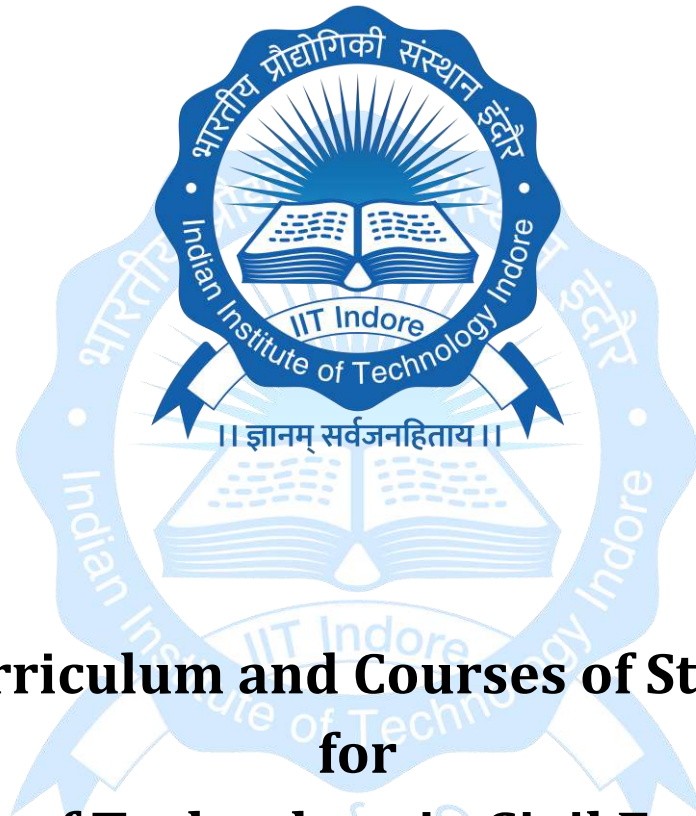


# Indian Institute of Technology Indore



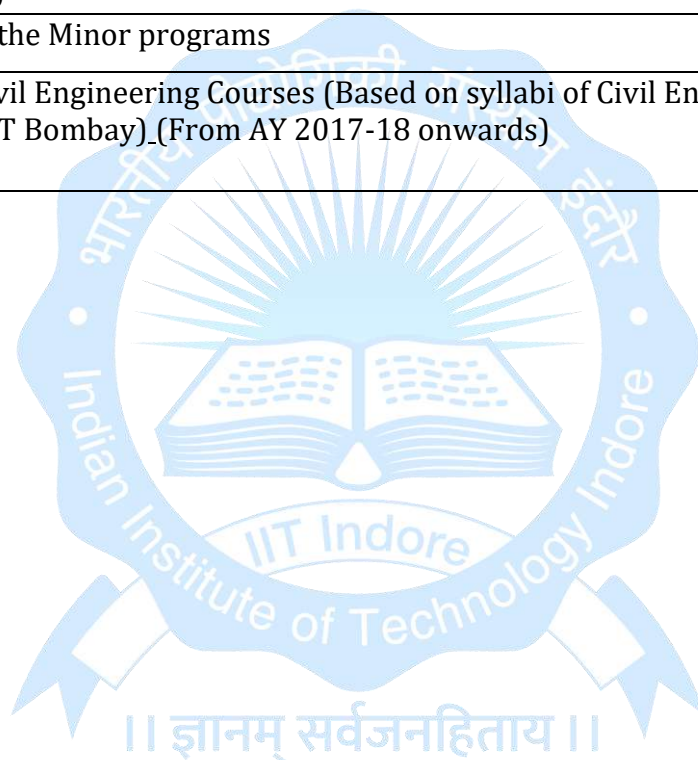
## Curriculum and Courses of Study for Bachelor of Technology in Civil Engineering Department

November 2025

[After incorporating decisions of the 58<sup>th</sup> meeting of the Senate held on November  
26, 2025]

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## Curriculum of 1<sup>st</sup> Year BTech (For AY 2009-10)

### Semester I

Course Code	Course Title	Weekly Contact	Credits
		Hours (L-T-P)	
CH 101	Chemistry	2-1-0	6
CS 101	Computer Programming & Utilization	2-0-2	6
MA 101	Calculus	3-1-0	8
PH 101	Physics –I	2-1-0	6
CH 151	Chemistry Lab	0-0-3	3
ME 151	Engineering Graphics & Drawing	0-1-3	5
NC 101#	National Cadet Crops (NCC)	0-0-0	P/NP
NO 101#	National Sports Organization (NSS)	0-0-0	P/NP
NS 101#	National Service Scheme (NSS)	0-0-0	P/NP
<b>Total</b>		<b>9-4-7</b>	<b>34</b>

### Semester II

Course Code	Course Title	Weekly	Credits
		Contact Hours (L-T-P)	
PH 102	Physics – II	2-1-0	6
HS101/ HS 103/ HS 105	Introduction to Philosophy/ Economics/ Reading Literature	3-0-0	6
CS 102	Abstractions and Paradigms for Programming*	3-0-2	8
EE 102	Intro. to Elect. And Electronics Circuit*	2-1-0	6
ME 102	Engineering Mechanics*	2-1-0	6
MA 102	Linear Algebra and Ordinary Differential Equation – I	3-1-0	8
ME 152	Workshop Practice	0-1-3	5
PH 112	Physics Lab	0-0-3	3
NC 102#	National Cadet Crops (NCC)	0-0-0	P/NP

NO 102#	National Sports Organisation (NSS)	0-0-0	P/NP
NS 102#	National Service Scheme (NSS)	0-0-0	P/NP
<b>Total</b>		<b>11/10-3/4- 8/6</b>	<b>36/34</b>

