and sensors in India.
- Understand the various types of image processing used for different data products.
- Learn the concepts of GIS based on vector and raster data model
- Understand the mapping and analysis of data.
- Understand the application of remote sensing and GIS in field of water resources engineering

#### **Unit I – INTRODUCTION TO REMOTE SENSING**

**9 Hours**

Definition, Principle of Remote Sensing, Remote Sensing Systems, Remote Sensing from Space, Remote Sensing Sensors, Resolution, Imaging sensors, Optical Infrared (OIR) Imagers, Optical Sensors, Thermal Sensors, Microwave Sensors, Active Microwave Sensors, Data Preprocessing, Remote Sensing in India.

#### **Unit II – INTRODUCTION TO IMAGE INTERPRETATION**

**9 Hours**

Basic Principles of Image Interpretation, Elements of Image Interpretation, Techniques of Image Interpretation, Interpretation Keys, Introduction to Digital Image Processing, Digital Image- Image Rectification And Registration- Geometric Correction, Image Enhancement Techniques (only concepts), Image Classification - Unsupervised Classification and Supervised Classification.

#### **Unit III – GEOGRAPHIC INFORMATION SYSTEMS (GIS)**

**9 Hours**

Definitions and related technology, GIS Operations, GIS Elements, GIS Concepts and Practice, Map projection and Coordinate system. Introduction, Vector Data Representation, Geometric Objects, Topology. Introduction, Elements of the Raster Data Model, Types of Raster Data, Satellite Imagery, Digital Elevation Models, Integration of Raster and Vector Data.

#### **Unit IV – TERRAIN MAPPING AND ANALYSIS**

**9 Hours**

Introduction, Data for Terrain Mapping and Analysis, DEM, TIN, Terrain Mapping, Contouring, Vertical Profiling, Hill Shading, Hypsometric Tinting, Perspective View, Terrain Analysis, Slope and Aspect, Surface Curvature, View shed Analysis, Grid versus TIN.

**Unit V – GIS APPLICATIONS IN WATER REOURCES****9 Hours**

Introduction, GIS Modeling, Binary Models, Index Models. Integration of Remote sensing and GIS. Remote Sensing & GIS application in water resources engineering with case studies

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 Describe the basic concepts of Remote Sensing and various sensors in India	Understand
CO2 Explain various types of image processing used for different data products.	Understand
CO3 Describe the concepts of GIS and its practical applications based and vector and raster model.	Understand
CO4 Explain the mapping and analysis of data.	Understand
CO5 Explain the application of remote sensing and GIS in field of water resources engineering with case studies	Understand

**Text Book(s)**

- T1. Fundamentals of Remote Sensing, George Joseph, C. Jeganathan, 3<sup>rd</sup> Edition, 2018, University Press, New Delhi.
- T2. Introduction to Geographic Information systems – Kang tsung chang, 9<sup>th</sup> Edition, 2017, McGraw Hill publications, New Delhi.

**Reference Book(s):**

- R.1 Remote Sensing of the Environment – An earth resource perspective, John R. Jensen, 2<sup>nd</sup> Edition, 2013, Pearson Education, New Delhi.
- R.2 Principles of Geographical Information, Burrough Peter A., 2015, Oxford University
- R.3 Lo, C.P., and Albert K.W. Young concepts and Technologies of Geographic Information Systems, 2007, Prentice hall of India (Pvt) Ltd, New Delhi.
- R.4 Remote sensing and image interpretation, Lillesand, T.M. and Kieffer, 7<sup>th</sup> Edition, 2015, John Wiley and Sons, New York, 1987.
- R.5 Introductory Digital Image processing, John R Jensen, 4<sup>th</sup> edition, 2018, Prentice Hall, New Jersey.
- R.6 Farsworth, R.K., Bawetl, E.C. & Dhanju, M.S., Application of remote sensing to hydrology including groundwater, IHP, UNESCO, 1984.

**Web References:**

1. <http://www.wamis.org/agm/pubs/agm8/Paper-1.pdf>
2. [http://ags.geography.du.ac.in/Study%20Materials\\_files/Punyatoya%20Patra\\_AM.pdf](http://ags.geography.du.ac.in/Study%20Materials_files/Punyatoya%20Patra_AM.pdf)
3. [http://hydrologie.org/hsj/410/hysj\\_41\\_04\\_0593.pdf](http://hydrologie.org/hsj/410/hysj_41_04_0593.pdf)
4. [http://www.wiley.com/legacy/wileychi/gis/Volume1/BB1v1\\_ch14.pdf](http://www.wiley.com/legacy/wileychi/gis/Volume1/BB1v1_ch14.pdf)
5. [http://gis-lab.info/docs/books/aerial-mapping/cr1557\\_15.pdf](http://gis-lab.info/docs/books/aerial-mapping/cr1557_15.pdf)

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	1	1	2	-	1	-	-
CO2	2	-	-	-	-	-	-	1	1	2	-	1	-	-
CO3	2	-	-	-	-	-	-	1	1	2	-	1	-	-
CO4	2	-	-	-	-	-	-	1	1	2	-	1	-	-
CO5	2	-	-	-	-	-	-	1	1	2	-	1	-	-

High-3; Medium-2; Low-1.

## CONSTRUCTION ENGINEERING AND MANAGEMENT ELECTIVES

<b>Course Code: 19CEEN1001</b>		<b>Course Title: ADVANCED CONSTRUCTION TECHNIQUES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Construction Materials and Practices

### **Course Objectives**

The course is intended to:

- Study the design concepts of Retaining walls for different backfill conditions.
- Study the design concepts of Flat-bottomed elevated square and circular water tanks along with staging.
- Study the design concepts of Solid slab bridge and box culvert.
- Study the design concepts of Portal frames by substitute frame method.
- Study the design concepts of Prestressed concrete.

### **UNIT I – SUB STRUCTURE**

**9 Hours**

Box jacking – Pipe jacking – Diaphragm walls and basement – Tunneling techniques – Piling techniques – Caissons – types – sinking process – Cofferdam – Cable anchoring and grouting – Shoring for deep cutting – Dewatering for underground open excavation.

### **UNIT II – SUPER STRUCTURE**

**9 Hours**

Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Slipform technique – Suspended formwork – Construction sequence in cooling towers, silos, chimney, sky scraper – In-situ pre-stressing in high rise structures – Post tensioning – Aerial transporting – handling and erecting lightweight components on tall structures – Erection of lattice towers – Rigging of transmission line structures.

### **UNIT III – SPECIAL STRUCTURE**

**9 Hours**

Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Laying operations for built up offshore system – Vacuum dewatered flooring – Concrete paving technology – Large span structures – launching techniques for heavy decks – Support structure for heavy equipment and conveyor – Construction sequence and methods in domes – Erection of articulated structures and space decks.

### **UNIT IV – PRECAST AND PREFABRICATION**

**9 Hours**

Pre-casting techniques – handling techniques – transportation, storage and erection of structures – Curing techniques – steam curing, hot air blowing – Skeletal and large panel constructions – Pre-cast and pre-fabricating technology for low cost and mass housing schemes – Ferro-cement in housing – quality control – Repairs and economical aspects on prefabrication.

## UNIT V – REPAIR AND DEMOLITION

9 Hours

Mud Jacking and grouting for foundation – micro piling and underpinning for strengthening floor and shallow profile – Sub grade water proofing – Repair techniques for cracks in concrete – Demolition techniques – sequence of operation – Dismantling – Safety precaution in demolition and dismantling.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the various techniques adopted for substructure construction.	Understand
CO.2 Explain the construction techniques for commercial and modern engineering structures	Understand
CO.3 Elucidate the construction techniques to be adopted for special structures.	Understand
CO.4 Describe the process involved in construction of prefabricated structures, precast structures and ferrocement.	Understand
CO.5 Explain the repair and demolition techniques.	Understand

### Text Book(s):

- T 1. Subir K. Sarkar and Subhajit Saraswati, "Construction Technology", Oxford University Press, New Delhi, 2008.  
T 2. R. Chudley, Roger Greeno, "Advanced Construction Technology" Prentice Hall, 2006

### Reference Book(s):

- R 1. Jerry Irvine, "Advanced Construction Techniques" CA Rockers, 1984.  
R 2. Peter.H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008  
R 3. Robertwade Brown, "Practical Foundation Engineering Hand Book", McGraw Hill Publications, 1995.

### Web References:

1. <http://nptel.ac.in/video.php?subjectId=105102088>  
2. <https://sites.google.com/a/venusict.org/actech/lecture-notes>

### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1004</b>		<b>Course Title: BUILDING SERVICES</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Understand the different types of machineries used in the buildings.
- understand the fundamentals of electrical systems in buildings.
- know the concepts of lighting and air conditioning systems in buildings.
- study the fixtures and fittings of plumbing and sanitary systems in buildings.
- understand the importance and systems of fire safety installation.