# Any one of these courses to be taken

\* Department Introductory course, specific to the students of concerned Departments



### Curriculum of 1<sup>st</sup> year BTech (common to all the Departments)

#### Semester I

Curriculum of 1 <sup>st</sup> Year B. Tech. Program (From AY 2010-11 to AY 2013-14)				Curriculum of 1 <sup>st</sup> Year B. Tech. Program (From AY 2014-15 to AY 2018-19)				
Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits	Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits	
CH 103	Chemistry	3-1-0	4	CH 103	Chemistry	3-1-0	4	
MA 103	Mathematics-I (Calculus)	3-1-0	4	MA 105	Calculus	3-1-0	4	
PH 103	Physics-I (Modern Physics)	2-1-0	3	PH 105	Physics-I	2-1-0	3	
HS 107	English Language and Literature	2-0-0	2	HS 159	English Language and Communication	0-3-0	3	
CS 103	Computer Programming	2-0-0	2	CS 103	Computer Programming	2-0-0	2	
CH 153	Chemistry Lab	0-0-3	1.5	CH 153	Chemistry Lab	0-0-3	1.5	
HS 157	English Language Lab	0-0-2	1					
CS 153	Computer Programming Lab	0-0-3	1.5	CS 153 <i>(upto AY 2017-18)</i>	Computer Programming Lab	0-0-3	1.5	
				IC 151 <i>(from AY 2018-19 onwards)</i>				
ME 153	Engineering Graphics	1-0-3	2.5	IC 153	Engineering Graphics	1-0-3	2.5	
NC 101/ NO 101/ NS 101	National Cadet Corps (NCC) National Sports Organization (NSO) National Service Scheme (NSS)	0-0-0 0-0-0 0-0-0	P/NP P/NP P/NP	NC 101/ NO 101/ NS 101	National Cadet Corps (NCC) National Sports Organization (NSO) National Service Scheme (NSS)	0-0-0 0-0-0 0-0-0	P/NP P/NP P/NP	
<b>Total</b>			<b>13-3-11</b>	<b>21.5</b>	<b>Total</b>			<b>11-6-9</b> <b>21.5</b>

## Semester II

Curriculum of 1 <sup>st</sup> Year B. Tech. Program (From AY 2010-11 to AY 2013-14)				Curriculum of 1 <sup>st</sup> Year B. Tech. Program (From AY 2014-15 to AY 2018-19)			
Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits	Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
MA 104	Mathematics-II(Linear Algebra and Ordinary Differential Equations-I)	3-1-0	4	MA 106	Linear Algebra and Ordinary Differential Equations-I	3-1-0	4
PH 104	Physics-II (Electricity and Magnetism)	2-1-0	3	PH 106	Physics-II	2-1-0	3
HS 108	Fundamentals of Economics	3-0-0	3	BSE 102	Bio-Sciences	2-1-0	3
EE 104	Basic Electrical and Electronics Engineering	2-1-0	3	HS 108	Fundamentals of Economics	3-0-0	3
ME 104	Basic Mechanical Engineering	3-0-0	3	EE 104	Basic Electrical and Electronics Engineering	2-1-0	3
PH 154	Physics Lab	0-0-3	1.5	ME 106	Basic Mechanical Engineering	2-1-0	3
EE 154	Basic Electrical and Electronics Engineering Lab	0-0-2	1	PH 156	Physics Lab	0-0-3	1.5
ME 154	Basic Manufacturing Techniques	2-0-2	3	EE 154	Basic Electrical and Electronics Engineering Lab	0-0-2	1
NC 102/ NO 102/ NS 102	National Cadet Corps (NCC) National Sports Organization (NSO) National Service Scheme (NSS)	0-0-0 0-0-0 0-0-0	P/NP P/NP P/NP	IC 156	Basic Manufacturing Techniques	0-0-3	1.5
				NC 102 / NO 102 / NS 102	National Cadet Corps (NCC) National Sports Organization (NSO) National Service Scheme (NSS)	0-0-0 0-0-0 0-0-0	P/NP P/NP P/NP
<b>Total</b>		<b>15-3-7</b>	<b>21.5</b>	<b>Total</b>		<b>15-4-8</b>	<b>23</b>

**Sections and Course structure of 1<sup>st</sup> year BTech (from AY 2019-20 to AY 2022-23)**

<b>Section-A (CSE + CE + MEMS)</b>				<b>Section-B (EE + ME)</b>			
<b>Classroom No. 1B-201, Titanium POD</b>				<b>Classroom No. 1D-105, Chromium POD</b>			
<b>1<sup>st</sup> (i.e. Autumn) Semester</b>							
<b>Course Code</b>	<b>Course Title</b>	<b>Teaching Hours (L-T-P)</b>	<b>Credits</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Teaching Hours (L-T-P)</b>	<b>Credits</b>
CH 103	Chemistry	3-1-0	4	BSE 102	Bio-Sciences	2-1-0	3
MA 105	Calculus	3-1-0	4	MA 105	Calculus	3-1-0	4
PH 105	Physics-I	2-1-0	3	PH 106	Physics-II	2-1-0	3
CS 103	Computer Programming	2-0-0	2	EE 104	Basic Electrical and Electronics Engineering	2-1-0	3
				ME 106	Basic Mechanical Engineering	2-1-0	3
HS 159	English Language and Communication	0-3-0	3	HS 108	Fundamentals of Economics	3-0-0	3
CH 153	Chemistry Lab	0-0-3	1.5	PH 156	Physics Lab	0-0-3	1.5
IC 151	Computer Programming Lab	0-0-3	1.5	EE 154	Basic Electrical and Electronics Engineering Lab	0-0-2	1
IC 153	Engineering Graphics	1-0-3	2.5	IC 156	Basic Manufacturing Techniques	0-0-3	1.5
NO 101	National Sports Organization (NSO)	0-0-0	P/N P	NO 101	National Sports Organization (NSO)	0-0-0	P/NP
<b>Total</b>		<b>11-6-9</b>	<b>21.5</b>	<b>Total</b>		<b>14-5-8</b>	<b>23</b>
<b>2<sup>nd</sup> (i.e. Spring) Semester</b>							
BSE 102	Bio-Sciences	2-1-0	3	CH 103	Chemistry	3-1-0	4
MA 106	Linear Algebra and Ordinary Differential Equations-I	3-1-0	4	MA 106	Linear Algebra and Ordinary Differential Equations-I	3-1-0	4
PH 106	Physics-II	2-1-0	3	PH 105	Physics-I	2-1-0	3
EE 104	Basic Electrical and Electronics Engineering	2-1-0	3	CS 103	Computer Programming	2-0-0	2

ME 106	Basic Mechanical Engineering	2-1-0	3				
HS 108	Fundamentals of Economics	3-0-0	3	HS 159	English Language and Communication	0-3-0	3
EE 154	Basic Electrical and Electronics Engineering Lab	0-0-2	1	IC 151	Computer Programming Lab	0-0-3	1.5
PH 156	Physics Lab	0-0-3	1.5	CH 153	Chemistry Lab	0-0-3	1.5
IC 156	Basic Manufacturing Techniques	0-0-3	1.5	IC 153	Engineering Graphics	1-0-3	2.5
NO 102	National Sports Organization (NSO)		P/N P	NO 102	National Sports Organization (NSO)		P/NP
<b>Total</b>		<b>14-5-8</b>	<b>23</b>	<b>Total</b>		<b>11-6-9</b>	<b>21.5</b>



**Sections and Course structure of 1<sup>st</sup> year BTech (from AY 2023-24 onwards)**

Section-A (CSE+CE+MEMS+ChE+EP)				Section-B (EE+ME+MC+SSE)			
Semester-I	Autumn Semester			Semester-I	Autumn Semester		
Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits	Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
EE 101	Basic Electrical Engineering	1-1-0	2	EE 101	Basic Electrical Engineering	1-1-0	2
ME 101	Engineering Mechanics	2-0-0	2	ME 101	Engineering Mechanics	2-0-0	2
PH 107	Basics of Physics	2-1-0	3	CH 105	Chemistry	3-0-0	3
PH 157	Physics Lab- I	0-0-2	1	CH 155	Chemistry Lab	0-0-2	1
MA 101N	Calculus-I (half Semester)	3-1-0 (=4/2)	2	MA 101N	Calculus-I (half Semester)	3-1-0 (=4/2)	2
MA 103N	Calculus-II (half Semester)	3-1-0 (=4/2)	2	MA 103N	Calculus-II (half Semester)	3-1-0 (=4/2)	2
HS 109	Language and Composition	2-0-0	2	HS 109	Language and Composition	2-0-0	2
HS XXX	Flexible Elective (HSS)	1-0-0	1	HS XXX	Flexible Elective (HSS)	1-0-0	1
IC 152	Makerspace	1-0-6	4	CS 103	Computer Programming	2-0-0	2
CS 103	Computer Programming	2-0-0	2	IC 151	Computer Programming Lab	0-0-3	1.5
IC 151	Computer Programming Lab	0-0-3	1.5	NO 101	National Sports Organization (NSO)	0-0-0	P/NP
NO 101	National Sports Organization (NSO)	0-0-0	P/NP				
<b>Total</b>		<b>14-3-11</b>	<b>22.5</b>	<b>Total</b>		<b>14-2-5</b>	<b>18.5</b>

Semester-II	Spring Semester		
Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
BSE 102	Biosciences	2-1-0	3
MA 102N	Linear Algebra (half Semester)	2-1-0 (=3/2)	1.5
MA 104N	Differential Equations-I (half Semester)	2-1-0 (=3/2)	1.5
ES 102	Environmental Studies: Scientific and Engineering Aspects (half Semester)	2-1-0 (=3/2)	1.5
HS 102	Environmental Studies: Social Aspects (half Semester)	2-1-0 (=3/2)	1.5
HS 104	Fundamentals of Economics	2-0-0	2
CH 105	Chemistry	3-0-0	3
CH 155	Chemistry Lab	0-0-2	1
ZZ XXX	Flexible Elective	1-0-0	1
ZZ XXX	Flexible Elective	1-0-0	1
ZZ XXX	Flexible Elective (HSS)	1-0-0	1
NO 102	National Sports Organization (NSO)	0-0-0	P/NP

Semester-II	Spring Semester		
Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
BSE 102	Biosciences	2-1-0	3
MA 102N	Linear Algebra (half Semester)	2-1-0 (=3/2)	1.5
MA 104N	Differential Equations-I (half Semester)	2-1-0 (=3/2)	1.5
ES 102	Environmental Studies: Scientific and Engineering Aspects (half Semester)	2-1-0 (=3/2)	1.5
HS 102	Environmental Studies: Social Aspects (half Semester)	2-1-0 (=3/2)	1.5
HS 104	Fundamentals of Economics	2-0-0	2
IC 152	Makerspace	1-0-6	4
PH 107	Basics of Physics	2-1-0	3
PH 157	Physics Lab- I	0-0-2	1
ZZ XXX	Flexible Elective	1-0-0	1
ZZ XXX	Flexible Elective	1-0-0	1
ZZ XXX	Flexible Elective (HSS)	1-0-0	1