### **UNIT I – MACHINERIES**

**9 Hours**

Hot Water Boilers – Lifts and Escalators – Special features for physically handicapped and elderly – Conveyors – Vibrators – Concrete mixers – DC/AC motors – Generators – Laboratory services – Gas, water, air and electricity

### **UNIT II – ELECTRICAL SYSTEMS IN BUILDINGS**

**9 Hours**

Basics of electricity – Single / Three phase supply – Protective devices in electrical installations – Earthing for safety – Types of earthing – ISI specifications – Types of wires, wiring systems and their choice – Planning electrical wiring for building – Main and distribution boards – Transformers and switch gears – Layout of substations

### **UNIT III – PRINCIPLES OF ILLUMINATION AND REFRIGERATION**

**10 Hours**

Visual tasks – Modern theory of light and colour – Classification of lighting –Design of modern lighting – Lighting for stores, offices, schools, hospitals and house lighting. Special features for physically handicapped and elderly – Pressure temperature relationship for liquids – Refrigerants – Vapour compression cycle – Refrigerant control devices – Air conditioning systems for different types of buildings – Protection against fire caused by A.C. Systems

### **UNIT IV – PLUMBING AND SANITARY SYSTEMS IN BUILDINGS**

**8 Hours**

Plumbing system components – Water supply and distribution system – plumbing valves – plumbing fixtures – Piping systems – Valves – Sanitary piping systems – Soil piping system – Ventilation system – House drain.

### **UNIT V – FIRE SAFETY INSTALLATION**

**9 Hours**

Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction of staircases and lift lobbies, fire escapes and A.C. systems. Special features for physically handicapped and elderly in building types –

Heat and smoke detectors – Fire alarm system, snorkel ladder –Dry and wet risers – Automatic sprinklers.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explain the working principle and functions of boilers, conveyors, motors and generators used in building.	Understand
CO.2 Describe the elements of electrical systems and the different types of earthing & wiring adopted in building.	Understand
CO.3 Explain the types of lighting, air conditioning systems and its control devices used in building.	Understand
CO.4 Explain the various fixtures and fittings of plumbing and sanitary systems used in building.	Understand
CO.5 Describe the planning considerations for fire safety and the various fire-fighting equipments used in building.	Understand

**Text Book(s):**

- T 1. Fred Hall and Roger Greeno, "Building Services Handbook", Routledge and CRC Press, 2017.  
T 2. Subhash M. Patil, "Building services", Standard publishers, 2014.

**Reference Book(s):**

- R 1. Thomas Everitt Coleman, "Sanitary House Drainage: Its Principles and Practice: A Handbook", Wentworth Press publishers, 2019  
R 2. William Paul Gerhard, "House–Drainage and Sanitary Plumbing", General Books publishers, 2012  
R 3. R. Udayakumar, "A text book on Building Services", Eswar Press, Chennai, 2011

**Web References:**

1. <https://www.scribd.com/doc/55417572/Building-Services-Notes>  
2. <https://lecturenotes.in/download/material/47960-note-of-building-services-by->

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2;Low–1

<b>Course Code: 19CEEN1015</b>		<b>Course Title: QUALITY CONTROL AND ASSURANCE</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ NIL

### **Course Objectives**

The course is intended to:

- To learn about the quality plan, quality management guidelines and responsibilities of the authorities.
- To know the quality standards, training, implementation and certification process.
- To study about the importance of quality planning, documentation and inspection procedures in execution of a project.
- To learn about the need of QA/QC, magnificent seven tools and FMEA for quality analysis.
- To know about the various factors influencing quality and the ways of improving quality.

### **UNIT I – QUALITY MANAGEMENT**

**9 Hours**

Introduction – Definitions and objectives – Factor influencing construction quality – Responsibilities and authority – Quality plan – Quality management guidelines – Quality circles.

### **UNIT II – QUALITY SYSTEMS**

**9 Hours**

Introduction – Quality system standard – ISO 9000 family of standards – Requirements – Preparing quality system documents – Quality related training – Implementing a quality system – Third party certification.

### **UNIT III – QUALITY PLANNING**

**9 Hours**

Quality policy, Objectives and methods in construction industry –Consumer's satisfaction, Ergonomics – Time of completion – Statistical tolerance – Taguchi's concept of quality – Six Sigma – Codes and standards – Documents – Contract and construction programming – Inspection procedures – Cost implication.

### **UNIT IV – QUALITY ANALYSIS**

**9 Hours**

Objectives – Regularity agent, owner, design, contract and construction-oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality –Appraisals, factors affecting construction quality management – Critical, major failure aspects and failure mode analysis –Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction.

### **UNIT V – QUALITY IMPROVEMENT TECHNIQUES**

**9 Hours**

Selection of new materials – Influence of drawings, detailing, specification, standardisation– Bid preparation – Construction activity, environmental safety, social and environmental factors

– Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the quality management principles.	Understand
CO.2 Explain the quality system standards.	Understand
CO.3 Describe the elements of quality planning and its implication.	Understand
CO.4 Elucidate the objectives and perform failure analysis related to QA/QC.	Understand
CO.5 Describe the quality improvement techniques.	Understand

**Textbook(s):**

- T 1. James J.O'Brien, "Construction Inspection Handbook: Quality Assurance and Quality Control", Third Edition, Van Nostrand Reinhold Company, 2012.
- T 2. J.L. Ashford, "The Management of Quality in Construction", E & FN SPON, 2003

**Reference Book(s):**

- R 1. Ram Babu Sao, "Perfect Quality Assurance & Quality Control", First Edition, Create space Independent Pub, 2016

**Web References:**

1. <http://nptel.ac.in/courses/116102019/>
2. [http://pmbook.ce.cmu.edu/13\\_Quality\\_Control\\_and\\_Safety\\_During\\_Construction.html](http://pmbook.ce.cmu.edu/13_Quality_Control_and_Safety_During_Construction.html)

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO2	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	1	-	-	-	-	-	-	-	-	-	2	-	2

High-3; Medium-2; Low-1



<b>Course Code: 19CEEN1018</b>		<b>Course Title: SAFETY IN CONSTRUCTION</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Study the cases of constructional accidents and legal implications.
- Acquire knowledge on safety programme.
- List the safety considerations in a construction contract.
- Study the importance of designing safety work culture.
- Know the responsibility of owner and designers.

#### **UNIT I – CONSTRUCTION ACCIDENTS AND SAFETY MANAGEMENT 9 Hours**

Accidents – Types of accidents and their causes – Cost of Constructional Accidents – Direct and Indirect cost – Occupational and safety hazard assessment – Safety Management of Accidents – Human errors and their role in safety management – Legal Implications.

#### **UNIT II – SAFETY PROGRAMMES 9 Hours**

Construction Safety – Benefits – Safety meetings – Elements of effective safety programme – problem areas in construction site – Job-site safety assessment – Safety Incentives – approaches to Improve Safety – OSHA – Indian Standards and Acts.

#### **UNIT III –CONTRACTUAL OBLIGATIONS 9 Hours**

Safety in construction contracts – Obligations and Types – Sub contractual Obligations – Substance abuse – Drug Abuse, Alcohol Abuse, Tobacco Abuse – Safety record keeping– Safety Personnel.

#### **UNIT IV – DESIGNING FOR SAFETY 9 Hours**

Safety culture – Safe Workers – Role of Employee, safety officer and management in designing safety – Safety Personnel– Safety Checklist – Project coordination and safety Procedures –Workers' compensation

#### **UNIT V –OWNER'S, ENGINEER AND DESIGNERS OUTLOOK 9 Hours**

Owner's responsibility for safety – Owner preparedness – Role of Engineer and Designer in ensuring safety – Safety clause in design document.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Identify the types of construction accidents, effects and safety measures to be followed in construction projects.	Understand
CO.2 Explain the safety norms as per various acts and standards.	Understand
CO.3 Explain the types of obligations on contracts and sub contracts and to describe the types of substance abuse.	Understand
CO.4 Illustrate the role of employee in designing safety norms in construction industry.	Understand
CO.5 Illustrate the roles and responsibilities of owner, engineer and designers in a construction project.	Understand

**Textbook(s):**

- T 1. Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 1997.  
T 2. Amarjit Singh, Jimmie Hinze, "Implementation of Safety and Health on Construction Sites" Taylor & Francis, 1999.

**Reference Book(s):**

- R 1. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, "Construction Safety and Health Management" Prentice Hall Inc., 2001  
R 2. Tim Howrath, Paul Watson "Construction Safety Management" John Wiley & Sons, 2008.  
R 3. Tamil Nadu Factory Act, Department of Inspectorate of factories, Tamil Nadu

**IS Code Books:**

1. IS 13415:1992  
2. IS 7293:1974  
3. IS 13416:1992(Part 1 to 5)  
4. SP 70: 2001

**Web References:**

1. <http://www.osha.gov/video/>  
2. <http://www.youtube.com/watch?v=t-P6mMp23ug>  
3. <https://nptel.ac.in/courses/114106017/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2;Low-1



Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Describe the role of human resource manager and the process of manpower planning.	Understand
CO.2 Explain the elements, dimensions, determinants and structure of an organisation.	Understand
CO.3 Elucidate the influence of interpersonal skills of individuals in an organisation towards teamness and organisational behaviour.	Understand
CO.4 Explicate the monetary benefits and other relevant perks an organisation should offer and the prevailing laws relevant to it.	Understand
CO.5 Describe the career advancement options in an organisation in terms of training, promotions and transfer based on performance assessment.	Understand

#### Reference Book(s):

- R 1. K.Aswathappa and Sadhna Dash, "Human Resource Management", McGraw Hill Publisher, 9<sup>th</sup> Edition, 2021.
- R 2. Dwivedi R.S, Human Relations and Organisational Behaviour, Laxmi Publications, 5<sup>th</sup> Edition, 2008.
- R 3. Michael Armstrong, "A handbook of Human Resource Management Practice, Kongan Page Limited, 10<sup>th</sup> Edition, 2006.
- R 4. Carleton Counter III and Jill Justice Coulter, "The Complete Standard Hand Book of Construction Personnel Management ", Prentice Hall, New Jersey, 1989.