## Curriculum for BTech (Civil Engineering)

### 2<sup>nd</sup> Year B. Tech. (Civil Engineering)

from AY 2016-17 to AY 2023-24

#### Semester III

Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
ZZ XXX	Course-I for Minor Program	X-X-X	3
MA 203	Complex Analysis and Differential Equations-II	3-1-0	4
CE 201	Solid Mechanics	3-1-0	4
CE 203	Fluid Mechanics-I	2-1-0	3
CE 251	Solid Mechanics Lab	0-0-3	1.5
CE 253	Fluid Mechanics Lab-I	0-0-2	1.0
CE 257	Civil Engineering Drawing	1-0-3	2.5
IC 211	Experimental Engineering Lab	0-0-3	1.5
<b>Total</b>		<b>9-3-11= 23</b>	<b>17.5/20.</b> <b>5</b>

#### Curriculum of 2<sup>nd</sup> Year B. Tech. (CE)

[From AY 2024-25 onwards] (Batch admitted in and after AY 2023-24)

Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
ZZ 2xx	Course-I for Minor Program	X-X-X	3
MA 205	Complex Analysis	3-1-0 (1/2 semester)	2
MA 207	Differential Equations-II	3-1-0 (1/2 semester)	2
CE 205	Strength of Materials	2-1-0	3
CE 203N	Fluid Mechanics	2-1-0	3
CE 253N	Fluid Mechanics Lab	0-0-3	1.5
CE 207	Building Materials	2-0-2	3
CE 209	Surveying	2-1-0	3
CE 255	Strength of Materials Lab	0-0-2	1
CE 259	Surveying Lab	0-0-2	1
CE 2XX	Department Elective I	x-x-x	3
<b>Total</b>			<b>22.5/25.5</b>

**Semester IV**

Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
ZZ XXX	Course-II for Minor Program	X-X-X	3
MA 204	Numerical Methods	3-0-2	4
CE 202	Structural Mechanics-I	2-1-0	3
CE 204	Fluid Mechanics-II	2-1-0	3
CE 206	Geodesy-I	2-1-0	3
CE 208	Water and Waste Water Engineering	2-1-0	3
CE 254	Fluid Mechanics Lab-II	0-0-2	1.0
CE 256	Geodesy Laboratory-I	0-0-3	1.5
<b>Total</b>		<b>11-5-5 = 21</b>	<b>18.5 / 21.5</b>

**Curriculum of 2<sup>nd</sup> Year B. Tech. (CE)**

[From AY 2024-25 onwards ] (Batch admitted in and after AY 2023-24)

Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
ZZ 2XX	Course-II for Minor Program	X-X-X	3
MA 204N	Numerical Methods	2-0-2	3
CE 210	Structural Analysis-I	2- 1- 0	3
CE 212	Soil Mechanics-I	2- 1- 0	3
CE 214	Engineering Geology	2- 0- 2	3
CE 252	Soil Mechanics Lab I	0- 0- 2	1
CE 218	Environmental Engineering	2- 1- 0	3
CE 258	Environmental Engineering Lab	0- 0- 2	1
CE 2XX	Department Elective II	x-x-x	3
ZZ 2XX	Institute Elective I	x-x-x	3
<b>Total</b>			<b>23 /26</b>

**3<sup>rd</sup> Year B. Tech. (Civil Engineering)  
from AY 2016-17 to AY 2024-25**

**Semester V**

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
ZZ XXX	Course-III for Minor Program	X-X-X	3
CE 301	Hydrology	2-1-0	3
CE 303	Soil Mechanics-I	2-1-0	3
CE 305	Structural Mechanics-II	2-1-0	3
CE 307	Design of Structures-I	2-1-0	3
CE 309	Engineering Geology	2-1-0	3
CE 353	Soil Mechanics Laboratory-I	0-0-2	1.0
CE 357	Design Laboratory-I	0-0-3	1.5
CE 359	Engineering Geology Laboratory	0-0-3	1.5
CE 361	Design of Open Channel Flow	1-0-2	2
<b>Total</b>		<b>11-4-11 = 26</b>	<b>21/24</b>

**Semester VI**

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
HS 302	Environmental Studies: Social Aspects (Half Semester course)	3-0-0	1.5
ES 302	Environmental Studies: Scientific and Engineering Aspects (Half Semester course)	3-0-0	1.5
CE 302	Geodesy-II	2-1-0	3
CE 304	Soil Mechanics-II	2-1-0	3
CE 306	Structural Mechanics-III	2-1-0	3
CE 308	Design of Structure-II	2-1-0	3
CE 310	Transportation Engineering-I	3-0-2	4
CE 352	Geodesy Lab-II	0-0-3	1.5
CE 354	Soil Mechanics Laboratory-II	0-0-2	1.0
CE 358	Design Laboratory II	0-0-3	1.5
<b>Total</b>		<b>15-3-10 = 28</b>	<b>23</b>

**3<sup>rd</sup> Year B. Tech. (Civil Engineering)  
from AY 2025-26 onwards  
(Batch admitted in and after AY 2023-24)**

**Semester V**

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
ZZ XXX	Course-III for Minor Program	X-X-X	3
CE 311	Structural Analysis-II	2- 1- 0	3
CE 321	Soil Mechanics-II	2- 1- 0	3
CE 313	Transportation Engineering	2- 1- 0	3
CE 315	Design of Reinforced Concrete Structures	2- 1- 0	3
CE 365	Structural Analysis Lab	0- 0- 2	1
CE 354	Soil Mechanics Lab-II	0- 0- 2	1
CE 363	Transportation Engineering Lab	0- 0- 2	1
CE 3XX	<b>Department Elective (DE-III)</b>	2- 1- 0	3
ZZ XXX	<b>Institute Elective-II</b>	2- 1- 0	3
<b>Total</b>			<b>21/24</b>

**Semester VI**

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
ZZ XXX	Course-IV for Minor Program	X-X-X	3
CE 312	Design of steel structures	2- 1- 0	3
CE 320	Engineering Hydrology	2- 1- 0	3
CE 356	Computer Aided Design and Drawing Lab	0- 1- 2	2
CE 314	Introduction to Finite Element Methods	2- 1- 0	3
CE 3XX	<b>Department Elective (DE-IV)</b>	2- 1- 0	3
CE 3XX	<b>Department Elective (DE-V)</b>	2- 1- 0	3
ZZ XXX	<b>Institute Elective-III</b>	2- 1- 0	3
<b>Total</b>			<b>20/23</b>

### Semester V-Elective Courses

Semester	Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
V (DE-III)	CE 317	Water and Wastewater Engineering	2-1-0	3
	CE 319	Open Channel Hydraulics	2-0-2	3

### Semester VI-Elective Courses

Semester	Course Code	Course Title	Weekly Contact Hours (L-T-P)	Credits
VI (DE IV & V)	CE 316	Statistical Hydroclimatology	2-1-0	3
	CE 318	Computational Hydraulics	2-1-0	3



### 4<sup>th</sup> Year B. Tech. (Civil Engineering)

#### Semester VII

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
CE 493	<b>B Tech Project (BTP)</b> 1. Student can do B Tech project either outside the institute or within the institute under a supervision of an IIT Indore Faculty. 2. Summer Internship, if any, will be part of B Tech Project. 3. The choice is to be made latest by 30 <sup>th</sup> April. 4. Duration: 6-7 months during 2 <sup>nd</sup> week of May to Last week of Nov. 5. Last Date of Thesis submission: 1 <sup>st</sup> week of Dec. 6. Last Date of Submission of Grades: 2 <sup>nd</sup> week of Dec.	0-0-40	20
<b>Total</b>		0-0-40	<b>20</b>

#### Semester VIII (from AY 2016-17 to AY 2019-20)

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
CE 402/ CE 602	Water Resources Engineering	2-1-0	3
CE 404	Design of Structures-III	2-1-0	3
CE 406	Transportation Engineering-II	2-1-0	3
CE 408	Foundation Engineering	2-0-2	3
ZZ xxx	Open Elective-I	x-x-x	3
ZZ xxx	Open Elective-II (or Course-IV for Minor Program)	x-x-x	3
ZZ xxx	Open Elective-III (or Course-V for Minor Program)	x-x-x	3
<b>Total</b>			<b>21</b>

#### Semester VIII (from AY 2020-21 onwards)

Course Code	Subject Name	Weekly Contact Hours (L-T-P)	Credits
CE 402/ CE 602	Water Resources Engineering	2-1-0	3
CE 404	Design of Structures-III	2-1-0	3

CE 406	Transportation Engineering-II	2-1-0	3
CE 408	Foundation Engineering	2-0-2	3
CE xxx	Department Elective-I	x-x-x	3
ZZ xxx	Open Elective-I (or Course-IV for Minor Program)	x-x-x	3
ZZ xxx	Open Elective-II (or Course-V for Minor Program)	x-x-x	3
<b>Total</b>			<b>21</b>

**4<sup>th</sup> Year B. Tech. (Civil Engineering)  
from AY 2026-27 onwards  
(Batch admitted in and after AY 2023-24)  
{Senate Resolution 58.5}**

**Semester VII**

Course Code	Course title	Weekly Contact hours (L-T-P)	Credits
ZZ 4XX	Course-V for Minor project/field study/white paper/domain comprehension (Seminar)/Lab course	X-X-X	2
CE 493N	B.Tech. project (BTP)	0-0-32	16
CE 495	Internship	X-X-X	1.5
ZZ XXX	OR Professional/ Societal-Connect basket course		
<b>TOTAL</b>			<b>17.5/ 19.5</b>

**Semester VIII**

Course Code	Course title	Weekly Contact hours (L-T-P)	Credits
CE 4XX	Department Elective (DE-6)	X-X-X	3
CE 4XX	Department Elective (DE-7)	X-X-X	3
ZZ 4XX	Institute Open Elective	X-X-X	3
ZZ 4XX	Institute Open Elective	X-X-X	3
ZZ 4XX	Institute Open Elective	X-X-X	3
<b>TOTAL</b>			<b>15</b>