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO2	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO3	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO4	2	1	-	-	-	-	-	1	-	1	-	2	2	-
CO5	2	1	-	-	-	-	-	1	-	1	-	2	2	-

High-3; Medium-2; Low-1



Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Explicate the properties and applications of wood, metals, alloys and significance of coating the rebar.	Understand
CO.2 Describe the properties and types of materials used for water proofing, floor finishes and acoustic treatment.	Understand
CO.3 Elucidate the manufacturing process and applications of polymer composites.	Understand
CO.4 Explain the properties and applications of various types of special concretes.	Understand
CO.5 Portray the features and applications of smart and intelligent materials in construction.	Understand

**Reference Book(s):**

- R 1. N. Subramanian, "Building Materials", Oxford University Press, 1<sup>st</sup> Edition, 2019.
- R 2. C. Ganapathy, "Modern Construction Materials", Eswar Press, 2015.
- R 3. M.S. Shetty, "Concrete Technology: Theory and Practice", S.Chand & Company Ltd., 8<sup>th</sup> Edition, 2019.

**Web References:**

1. <https://archive.nptel.ac.in/courses/105/106/105106053/>
2. <http://www.infocobuild.com/education/audio-video-courses/architectural-and-civil-engineering/modern-construction-materials-iit-madras.html>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	-	-	-	-	-	1	-	3	1	-
CO2	2	1	2	-	-	-	-	-	-	1	-	3	1	-
CO3	2	1	2	-	-	-	-	-	-	1	-	3	1	-
CO4	2	1	2	-	-	-	-	-	-	1	-	3	1	-
CO5	2	1	2	-	-	-	-	-	-	1	-	3	1	-

High-3; Medium-2; Low-1



Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Portray the basics of economics and the contribution of civil engineering to the economy.	Understand
CO.2 Elucidate the construction economics with respect to land, resources and design and complications related to construction labourers.	Understand
CO.3 Explain the significance and process involved in financial management and analysis.	Understand
CO.4 Describe different methods of accounting applied in civil engineering.	Understand
CO.5 Apply cost estimation methods to get close approximate solutions to complex engineering problems.	Apply

#### Reference Book(s):

- R 1. Kiran H.Ghorpade and Shrikant R Kate "Engineering Economics & Financial Management", Tech-Neo Publications, 2021.
- R 2. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000
- R 3. Shrivastava,U.K., Construction Planning and Management,2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi, 2001.

#### Web References:

1. <https://archive.nptel.ac.in/courses/105/103/105103023/>
2. <https://www.coursera.org/learn/construction-finance>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	-	-	-	-	1	-	-	-	-	3	2	-
CO2	1	2	-	-	-	-	1	-	-	-	-	3	2	-
CO3	1	2	-	-	-	-	1	-	-	-	-	3	2	-
CO4	2	2	-	-	-	-	1	-	-	-	-	3	2	-
CO5	3	2	-	-	-	-	1	-	-	-	-	3	2	-

High-3; Medium-2; Low-1



## **TRANSPORTATION AND URBAN PLANNING ELECTIVES**

<b>Course Code: 19CEEN1016</b>		<b>Course Title: RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Transportation Engineering

### **Course Objectives**

The course is intended to:

- Understand the functions of various components of railway track.
- Learn the operation, construction, and maintenance of railway track.
- Know the various factors considered for planning and design of airport.
- Understand the importance of visual aids and air traffic control in airport.
- Study the various components of harbour and dock.

### **UNIT I – RAILWAY PLANNING AND DESIGN**

**9 Hours**

Role of Indian Railways in National Development –Factors controlling Alignment – Engineering Surveys for Track Alignment –Elements of permanent way and its functions – Rails, Sleepers, Ballast, rail fixtures and fastenings – Coning of wheels – Creep in rails – Defects in rails – Geometric design of railway tracks – gradient, super elevation, widening of gauge on curves.

### **UNIT II – RAILWAY TRACK OPERATION, CONSTRUCTION AND MAINTENANCE**

**9 Hours**

Working Principle of Points and Crossing, Signaling, Interlocking and Track Circuiting – Lay outs of Railway Stations and Yards – Level Crossings – Earthwork – Stabilization of track on poor soil – Tunneling Methods, drainage and ventilation – Calculation of Materials required for track laying – Construction and maintenance of tracks – Track renewals – Passenger amenities

### **UNIT III – AIRPORT PLANNING AND DESIGN**

**9 Hours**

Advantages and Limitations of Air Transport, Classification – Components of Airports – Airport Planning – Site Selection, Airport Obstructions and Zones – Runway Design – Orientation, Cross wind Component, Wind rose Diagram, Geometric Design and

Corrections for Gradients (Problems), Elements of Taxiway Design, Clearance over Highways and Railways.

#### **UNIT IV – AIRPORT LAYOUTS, VISUAL AIDS, AND AIR TRAFFIC CONTROL**

**9 Hours**

Airport Layouts –Parking and Circulation Pattern–Airport Buildings – Primary functions, Planning Concept, Principles of Passenger Flow, Passenger Facilities–Visual Aids – Runway and Taxiway Markings, Wind Direction Indicators, Runway and Taxiway Lightings– Air traffic control – primary functions, Air traffic control network.

#### **UNIT V – HARBOUR AND DOCKS ENGINEERING**

**9 Hours**

Advantages and Limitations of Water transport – Definition of terms –Requirements, Classification and location of harbour –planning and design considerations. Docks – classification – Mooring and Mooring accessories – Navigational aids – Coastal structures – Waves and their actions on Coastal structures – classifications of coastal regulation zones – coastal protection works.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Describe the various factors, surveys for track alignment and calculate the geometric design elements for railway track.	Apply
CO.2 Explain the operation, construction, and maintenance of railway track.	Understand
CO.3 Elaborate the various components of airports and the factors considered for geometric design of runway and taxiway.	Understand
CO.4 Describe the elements of airport building and the different types of visual aids and control devices.	Understand
CO.5 Describe the different types of harbour and dock and the various types of navigational aids and coastal protection works.	Understand

#### **Textbook(s):**

- T 1. Subramaniam K.P., “Railway, Airport and Harbour Engineering”, Scitech Publications (India) pvt Ltd. Chennai (2018)
- T 2. Subhash C. Saxena, “Airport engineering Planning and Design”, CBS publications, New Delhi, 2020

#### **Reference Book(s):**

- R 1. Saxena, S.C. Arora, S. P. “A text book of Railway Engineering”, Dhanpat Rai & Sons, New Delhi. 2015
- R 2. Horonjeff, R. Mckelvey, F. X. “Planning & Design of Airports”, McGraw hill, New York, 2010
- R 3. Gautam H. Oza, Hasmukh P. Oza, “Dock & Harbour Engineering”, Charotar Publishing House Pvt. Ltd, 2017.

**Web References:**

1. <http://annauniversityweb.blogspot.com/2013/06/anna-university-civil-notes-3rd->
2. <https://easyengineering.net/ce6604-railways-airports-and-harbour/damage/13870/>
3. <http://nptel.ac.in/courses/105107123/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2;Low-1

<b>Course Code:</b> <b>19CEEN1021</b>	<b>Course Title: ARCHITECTURE AND TOWN PLANNING</b>		
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Understand the difference between architectural styles of eastern and western world.
- Comprehend the principles of Architectural design
- Gain knowledge on the concept of composing spaces of buildings using design concepts, planning principles.
- Know about the town planning concepts in ancient India
- Understand the standards, landscaping features and regulations controlling expansion of the towns and the cities.

#### **UNIT I – HISTORY OF ARCHITECTURE**

**9 Hours**

**Western Architecture:** Egyptian, Greek, Roman Architectures.

**Indian Architecture:** Vedic age, Indus valley civilization– Buddhist period: Stambas, Stupa, Toranas, Chaityas, Viharas – Hindu temples: Dravidian and Indo Aryan Styles– Temple of Aihole, Madurai, Bhuvaneshwar, Mount Abu.

**Indo Sarsanic (Islamic) Architecture:** Mosque – Palace – Fort – Tomb.

#### **UNIT II – PRINCIPLES OF ARCHITECTURAL DESIGN**

**9 Hours**

Principles of designing – Composition of Plan – relationship between plan and elevation– building elements, form, surface texture, mass, line, color, tone– Principles of Composition: Unity, contrast, proportion, scale, balance, circulation, rhythm, character, expression.

#### **UNIT III – PRINCIPLES OF PLANNING**

**9 Hours**

Principles of planning a residence– site selection, site orientation– aspect, prospect, grouping, circulation, privacy, furniture requirements, services and other factors.

**Post–classic Architecture:** Introduction of post–classic architecture contribution of eminent architects to modern period–Edward Lutyens, Le Corbusier, Frank Lloyd Wrigt, Walter Groping

#### **UNIT IV – HISTORICAL BACKGROUND OF TOWN PLANNING**

**9 Hours**

Town planning in India – Town plans of mythological Manasa–Town plans of ancient towns: Harappa, Mohenjodaro, Pataliputra, Delhi, Acropolis (Greece), Jerusalem, Mecca, Rome, London.

**UNIT V – MODERN TOWN PLANNING****9 Hours**

Zoning – Roads and road traffic – Housing – Slums, Parks, Playgrounds – Public Utility Services – Surveys and maps for planning – Neighborhood Planning. Standards of Town planning: Planning new towns, planning standards and specifications, national and regional planning, town planning and legislation – planning regulations and limitations. Land scaping for the towns, horizontal and vertical expansion of towns – garden cities, satellite towns – floating towns – skyscrapers – pyramidal cities.

Course Outcomes		Cognitive Level
At the end of this course, students will be able to:		
CO.1	Explain the architectural styles adopted in western architecture and Indian architecture.	Understand
CO.2	Illustrate the principles of architectural design for planning a building.	Understand
CO.3	Identify proper aligned dimensioning techniques, and spacing as per planning principles for planning a residential building.	Understand
CO.4	Describe the ancient town planning techniques adopted in India.	Understand
CO.5	Explain the standards, landscaping features and regulations controlling expansion of the towns and the cities towards modern town planning.	Understand

**Textbook(s):**

- T 1. G. K. Hiraskar, "The Great Ages of World Architecture" (With Introduction to Landscape Architecture) (2018–2019), Session Paperback – 1 January 2018
- T 2. G.K. Haraskar , 'Fundamentals of Town Planning', Dhanpat Rai Publishing Co Pvt Ltd, 2018.

**Reference Book(s):**

- R 1. Hepler Drafting and Design for Architecture, Cengage Learning, 2012
- R 2. John Patten Guthrie, Architect's Portable Handbook, Mc Graw Hill International Publications, 2010
- R 3. R. S. Deshpande, Modern Ideal Homes for India, United book corporation digital library India, 2017

**Web References:**

1. <https://nptel.ac.in/courses/124/106/124106009/>
2. <https://nptel.ac.in/courses/124/107/124107001/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2;Low–1

<b>Course Code: 19CEEN1044</b>		<b>Course Title: PAVEMENT ENGINEERING</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Transportation Engineering

### **Course Objectives**

The course is intended to:

- Gain knowledge on various IRC guidelines for designing rigid and flexible pavements.
- assess quality and serviceability conditions of roads.

### **Unit I – PAVEMENT MATERIALS AND SUBGRADE ANALYSIS 9 Hours**

Introduction – Pavement as layered structure – Pavement types -rigid and flexible- Subgrade analysis- Stress and deflections in pavements- Pavement Materials and Testing- Modified Binders.

### **Unit II - DESIGN OF FLEXIBLE PAVEMENTS 9 Hours**

Flexible pavement design – Advantages and disadvantages -Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.

### **Unit III - DESIGN OF RIGID PAVEMENTS 9 Hours**

Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.

### **Unit IV – PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE 10 Hours**

Construction Techniques practice of flexible and concrete pavement Pavement Evaluation – Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

### **Unit V - STABILISATION OF PAVEMENTS 8 Hours**

Stabilisation with special reference to highway pavements - Choice of stabilisers -Testing and field control –Stabilisation for rural roads in India -use of Geosynthetics (geotextiles & geogrids) in roads.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the significance, functions and various construction methods of flexible and rigid pavements.	Understand
CO.2 Design the flexible pavement as per IRC guidelines.	Apply
CO.3 Design the rigid pavement as per IRC guidelines.	Apply
CO.4 Explain the various construction methods, evaluation surveys and its methods for measuring the performance of pavements as per IRC recommendations.	Understand
CO.5 Explain the various factors and methods involved in the stabilisation of pavements.	Understand

**Text Book(s):**

- T1. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna Publications, New Delhi, 2005.
- T2. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
- T3. Wright, P.H., "Highway Engineers", John Wiley & Sons, Inc., New York, 1996.
- T4. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001

**Reference Book(s):**

- R.1 Yoder R.J and Witczak M.W., "Principles of Pavement Design", John Wiley, 1975.
- R.2 Guidelines for the "Design of Flexible Pavements", IRC:37 - 2001, The Indian roads Congress, New Delhi.
- R.3 Guideline for the "Design of Rigid Pavements for Highways", IRC:58-1998, The Indian Roads Congress, New Delhi.
- R.4 Guideline for "Standard Specifications and Code of Practice for Construction of Concrete Roads", IRC 15 – 2002, The Indian Roads Congress, New Delhi.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	3	-	-	-	3	3	-
CO3	3	-	-	-	-	-	-	3	-	-	-	3	3	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1045</b>		<b>Course Title: TRAFFIC ENGINEERING AND MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

- Transportation Engineering

### **Course Objectives**

The course is intended to:

- Gain knowledge of the traffic components and assess the traffic characteristics and related problems.
- Gain knowledge of traffic planning and its management in any transportation area
- Gain knowledge of traffic control devices and its techniques in transportation interaction.

### **Unit I - TRAFFIC SURVEYS AND ANALYSES**

**9 Hours**

Traffic characteristics: Human, vehicular, and Pavement Characteristics, Problems- presentation of traffic volume data, Annual Average Daily Traffic, Average Daily Traffic, Design hourly traffic volume; Speed- spot speed, presentation of spot speed data, speed and delay studies, methods of conducting spot-speed studies and Speed and Delay studies; Problems Origin and Destination – methods of conducting the survey and presentation of data; parking surveys, presentation of data and analyses, determination of parking demand; Accident studies and analyses; Different problems.

### **Unit II - TRAFFIC FLOW AND ROADWAY CAPACITY**

**9 Hours**

Traffic Flow Characteristics – Basic traffic manoeuvres, Traffic stream flow characteristics, Speed- Flow- Density Relations; Passenger Car Units – Mixed traffic flow and related issues – Concept of PCU value- Factors affecting PCU values- Recommended PCU values for different conditions; Capacity and Level of Service – Factors affecting practical capacity – Design Service Volumes

### **Unit III - COST – EFFECTIVE TRAFFIC MANAGEMENT TECHNIQUES**

**9 Hours**

Traffic System Management: Regulatory Techniques- one way street, Reversible Street, Reversible lane, Turning moment restrictions, closing streets; Traffic Control Devices – Traffic Signs – Road Markings, Traffic Signals, Miscellaneous traffic control devices; Traffic Segregation – segregation, Pedestrian segregation, Traffic signals design; Bus Priority Techniques – Priority manoeuvres – With-flow bus lane and contra-flow bus lane; Self-Enforcing Techniques- Demand Management Techniques (TDM) Road pricing, parking control, Tolls, Staggering of office/educational institution hours.

### **Unit IV - DESIGN OF ROAD INTERSECTIONS**

**9 Hours**

Importance and Classification; Intersections at-grade – uncontrolled, channelised; Rotary intersections (problems)- Signalised intersections (problems)- Grade Separated



Intersections – merits and demerits, types, pattern of intersections with different types of interchanges- Capacity, Concept diagrams.

**Unit V - DESIGN OF PARKING AND PEDESTRIAN FACILITIES AND CYCLE TRACKS**

**9 Hours**

Parking: Need for parking studies and its ill effects- Parking Standards for different land uses, different types of parking - Conceptual plans for different types of parking; Pedestrians: Importance, Barriers, Behaviour, Pedestrian facilities – Principles of planning, Level of Service (LoS), Design standards.; Cycle Tracks: Principles of design, Design criteria, Design standards for Rural Expressways.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO.1 Apply the knowledge of science and engineering fundamentals in conducting traffic surveys, analyze the problems and relating it with standards	Understand
CO.2 Explain the principles of traffic flow characteristics and their relationships	Understand
CO.3 Explain the various traffic management measures in addressing the demand Pricing and ITS applications.	Understand
CO.4 Designing various types of control and regulatory measures to meet an efficient traffic network.	Understand
CO.5 Explain the various type of facilities and plan for Non Motorised Transport	Understand

**Text Book(s):**

- T1. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi
- T2. Jotin Khisty, S.C. and Kent Lall, B., Transportation Engineering – An Introduction, Prentice-Hall, NJ
- T3. S.C. Saxena Traffic Planning And Design, Dhanpat Rai Pub, New Delhi

**Reference Book(s):**

- R.1 Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.
- R.2 John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Pub. Co.
- R.3 Vukan R. Vuchic, Urban Public Transportation System & Technology, Prentice Hall,
- R.4 Papacostas, C.S., Fundamentals of Transportation System Analysis, PHI

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	-	-	-	-	-	-	-	-	-	-	2	2	-

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1046</b>		<b>Course Title: HOUSING PLANNING AND MANAGEMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max. Marks:100</b>

#### **Pre-requisites**

➤ **Nil**

#### **Course Objective:**

The course is intended to:

- train the students to have a comprehensive knowledge of planning, design, evaluation, construction and financing of housing projects.
- Study the course focuses on cost effective construction materials and methods.
- Students able to emphasis on the principles of sustainable housing policies and programmes.