**CE Courses available for the Open Elective Courses of BTech in CE (From AY 2024-25 onwards)**

- CE 102 Computations in Civil Engineering
- CE 211 Smart Cities (2-1-0-3)
- CE 213 Optimization Methods in Civil Engineering (2-1-0-3)
- CE 220 Water Resources Planning and Management (2-1-0-3)
- CE 222 Estimation and Costing (2-1-0-3)
- CE 322 Railway Engineering (2-1-0-3)
- CE 324 Sustainable Geotechnics (2-1-0-1.5)
- CE 326 : Intelligent Transportation Systems (3-0-0-3)
- CE 401/ CE 601 Mechanics of Advanced Composite Materials and Structures (2-1-0-3)
- CE 410/ CE 610 Offshore Engineering (2-1-0-3)
- CE 412/ CE 612 Sustainable Construction (2-1-0-3)
- CE 414/ CE 614 Design of Short and Medium Span Bridges (2-1-0-3)
- CE 418/ CE 618 Disaster Management (2-1-0-3)
- CE 422 Hydraulic Structures (2-1-0-3)
- CE 424 Ground Water Hydrology (2-1-0-3)
- CE 426 Water Resources Systems (2-1-0-3)
- CE 428/ CE 628 Theory of Plates and Shells (2-1-0-3)
- CE 430/ CE 630 Elastic Stability (2-1-0-3)
- CE 432/ CE 632 Plastic Analysis and Design (2-1-0-3)
- CE 434/ 634 Numerical Methods in Civil Engineering (2-1-0-3)
- CE 436 Finite Element Analysis (2-1-0-3)
- CE 438 Probabilistic and Statistical Methods in Civil Engineering (2-1-0-3)
- CE 442 Machine Foundations (2-1-0-3)
- CE 444/ CE 644 Solid Waste Engineering and Management (2-0-2-3)
- CE 448 Pre-stressed Concrete (2-1-0-3)
- CE 462/ CE 662 Structural Dynamics (2-1-0-3)
- CE 464/ CE 664 Advanced Solid Mechanics (2-1-0-3)
- CE 470 Transportation Planning (2-1-0-3)
- CE 472 Advanced Traffic Engineering (2-1-0-3)
- CE 474/ CE 674 Road Safety (2-1-0-3)
- CE 476 Geo-Informatics in Transportation Engineering (2-1-0-3)
- CE 478 Advanced Pavement Material and Design (2-1-0-3)

CE 480 Computer Aided Design of Civil Engineering System (2-1-0-3)

CE 482 Construction Management (2-1-0-3)

CE 484/ CE 684 Advanced Concrete Technology (2-0-2-3)

CE 486 Rock Mechanics and Tunneling Technology (2-1-0-3)

CE 488 Environmental Geotechnics (2-1-0-3)

CE 490 Elements of Remote Sensing (2-1-0-3)

CE 494/ CE 694 Earthquake Engineering (2-1-0-3)

CE 496/ CE 696 Safety of Dams and Reservoirs (2-1-0-3)

CE 4XX/ CE XX Pre-stressed Concrete Design (2-1-0-3)



### Structure of the Minor programs [from AY 2014-15 to AY 2020-21]

A student has to register and pass at least FIVE courses (three core courses and two elective courses) as prescribed for a minor program in order to get a minor degree in that specialization along with the regular BTech degree in his/her engineering Department. A minor program will run only when at least TEN students register for it. Following minor programs are available from AY 2014-15 onwards.

**1. Minor program in Biosciences and Biomedical Engineering (BSBE):** To get a minor degree in BSBE, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course* BSE 101 Bio-Sciences for successful minor degree in BSBE.

**2. MINOR PROGRAM IN CHEMISTRY:** To get a minor degree in Chemistry, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course CH 103*. Following are courses for successful minor degree in Chemistry.

**3. Minor Program in HSS:** A student needs to register and pass **at least FIVE prescribed courses of Humanities and Social Sciences** *excluding the core courses* HS 159 and HS 108 for successful minor degree in Humanities or Social Sciences.

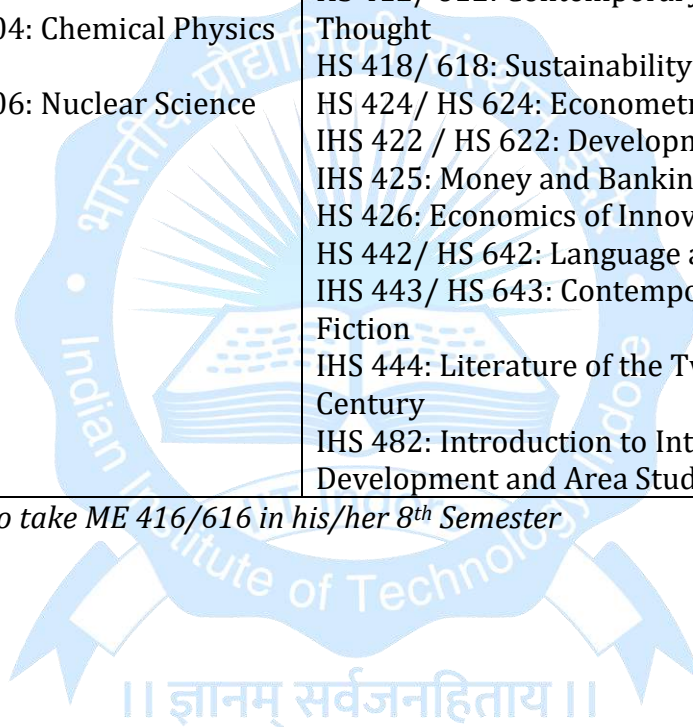
**4. Minor Program in Astronomy (from AY 2016-17):** To get a minor degree in Astronomy, a student needs to register and pass **at least FIVE prescribed** courses. Following are courses for successful minor degree in Astronomy.

#### Course structures of various Minor programs

Semester: Minor course	Minor Program in BSBE	Minor Program in Chemistry	Minor Program in Humanities and Social Sciences	Minor Program in Astronomy (from AY 2016-17 onwards)
3 <sup>rd</sup> : Minor1	BSE 201: Biophysics	CH 201: Molecules that Change the World	HS 201: Understanding Philosophy HS 203: Psychology HS 205: Sociology HS 207: French Language-I	AA 201: Introduction to Astronomy
4 <sup>th</sup> : Minor 2	BSE 202: Biomedical Technologies	CH 202: Chemistry of Transition Metals and Lanthanides &	HS 206: Paradigms and Turning Points # HS 208: French Language-II HS 210: Indian Economy HS 211: German Literature and Culture Studies HS 214: History of Indian Culture and Civilization HS 216: Introduction to Hindi Cinema	AA 202N: Astronomical Techniques
5 <sup>th</sup> : Minor 3	BSE 301: Introduction to Molecular Biology	CH 301: Functional Materials	HS 311: Life and Thought of Gandhi HS 313: History of Early Cinema	AA 301: High Energy Astronomy