#### **Unit-I INTRODUCTION TO HOUSING**

**7 Hours**

Definition of Basic Terms -House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies including Slum Housing Policy, Principle of Sustainable Housing -Integrated approach on arriving holding capacity and density norms - All basic infrastructure consideration -Institutions for Housing at National, State and Local levels.

#### **Unit-II HOUSING PROGRAMMES**

**9 Hours**

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighborhoods- Plotted land development programs, Open Development Plots, Apartments, Gated communities, Townships, Rental Housing, Co-operative Housing, Slum Housing Programmes - Slum improvement - Slum redevelopment and Relocation -Use of GIS and MIS in Slum Housing Projects,, Role of Public housing agencies, and Private sector in supply , quality, infrastructure and pricing - Role of Non-Government Organizations in slum housing.

#### **Unit-III PLANNING AND DESIGN OF HOUSING PROJECTS**

**10 Hours**

Formulation of Housing Projects - Land Use and Soil suitability analysis -Building Byelaws and Rules and Development Control Regulations - Site Analysis, Layout Design, Design of Housing Units (Design Problems) - Housing Project Formulation.

#### **Unit-IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS**

**10 Hours**

New Constructions Techniques - Cost Effective Modern Materials and methods of Construction- Green building concept

**Unit-V HOUSING FINANCE AND PROJECT APPRAISAL****9 Hours**

Evaluation of Housing Projects for sustainable principles - Housing Finance, Cost Recovery - Cash Flow Analysis, Subsidy and Cross Subsidy- Public Private Partnership Projects - Viability Gap Funding.

<b>COURSE OUTCOMES:</b>	<b>Cognitive Level</b>
CO.1 Explain the basics of housing	Understand
CO.2 Explain the different types of housing programmes	Understand
CO.3 Explain the planning and Design of housing projects	Understand
CO.4 Explain the construction techniques and materials used in housing projects	Understand
CO.5 Evaluate the housing projects and explain the concepts of housing finance	Understand

**TEXTBOOKS:**

T1. Meera Mehta and Dinesh Mehta, "Metropolitan Housing Markets", Sage Publications Pvt. Ltd., New Delhi, 1999.

T2. Francis Cherunilam and Odeyar D Heggade, "Housing in India", Himalaya Publishing House, Bombay, 1997.

**REFERENCES:**

R1. Wiley- Blackwell, "Neufert Architects" Data, 4th Edition, Blackwell Publishing Ltd, 2012

R2. Donald Watson and Michael J.Crosbie, "Time Saver Standards for Architectural Design", 8th Edition, Tata McGraw Hill Edition, 2011

R3. Walter Martin Hosack, "Land Development Calculations", McGraw Hill 2nd Edition, USA 2010

R4. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2004.

R5. Government of India, National Housing Policy, 1994

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	-	2

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1047</b>		<b>Course Title: INTELLIGENT TRANSPORTATION SYSTEMS(ITS)</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max. Marks:100</b>

#### **Pre-requisites**

- **Transportation Engineering**

#### **Course Objective:**

The course is intended to:

- Learn the fundamentals of ITS.
- Study the ITS functional areas.
- Have an overview of ITS implementation in developing countries.

#### **Unit-I INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM (ITS) 7 Hours**

Fundamentals of ITS: Definition of ITS, Challenges in ITS Development-Purpose of ITS Deployment Benefits of ITS- Overview of application of ITS in Transportation Planning

#### **Unit-II DATA COLLECTION THROUGH ITS 9 Hours**

Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques □ vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)

#### **Unit-III ITS IN TRAFFIC MANAGEMENT 10 Hours**

ITS User Needs and Services and Functional areas □ Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections

#### **Unit-IV ITS IN TRANSPORTATION PLANNING 10 Hours**

ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations - public transportation applications- Weight -in Motion

**Unit-V ITS IN TRANSPORTATION PLANNING****9 Hours**

Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics- E commerce

**COURSE OUTCOMES**

At the end of the course, students will be able to:	Cognitive Level
CO.1 Explain the fundamentals of ITS and its benefits.	Understand
CO.2 Explain the various data collection methods using sensors and its applications.	Understand
CO.3 Explain the principles of ITS in Traffic Management	Understand
CO.4 Explain the applications of ITS in Transportation Planning	Understand
CO.5 Explain the various applications of ITS in Logistics	Understand

**TEXT BOOKS:**

T1. R. Srinivasa Kumar, "Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022.

**REFERENCES:**

R1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.

R2. Henry F. Korth, and Abraham Silberschatz, Data Base System Concepts, McGraw Hill, 1992.

R3. Turban E., "Decision Support and Expert Systems Management Support Systems", Maxwell Macmillan, 1998.

R4. Sitausu S. Mitra, "Decision Support Systems—Tools and Techniques", John Wiley, New York, 1986.

R5. Cycle W. Halsapple and Andrew B. Winston, "Decision Support Systems—Theory and Application", Springer Verlag, New York, 1987

R6. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO5	3	-	-	-	-	-	-	-	-	-	-	3	-	3

High-3; Medium-2; Low-1

<b>Course Code: 19CEEN1048</b>		<b>Course Title: URBAN PLANNING AND DEVELOPMENT</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Practice</b>	
<b>L:T:P (Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max. Marks:100</b>

### **Pre-requisites**

- **Transportation Engineering**

### **Course Objective:**

#### **The course is intended to:**

- Enable students to have the knowledge on planning process
- Study about the regulations and laws related to Urban Planning.
- Study about the regulations and laws related to Urban Planning.

### **Unit-I INTRODUCTION 7 Hours**

Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas □ Positive and negative impacts of urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

### **Unit-II PLANNING PROCESS AND THEORIES 9 Hours**

Principles of Planning □ Stages in Planning Process □ Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radburn Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept

### **Unit-III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION 10 Hours**

ITS User Needs and Services and Functional areas □ Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections

**Unit-IV PLAN IMPLEMENTATION****10 Hours**

Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints □ Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.

**Unit-V URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS****9 Hours**

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.

<b>COURSE OUTCOMES</b>	<b>Cognitive Level</b>
CO.1 Explain the basic issues and terminologies in urban planning	Understand
CO.2 Explain the different types of theories of urban planning and city development.	Understand
CO.3 Explain the different types of plan, their strategies and their preparation process.	Understand
CO.4 Comprehend the planning standards, evaluate the constraints and the financial mechanism	Understand
CO.5 Explain the various country planning acts and their functions.	Understand

**TEXT BOOKS:**

- T1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
- T2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
- T3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
- T4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

**REFERENCES:**

- R1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai
- R2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
- R3. Chennai City Municipal Corporation Act, 1919 and Tamil Nadu District Municipalities Act, 1920

R4. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013

R5. The Tamil Nadu Combined Development and Building Rules, 2019

R6. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, Vol I & II, Jan 2015, Govt of India, Ministry of Urban Development

R7. <http://moud.gov.in> Course Articulation Matrix

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	-	-	2	-	2

High-3; Medium-2; Low-1



<b>Course Code: 19SCEC2001</b>		<b>Course Title: Cyber Security (Common to all)</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Introductory</b>	
<b>L:T:P (Hours/Week) 2: 0: 2</b>	<b>Credits:3</b>	<b>Total Contact Hours:60</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ NIL

#### **Course Objectives**

The course is intended to:

1. Discuss the various concepts in Cyber security and infrastructures involved.
2. Describe the cyber-crimes, reporting procedures and legal remedies.
3. Explain various social media related security issues and reporting flaws.
4. Explain various settings related to E-Commerce and digital payments.
5. Demonstrate the security aspects related to digital devices and technology.

**6 Hours**

#### **Unit I Introduction to Cyber Security**

Defining Cyberspace and Overview of Computer and Web-technology - Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security

#### **Unit II Cyber crime and Cyber law**

**6 Hours**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legalperspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies

#### **Unit III Social Media Overview and Security**

**6 Hours**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

**Unit IV      E-Commerce and Digital Payments****6 Hours**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act,2007.

**Unit V      Digital Devices Security, Tools and Technologies for  
Cyber Security****6 Hours**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions

**List of Exercises****30 Hours**

1. Prepare checklist for following scenarios :
  - a) Reporting cybercrime at Cybercrime Police Station.
  - b) Reporting cybercrime online.
  - c) Using popular social media platforms.
  - d) Secure net banking.
2. Demonstrate the following:
  - a) Reporting phishing emails, email phishing attack and preventive measures.
  - b) Reporting and redressal mechanism for violations and misuse of Social media platforms.
3. Manage the following activities:
  - a) Privacy and security settings for popular Social media platforms, Mobile Wallets and UPIs.
  - b) Application permissions in mobile phone.
4. Perform the following activities:
  - a) Setting, configuring and managing three password policy in the computer (BIOS, Administrator and Standard User).
  - b) Setting and configuring two factor authentication in the Mobile phone.
5. Demonstrate the following:
  - a) Security patch management and updates in computer and mobiles.
  - b) Wi-Fi security management in computer and mobile.
6. Install and configure computer Anti-virus & Computer Host Firewall.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the concept of Cyber Security and infrastructure involved.	Understand
CO2: Develop procedures for reporting various cyber-crimes through available platforms.	Apply
CO3: Demonstrate various social media related security issues and reporting flaws.	Apply
CO4: Illustrate various settings in e-commerce and digital payment applications.	Apply
CO5: Demonstrate the digital devices security, tools and technologies for cyber security.	Apply

### Text Book(s):

- T1. Cyber Crime Impact in the New Millennium, R. C Mishra. Author Press.T2, 2010
- T2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, 1<sup>st</sup> Edition, Wiley India Pvt. Ltd, 2011.
- T3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform, Pearson Education, 2001.

### Reference Book(s):

- R1. Network Security Bible, Eric Cole, Ronald Krutz, James W. Conley, 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd, 2001
- R2. Security Fundamentals of Network by E. Maiwald, McGraw Hill ,2014
- R3. Cyber Laws: Intellectual Property & E-Commerce Security by Kumar K, Dominant Publishers, 2011.

### Web Reference(s):

1. <https://unacademy.com/content/upsc/study-material/science-and-technology/initiatives-taken-by-indian-government-for-cyber-security/>
2. <https://cybercrime.gov.in/>
3. <https://www.meity.gov.in/cyber-security-division>
4. <https://intellipaat.com/blog/what-is-cyber-security/>

**Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	3	-	1	-	-	3	-
CO2	-	-	-	2	-	3	3	3	3	2	-	-	3	-
CO3	-	-	-	2	-	3	3	3	3	2	-	-	3	-
CO4	1	-	1	3	2	3	2	3	3	2	-	2	3	3
CO5	1	-	1	3	2	3	2	3	-	1	-	3	3	3

High-3; Medium-2;Low-1

<b>Course Code: 19MEEEC1025</b>		<b>Course Title: FUNDAMENTALS OF ENTREPRENEURSHIP</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level : Introductory</b>	
<b>L: T: P(Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max. Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

1. Describe the types, characteristics of entrepreneurship and its role in economic development.
2. Define the types of entrepreneurship.
3. Explain the appropriate form of business ownership in setting up an enterprise.
4. Disseminate the support and management to entrepreneurs in the growth strategies in enterprise.
5. Explain the techniques involved in development of industries

#### **Unit I Entrepreneurship 9 Hours**

Entrepreneur – Characteristics – Entrepreneurial Decision Process-Types of Entrepreneurs – Difference between Entrepreneur and a manager-Intrapreneur-Social Entrepreneur –Entrepreneurial Growth- Role of Entrepreneurship in Economic Development.

#### **Unit II Types of Entrepreneurship 9 Hours**

Women Entrepreneurship-Rural Entrepreneurship-Tourism Enterprise, Entrepreneurship-Policy Measure of Tourism Entrepreneurship-Eco-Tourism/Nature Tourism/Rural Tourism-Need, Opportunities, Challenges for Developing Agri-preneurship-Social Entrepreneurship.

#### **Unit III Start-Up 9 Hours**

Small Enterprises-Micro and Macro Units-Essentials, Features and Characteristics-Relationship between Micro and Macro Enterprises-Scope of Micro and Small Enterprises-Enterprise and Society-Package for Promotion of Micro and Small-Scale Enterprises-Problems of Micro and Small Enterprises- Identification of Business Opportunity-Steps in

Setting Up of a Small Business Enterprise – Content of Business Plan- Significance of Business Plan, Formulation of Business Plan – Guidelines for Formulating Project Report– Project Appraisal.

#### **Unit IV Support and Management**

**9 Hours**

Institutional Finance-Types of Lease Agreements-Lease Financing-Concept and Procedure for Hire-Purchase-Institutional Support to Small Entrepreneurs-Tax Benefits-Depreciation, Rehabilitation Allowance- Investment Allowance-Expenditure to Scientific Research-Tax Concession in Rural and Backward Areas-Difference between Management and Administration-Management of Working Capital-Methods of Inventory Management-Production Design-Market Segmentation-Marketing Mix

#### **Unit V Development**

**9 Hours**

Accounting for Small Enterprise-Types of Growth Strategies-Signal and Symptoms, Causes and Consequences of Industrial Sickness-Forms of Export Business-Types of Documents-E-Commerce Suitability for Small Enterprises-Types of Franchising-Evaluation of Franchise Arrangement-Corporate Citizenship.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1:Explain the types, characteristics of entrepreneurship and its role in economic development.	Apply
CO2:Classify various types of entrepreneurship and highlight the opportunities to improve the economy of India.	Apply
CO3:Select the appropriate form of business ownership in setting up an enterprise.	Apply
CO4:Determine the financial planning to become an entrepreneur and manage tax benefits that can be provided to the small Entrepreneurs	Analyze
CO5:Identify the techniques involved in the development of the small enterprise for the growth of industries.	Apply

#### **Text Book(s):**

T1. S.S.Khanka, “Entrepreneurial Development” S.Chand & Co. Ltd. Ram Nagar New Delhi,2020.

#### **Reference Book(s):**

R1.Charantimath, P. M., “Entrepreneurship Development and Small Business Enterprises”, Pearson, 2006.

R2.Mathew J Manimala,” Entrepreneurship theory at cross roads: paradigms and praxis” Dream tech, 2nd edition 2006.

R3.Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 2003.

R4.Singh, A. K., "Entrepreneurship Development and Management", University Science Press, 2009.

#### Web References:

1. <https://nptel.ac.in/courses/127105007>
2. <https://ncert.nic.in/ncerts//lebs213.pdf>

#### Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2		2				3	3					
CO3				2						2		
CO4					3			3			3	
CO5			2						2			

High-3; Medium-2; Low-1

<b>Course Code: 19MEEEC1026</b>		<b>Course Title: DESIGN THINKING AND INNOVATION</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level: Introductory</b>	
<b>L: T: P(Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours: 45</b>	<b>Max. Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objectives**

The course is intended to:

1. Disseminate the fundamental concepts and principles of design thinking
2. Explain the design thinking methods in each stage of the problem
3. Conceptualize innovative ideas using prototypes
4. Explain the significance of Evaluating and Testing Ideas
5. Describe the design thinking approach to real world problems

#### **Unit I INTRODUCTION TO DESIGN THINKING**

**9 Hours**

Design thinking overview - Impact of Design Thinking - Design Process – Principles of Design Thinking – Creating Ideal Conditions – Case Study: Identify problem in AI

#### **Unit II UNDERSTAND THE PROBLEM**

**9 Hours**

Information Gathering – Analysis – Storytelling tool- Innovation- Ideation Finding and Evaluating Ideas –Mind Mapping Tool. Case Study: Analysis of the Identified Problem.

#### **Unit III DEFINING PROTOTYPES**

**8 Hours**

Tasks in Prototyping – Understanding Different Prototypes - Developing different prototypes – Demonstration – Prototyping Tools. Case Study: Prototype the solution.

#### **Unit IV EVALUATING AND TESTING IDEAS**

**10 Hours**

Finding Ideas – Developing Ideas Intuitively and Creatively - Selecting Evaluation method – Evaluating Ideas with checklist –Testing Ideas and Assumptions – Tasks in the Test Phase – Testing with Interviews – Testing with Online Studies – Case Study: Evaluate the solution.

#### **Unit V APPLICATIONS**

**9 Hours**

Politics and Society – Business – Strategic technology Plan – Creativity – Visioning, Listening and Diagramming - HealthCare and Science – Approach to treat Cancer – Law – Problem Definition – Alternatives.



<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1: Apply the key concepts of design thinking	Apply
CO2: Relate design thinking in all stages of problem solving	Apply
CO3: Identify the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices	Analyze
CO4: Determine the significance of testing and evaluating the solution	Analyze
CO5: Apply design thinking skills to solve real time user experience problems	Apply
<b>Text Book(s):</b>	

1. Muller-Roterberg "Design thinking for dummies" John Wiley & Sons,2020.(Unit-I,III & IV)
2. Andrew Pressman "Design Thinking A Guide to Creative Problem Solving for Everyone", Routledge Publication, 2019.(Unit-II & V)

#### **Reference Book(s):**

1. Robert Curedale, "Design Thinking Process & Methods" Design Community College, 5th Edition, 2019.
2. Alyssa Gallagher and Kami Thordarson, "Design Thinking in Play: An Action Guide for Educators", ASCD Book, 2020
3. Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins,2009.

#### **Web References:**

1. <https://www.open.edu/openlearn/science-maths-technology/design-innovation/design-thinking/content-section-6>
2. <https://www.interaction-design.org/literature/topics/design-thinking>
3. <https://venturewell.org/class-exercises/>

#### **Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											3
CO2		2				3	3					
CO3				2						3		
CO4					3			3			3	
CO5			2						2			

High-3; Medium-2; Low-1

<b>Course Code: 19ITEN1029</b>		<b>Course Title: INTELLECTUAL PROPERTY RIGHTS</b>	
<b>Course Category: Professional Elective</b>		<b>Course Level : Introductory</b>	
<b>L: T: P(Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max. Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

1. Describe the basic concepts of Intellectual Property Law.
2. Explain the classification of Patents and its Rights and Limitations.
3. Explain the Patent Searching Process and Application Filling Process.
4. Describe the concepts and principles of Trademark.
5. Explain the principles of copyright and its sources.