			HS 315: Sociology of Science and Technology HS 323: International Economics HS 341: Appreciating Indian English Literature	
8 <sup>th</sup> : Two elective courses as Minor 4 and Minor 5	BSE 402: Cancer Diagnosis and Therapy BSE 404/ BSE 604: Biomedical Imaging BSE 405/ BSE 605: Molecular Biophysics BSE 413/ BSE 613: Omics Technologies BSE 417/ BSE 617: Biomolecular Modeling EE 419/ EE 619: Biomedical Optics ME 407/ME 607: Bio-fluid Mechanics	CH 402: Chemistry in Industry  CH 404: Chemical Physics  CH 406: Nuclear Science	IHS 402: Twentieth Century World History: Critical Perspectives HS 412/ 612: Contemporary Indian Thought HS 418/ 618: Sustainability Studies HS 424/ HS 624: Econometrics-I IHS 422 / HS 622: Development Economics IHS 425: Money and Banking HS 426: Economics of Innovation HS 442/ HS 642: Language and Mind IHS 443/ HS 643: Contemporary Short Fiction IHS 444: Literature of the Twentieth Century IHS 482: Introduction to International Development and Area Studies	AA 404/ AA 604: Spacecraft and Payload Attitude Dynamics, Control and Pointing AA 471N/ AA 671N: Relativity and Cosmology AA 472N/ AA 672N: Galactic and Extragalactic Astronomy AA 474 / AA 674: Basics of Radio Astronomy AA 476/ AA 676: Satellite Based Navigation Systems AA 478/ AA 678: Space Weather

& A student who takes CH 202 will not be allowed to take ME 416/616 in his/her 8<sup>th</sup> Semester



### Structure of the Minor programs [For AY 2021-22]

A student has to register and pass at least FIVE courses (three core courses and two elective courses) as prescribed for a minor program in order to get a minor degree in that specialization along with the regular BTech degree in his/her engineering Department. A minor program will run only when at least TEN students register for it. Following minor programs are available from AY 2014-15 onwards.

**1. Minor program in Biosciences and Biomedical Engineering (BSBE):** To get a minor degree in BSBE, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course* BSE 101 Bio-Sciences for successful minor degree in BSBE.

**2. MINOR PROGRAM IN CHEMISTRY:** To get a minor degree in Chemistry, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course CH 103*. Following are courses for successful minor degree in Chemistry.

**3. Minor Program in HSS:** A student needs to register and pass **at least FIVE prescribed courses of Humanities and Social Sciences** *excluding the core courses* HS 159 and HS 108 for successful minor degree in Humanities or Social Sciences.

**4. Minor Program in Astronomy (from AY 2016-17):** To get a minor degree in Astronomy, a student needs to register and pass **at least FIVE prescribed** courses. Following are courses for successful minor degree in Astronomy.

#### Course structures of various Minor programs

Semester: Minor course	Minor Program in BSBE	Minor Program in Chemistry	Minor Program in Humanities and Social Sciences	Minor Program in Astronomy (from AY 2016-17 to AY 2021-22)
3 <sup>rd</sup> : Minor1	BSE 201: Biophysics	CH 201: Molecules that Change the World	HS 201: Understanding Philosophy HS 203: Psychology HS 205: Sociology HS 207: French Language-I	AA 201: Introduction to Astronomy
4 <sup>th</sup> : Minor 2	BSE 202: Biomedical Technologies	CH 202: Chemistry of Transition Metals and Lanthanides &	HS 206: Paradigms and Turning Points # HS 208: French Language-II HS 210: Indian Economy HS 211: German Literature and Culture Studies HS 214: History of Indian Culture and Civilization HS 216: Introduction to Hindi Cinema	AA 202N: Astronomical Techniques AA 204: Introduction to Space Exploration
5 <sup>th</sup> : Minor 3	BSE 301: Introduction to	CH 301: Functional	HS 311: Life and Thought of Gandhi	AA 301: High Energy

	Molecular Biology	Materials	HS 313: History of Early Cinema HS 315: Sociology of Science and Technology HS 323: International Economics HS 341: Appreciating Indian English Literature	Astronomy AA 303: IoT for Space Applications
8 <sup>th</sup> : Two elective courses as Minor 4 and Minor 5	BSE 402: Cancer Diagnosis and Therapy BSE 404/ BSE 604: Biomedical Imaging BSE 405/ BSE 605: Molecular Biophysics BSE 413/ BSE 613: Omics Technologies BSE 417/ BSE 617: Biomolecular Modeling BSE 419/ BSE 619: Renewable Energy Technologies EE 419/ EE 619: Biomedical Optics ME 407/ME 607: Bio-fluid Mechanics	CH 402: Chemistry in Industry CH 404: Chemical Physics CH 406: Nuclear Science	IHS 402: Twentieth Century World History: Critical Perspectives HS 412/ 612: Contemporary Indian Thought HS 418/ 618: Sustainability Studies HS 424/ HS 624: Econometrics-I IHS 422 / HS 622: Development Economics IHS 425: Money and Banking HS 426: Economics of Innovation HS 442/ HS 642: Language and Mind IHS 443/ HS 643: Contemporary Short Fiction IHS 444: Literature of the Twentieth Century IHS 482: Introduction to International Development and Area Studies	AA 404/ AA 604: Spacecraft and Payload Attitude Dynamics, Control and Pointing AA 471N/ AA 671N: Relativity and Cosmology AA 472N/ AA 672N: Galactic and Extragalactic Astronomy AA 474 / AA 674: Basics of Radio Astronomy AA 476/ AA 676: Satellite Based Navigation Systems AA 478/ AA 678: Space Weather

& A student who takes CH 202 will not be allowed to take ME 416/616 in his/her 8<sup>th</sup> Semester

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### Structure of the Minor programs [from AY 2022-23 onwards]

A student has to register and pass at least FIVE courses (three core courses and two elective courses) as prescribed for a minor program in order to get a minor degree in that specialization along with the regular BTech degree in his/her engineering Department. A minor program will run only when at least TEN students register for it. Following minor programs are available from AY 2014-15 onwards.