#### **Unit I                      Intellectual Property: An Introduction                      9 Hours**

Intellectual Property Law: Patent Law-Copyright Law-Trademark Law- Trade secret Law-Right of Publicity-Paralegal tasks in Intellectual Property Law-Ethical obligations of the paralegal in Intellectual Property Law-Trade secrets: Protectible as a trade secret-Maintaining trade secrets-Protecting an Idea

#### **Unit II                      Patents: Rights and Limitations                      9 Hours**

Sources of patent law-Subject matter of Patents: Utility Patents-Plant Patents-Design Patents-Design Patents and copyright-Design Patents and trademarks-Computer Software, Business methods and Patent Protection-Rights under Patent Law-Patent Requirements-Limitations on Patent Rights-Patent Ownership

#### **Unit III                      Patents: Research, Applications, Disputes, and International Considerations                      9 Hours**

Patent Search Process-Patent Application Process-Patent Infringement-Patent Litigation, International Patent laws

**Unit IV Principles of Trademark****9 Hours**

Trademarks and Unfair Competition-Acquiring Trademark Rights-Types of Marks, Strong Marks Versus Weak Marks-Selecting and Evaluating a Trademark-International Trademark Laws

**Unit V Principles of Copyrights****9 Hours**

Sources of Copyright Law- The Eight Categories of Works of Authorship-Derivative Works and Compilations- Rights and Limitations :Grant of Exclusive Rights–Copyrights Ownership- International Copyright Laws

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Describe the basics of Intellectual Property Law	Apply
CO2: Identify the Rights and Limitations of various patents	Apply
CO3: Apply the process of patent search and application filling process	Apply
CO4: Explain the concept of trademark and its types	Apply
CO5: Classify the concepts of copyrights and its limitations	Apply

**Text Book(s):**

T1. Richard Stim, "Intellectual Property: Copyrights, Trademark and Patents", Cengage learning, 2nd edition 2012.

**Reference Book(s):**

R1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2013.

R2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2017.

**Web References:**

- <https://ipindia.gov.in/writereaddata/Portal/ev/sections-index.html>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2						2
CO2	2			2								
CO3		3	3								2	
CO4								2	2			
CO5					2		2					2

High-3; Medium-2; Low-1

## OPEN ELECTIVES

<b>Course Code: 19CEOC1001</b>		<b>Course Title: ENVIRONMENTAL IMPACT ASSESSMENT</b>	
<b>Course Category: Open Elective</b>		<b>Course Level: Mastery</b>	
<b>L: T: P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

### **Pre–requisites**

- Environmental Sciences

### **Course Objectives**

The course is intended to:

- Understand the basic concepts involved in the EIA process.
- Apprehend the methods of EIA adopted for various infrastructural projects.
- Know the impacts of infrastructure projects on the environment.
- Understand the steps involved in preparation of environmental management plans.
- Familiarize with environmental impact assessment of infrastructural projects.

### **Unit I – INTRODUCTION**

**9 Hours**

Impact of development projects under civil engineering on the environment– Environmental impact assessment (EIA) – Environmental impact statement (EIS) – EIA capability and limitations – EIA notifications – EIA consultants

### **UNIT II – METHODOLOGIES**

**9 Hours**

Methods of EIA – Strength, weakness and applicability of EIA – Appropriate methodology – Process screening, Baseline studies, Mitigations. Types – Checklists, Matrices, Networks, Cost benefit analysis

### **UNIT III – AIR QUALITY, NOISE, ENERGY, WATER QUALITY, VEGETATION AND WILDLIFE IMPACT**

**9 Hours**

Background – typical consideration and factors, Air quality impact of industries, transport systems, human settlements. Effects of noise on people, noise scales and rating methods. Energy impact considerations – Water quality criteria and standards – Impact on flora and fauna – Socio economic impact – Rapid EIA – Environmental audit

### **UNIT IV – ENVIRONMENTAL MANAGEMENT PLAN**

**9 Hours**

Plan for mitigation of adverse impact on the environment – options for mitigation of impact on water, air and land, flora and fauna – ISO 14001

**UNIT V – CASE STUDIES****9 Hours**

EIA for infrastructural projects – Highways and bridges – stadium – railways – dams – multi-storey buildings – water supply and drainage projects – power plants.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1. Describe the objectives, capability, and limitations of EIA.	Understand
CO 2. Elucidate the methods of EIA with case studies.	Understand
CO 3. Explain the impacts of infrastructure projects on air quality, water quality, vegetation and wildlife.	Understand
CO 4. Explain and prepare an environmental management plan for an infrastructural project.	Apply
CO 5. Explain and prepare environmental impact assessment report for various infrastructural projects.	Apply

**Textbook(s):**

- T1. Peter Morris and Riki Therivel, "Methods of Environmental Impact Assessment", Routledge Publishers, First edition, 1995.
- T2. Y. Anjanayulu, "Environmental impact assessment methodologies", B.S. Publications, Hyderabad, Third edition, 2020.
- T3. S.R. Khandeshwar, N.S. Raman, A.R. Gajbhiye, "Environmental impact assessment", Dreamtech Press, 2019.

**Reference Book(s):**

- R1. John G. Rau and David C Hooten (Ed)., "Environmental impact analysis handbook", McGraw–Hill book company, 1990.
- R2. "Environmental assessment source book", Vol. I, II and III. The world bank, Washington, D.C., 1991.
- R3. Judith Petts, "Handbook of environmental impact assessment Vol. I and II", Blackwell science, 1999.

**Web References:**

1. <http://nptel.ac.in/courses/120108004>
2. <http://environmentalclearance.nic.in/writereaddata/EIA%20Notifications>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	3	3	-	-	-	-	2	2	-
CO2	2	1	-	-	-	3	3	-	-	-	-	2	2	-
CO3	2	1	-	-	-	3	3	-	-	-	-	2	2	-
CO4	3	2	-	-	-	3	3	-	-	-	-	2	3	-
CO5	3	2	-	-	-	3	3	-	-	-	-	2	3	-

High–3; Medium–2; Low–1

<b>Course Code:19CEOC1002</b>		<b>Course Title: SAFETY ENGINEERING</b>	
<b>Course Category: Open Elective</b>		<b>Course Level: Mastery</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

➤ Nil

#### **Course Objectives**

The course is intended to:

- Study the concepts in safety, safety policy and its techniques.
- Study the concepts in Health and hygiene in the occupational environment.
- Learn about Fire explosion control techniques in various industries.
- Know the Safety standards in construction industry.
- Know the Safety materials to be used in the field of work.

#### **UNIT I – INTRODUCTION TO CONCEPTS**

**9 Hours**

Concept of safety – Evolution of modern safety concept– Safety policy – Safety Organization – line and staff – functions for safety – Safety Committee– budgeting for safety. Techniques–Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

#### **UNIT II – OCCUPATIONAL HEALTH AND HYGIENE**

**9 Hours**

Physical hazards – Noise, noise exposure regulation, occupational damage, risk factors, and permissible exposure limit. Ionizing radiation, types, effects, monitoring instruments, control programs, control measures. Chemical hazards – Recognition of chemical hazards–dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, Methods of Control. Concept and spectrum of health – pre-employment and post-employment medical examinations –occupational related diseases, prevention of diseases.

#### **UNIT III – FIRE ENGINEERING AND EXPLOSION CONTROL**

**9 Hours**

Fire chemistry – Dynamics of fire behavior – Fire properties of solid, liquid and gas – Fire spread – Toxicity of products of combustion. Building evaluation for fire safety – Fire load – Fire resistance materials and fire testing – Structural Fire protection – Exits and egress. Statutory Rules and Techniques of firefighting – Indian Explosive acts and rules – Techniques of firefighting and demonstration.

#### **UNIT IV – SAFETY IN CONSTRUCTION**

**9 Hours**

General safety consideration – Analyzing construction jobs for safety–Contract document Safety certificate for statutory authorities for old building and construction. Safety in Erection and closing operation – Construction materials – Specifications – suitability – Limitations. Safety in typical civil structures – Dams–bridges–water Tanks–Retaining walls – Critical factors for failure–Regular Inspection and monitoring.

**UNIT V – SAFETY IN MATERIAL HANDLING****9 Hours**

General safety consideration in material handling – Ropes, Chains, Sling, Hoops, Clamps, Arresting gears. Selection, operation and maintenance of Industrial Trucks – Mobile Cranes, Tower crane – Checklist – Competent persons.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Explain the concepts of safety, techniques and safety audit procedure for industrial applications.	Understand
CO.2 Illustrate the types and effects of physical, chemical hazards and methods to control the hazards towards occupational health and hygienic.	Understand
CO.3 Explain the concepts of fire safety and control measures to be followed in industries.	Understand
CO.4 Illustrate the safety procedure to be adopted during construction of various civil engineering structures.	Understand
CO.5 Explain the safety considerations to be followed during handling of safety materials and machineries.	Understand

**Textbook(s):**

- T 1. R. K. Jain , Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publisher, 2000
- T 2. D.S.S.Ganguly , C.S.Changeriya, Safety Engineering, Chetan Publication, 2016

**Reference Book(s):**

- R 1. Accident Prevention Manual for Industrial Operations: National Safety Council, Chicago
- R 2. Construction Industry Training Board (CITB); 2nd Revised edition, 2018
- R 3. Safety Management System and Documentation Training Programme Handbook– 2019

**Web References:**

1. <https://nptel.ac.in/courses/110/105/110105094/>

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO2	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO3	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	-	2
CO5	2	1	-	-	-	-	-	-	-	-	-	2	-	2

High–3; Medium–2;Low–1

<b>Course Code: 19CEOC1003</b>		<b>Course Title: GEOGRAPHICAL INFORMATION SYSTEM</b>	
<b>Course Category: Open Elective</b>		<b>Course Level: Mastery</b>	
<b>L:T:P (Hours/Week)</b> <b>3: 0: 0</b>	<b>Credits:3</b>	<b>Total Contact Hours:45</b>	<b>Max Marks:100</b>

#### **Pre-requisites**

- Nil

#### **Course Objectives**

The course is intended to:

- Learn the basic concepts and principles of Remote Sensing.
- Know about the sensors in India and other countries with their characteristics.
- Understand the various types of image processing used for different data products.
- Learn the components of GIS and its practical applications in civil engineering.
- Understand the raster and vector data analysis and application of GIS.

#### **UNIT I – FUNDAMENTALS OF GIS**

**9 Hours**

Introduction to GIS – Basic spatial concepts – Coordinate Systems – GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open–source Software – Types of data – Spatial, Attribute data types of attributes – scales/ levels of measurements.

#### **UNIT II – SPATIAL DATA MODELS**

**9 Hours**

Database Structures – Relational, Object Oriented – Entities – Entity Relationship (ER) diagram – data models conceptual, logical and physical models – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models– TIN and GRID data models.

#### **UNIT III – DATA INPUT AND TOPOLOGY**

**9 Hours**

Scanner – Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitiser–Datum Projection and reprojection –Coordinate Transformation – Topology – Adjacency, connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data linking –Linking External Databases – ODBC – GPS (Global Positioning System) – GPS based mapping – GPS Data Integration

#### **UNIT IV – DATA ANALYSIS**

**9 Hours**

Vector Data Analysis tools – Raster Data Analysis tools – Network Analysis – Digital Education models – 3D data collection and utilisation.

#### **UNIT V – APPLICATIONS**

**9 Hours**

GIS Applicant – Natural Resource Management – Engineering – Navigation – Vehicle tracking and fleet management – Marketing and Business applications – Case studies

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO.1 Describe the basic concepts and principles of Remote Sensing.	Understand



CO.2 Classify the sensors in India and other countries with their characteristics.	Understand
CO.3 Explain various types of image processing used for different data products.	Understand
CO.4 Describe the components of GIS and its practical applications in civil engineering.	Understand
CO.5 Distinguish raster and vector data analysis and application of GIS.	Understand

**Textbook(s):**

- T 1. Kang–Tsung Chang, Introduction to Geographic Information Systems with Data Set CD– ROM, 9<sup>th</sup> Edition, Mc Graw Hill, 2018
- T 2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, 4<sup>th</sup> Edition, Pearson Education, 2012

**Reference Book(s):**

- R.1 C.P. Lo, Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, 2<sup>nd</sup> Edition, Prentice Hall, 2017
- R.2 Paul Bolstad, GIS Fundamentals: A First Text on Geographic Information Systems, NEW and UPDATED 6<sup>th</sup> Edition, 2019

**Web References:**

- <https://www.gislounge.com/open-source-gis-applications/>
- <https://www.arcweb.com/blog/geographic-information-systems-gis-defined>
- <http://www.fresnostate.edu/csm/ees/documents/facstaff/wang/gis200/lecture-notes/gis/chap11.pdf>
- [https://geogra.uah.es/patxi/gisweb/GISModule/GIST\\_Vector.htm](https://geogra.uah.es/patxi/gisweb/GISModule/GIST_Vector.htm)

**Course Articulation Matrix**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO3	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	-
CO5	2	1	-	-	-	-	-	-	-	-	-	2	2	-

High–3; Medium–2; Low–1

<b>Course Code: 19CEOC1004</b>		<b>Course Title: APPLIED DESIGN THINKING CONCEPTS</b>	
<b>Course Category: Open Elective</b>		<b>Course Level: Mastery</b>	
<b>L:T:P(Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours: 45</b>	<b>Max Marks:100</b>

### **Pre-requisites**

➤ Nil

### **Course Objective**

The course is intended to:

- Apply a scientific method to define & test various hypotheses to mitigate the inherent risks in product innovations.
- Design the solution concept based on the proposed value defined for the target customer exploring various alternate solutions to achieve value-price fit.
- Develop Skills in empathizing, Critical thinking, analyzing, storytelling & Pitching.
- Apply system thinking to reverse engineer a product/prototype and understand its internal components and their correlations.

### **UNIT I – DESIGN THINKING PRINCIPLES**

**9 Hours**

Exploring Human centered Design – Understanding the Innovation process, Discovering areas of opportunity, Interviewing & empathy building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] – Case studies

### **UNIT II – CUSTOMER-CENTRIC INNOVATION**

**9 Hours**

Importance of customer centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process – Customer interviews and field visits

### **UNIT III - APPLIED DESIGN THINKING TOOLS**

**9 Hours**

Concept of Minimum Usable Prototype [MUP] – MUP challenge brief – Designing & Crafting the value proposition – Deriving the Solution concept [MUP] iteratively-Activity: Ideate, Proto type and Test.

**UNIT IV – SYSTEM THINKING & REVERSE ENGINEERING****9 Hours**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components - Re-Engineering a complex system.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1: Enlighten Scientific Methods in product innovation	Apply
CO2: Expertise on the target customer exploring various alternate solutions to achieve value-price fit.	Apply
CO3: Inculcate variety of applied design thinking tools	Apply
CO4: Describe various skills in system thinking	Apply

**Web References:**

1. <https://www.ideo.com/pages/design-thinking#process>.
2. <https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253ca8624>.
3. <https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356>.
4. <https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e>.
5. <https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd>.
6. <https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85>.

**Course Articulation Matrix:**

<b>CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>
<b>CO1</b>	2	1	-	2	2	-	-	2	1	2	-	1
<b>CO2</b>	2	1	-	2	2	-	-	2	1	2	-	1
<b>CO3</b>	2	1	-	2	2	-	-	2	1	2	-	1
<b>CO4</b>	2	1	-	2	2	-	-	2	1	2	-	1

High-3; Medium-2; Low-1

<b>Course Code: 19CEOC1005</b>		<b>Course Title: STARTUP FUNDAMENTALS FOR ENGINEERS</b>	
<b>Course Category: Open Elective</b>		<b>Course Level: Mastery</b>	
<b>L:T:P(Hours/Week)</b> <b>3:0:0</b>	<b>Credits:3</b>	<b>Total Contact Hours: 45</b>	<b>Max Marks:100</b>

### **Prerequisites**

➤ Nil

### **Course Objectives**

The course is intended to:

- Develop an entrepreneurial mind-set that will help them identify, assess, shape & act on opportunities in a variety of contexts & organization.
- Demonstrate the potential of an innovative idea to create economic value, as a startup.
- Understand the scientific process to explore a viable business model to build a scale business.
- Acquire knowledge on the fundamental concepts of Intellectual Property to Draft the Patent for a product.

### **UNIT I – ENTREPRENEURIAL MINDSET & METHOD**

**9 Hours**

Introduction to Innovation-led, tech-powered entrepreneurship – Understand from research the attributes of an expert entrepreneur- Effectuation principles – Dealing with the unknowns – Case studies of startup failures.

### **UNIT II – IDEA TO ENTERPRISE**

**9 Hours**

Design and Planning of Product Concept – Business Model – Business Planning – Building Proof of Product and Value Testing – Target Market and Revenue Planning.

### **UNIT III – MINIMUM VIABLE BUSINESS**

**9 Hours**

Framework for Minimum Viable Business – Disruptive Innovation – Theory of Disruption – Competitive advantage – Building proof of viable business model –Demystifying Scalability – Pitch Clinic.

**UNIT IV – IPR AND PATENT DRAFTING****9 Hours**

Intellectual Property 101- Introduction and the need for Intellectual Property Rights, Prior Art Search & Case studies of IPR. Fundamentals of Patent Drafting - Invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications – Drafting complete specifications – Draft claims – Case studies on patent drafting.

<b>Course Outcomes</b>	<b>Cognitive Level</b>
At the end of this course, students will be able to:	
CO1: Explain the diverse in Scientific entrepreneurial mindset & method	Apply
CO2: Expertise on the potential of an innovative idea	Apply
CO3: Illustrate the Scientific process in business models	Apply
CO4: Exemplify fundamental concepts of Intellectual Property	Apply

**Reference Book(s):**

- R1. Steven Blank and Bob Dorf, (2012), The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, K&S Ranch.
- R2. Dr. Saras Sarasvathy, (2008), Effectuation: Elements of Entrepreneurial Expertise, New Horizons in Entrepreneurship series.

**Web References:**

1. [https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo\\_pub\\_489.pdf](https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

**Course Articulation Matrix:**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	2	2	-	-	2	1	2	-	1
CO2	2	1	-	2	2	-	-	2	1	2	-	1
CO3	2	1	-	2	2	-	-	2	1	2	-	1
CO4	2	1	-	2	2	-	-	2	1	2	-	1

High-3; Medium-2; Low-1