**1. Minor program in Biosciences and Biomedical Engineering (BSBE):** To get a minor degree in BSBE, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course* BSE 101 Bio-Sciences for successful minor degree in BSBE.

**2. MINOR PROGRAM IN CHEMISTRY:** To get a minor degree in Chemistry, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course CH 103*. Following are courses for successful minor degree in Chemistry.

**3. Minor Program in Economics:** A student needs to register and pass **at least FIVE prescribed courses of Humanities and Social Sciences** *excluding the core courses* HS 159 and HS 108 for successful minor degree in Humanities or Social Sciences.

**4. Minor Program in Liberal Arts**

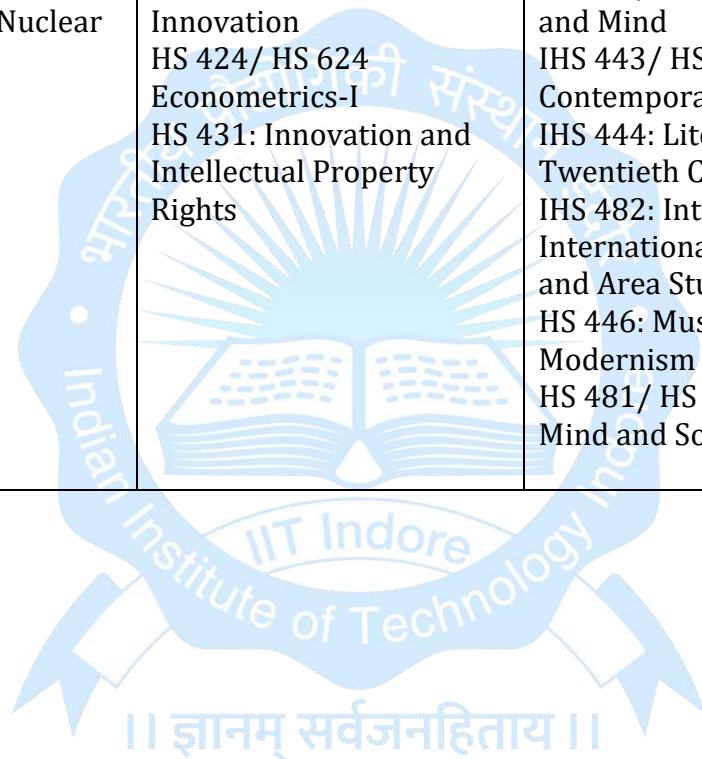
**5. Minor Program in Astronomy and Space Engineering (from AY 2022-23):** To get a minor degree in Astronomy, a student needs to register and pass **at least FIVE prescribed** courses. Following are courses for successful minor degree in Astronomy.

#### Course structures of various Minor programs

Semester: Minor course	Minor Program in BSBE	Minor Program in Chemistry	Minor Program in Economics  (from AY 2022-23 onwards with BTech batch admitted in AY 2021-22)	Minor Program in Liberal Arts  (from AY 2022-23 onwards with BTech batch admitted in AY 2021-22)	Minor Program in Astronomy  (from AY 2016-17 to AY 2021-22)  Minor Program in Astronomy and Space Engineering  (from AY 2022-23 onwards with BTech batch admitted in AY 2021-22)
3 <sup>rd</sup> : Minor1	BSE 201: Biophysics	CH 201: Molecules that Change the World	HS 209: Intermediate Microeconomics	HS 201: Understanding Philosophy HS 203: Psychology HS 205: Sociology HS 207: French Language-I	AA 201: Introduction to Astronomy

4 <sup>th</sup> : Minor 2	BSE 202: Biomedical Technologies	CH 202: Chemistry of Transition Metals and Lanthanides &	HS 210: Indian Economy	HS 206: Paradigms and Turning Points HS 208: French Language-II HS 211: German Literature and Culture Studies HS 212: History of India after Independence, 1947-2000 HS 213: Cognitive Psychology HS 214: History of Indian Culture and Civilization HS 216: Introduction to Hindi Cinema	AA 202N: Astronomical Techniques AA 204: Introduction to Space Exploration
5 <sup>th</sup> : Minor 3	BSE 301: Introduction to Molecular Biology	CH 301: Functional Materials	HS 323: International Economics HS 325: Industrial Organization	HS 311: Life and Thought of Gandhi HS 313: History of Early Cinema HS 315: Sociology of Science and Technology HS 321: History of Modern Indian Business HS 327: Mind, Action, and Technology HS 341: Appreciating Indian English Literature	AA 301: High Energy Astronomy AA 303: IoT for Space Applications

<p>8<sup>th</sup> : Two elective courses as Minor 4 and Minor 5</p>	<p>BSE 402: Cancer Diagnosis and Therapy          BSE 404/ BSE 604: Biomedical Imaging          BSE 405/ BSE 605: Molecular Biophysics          BSE 413/ BSE 613: Omics Technologies          BSE 417/ BSE 617: Biomolecular Modeling          BSE 419/ BSE 619: Renewable Energy Technologies          EE 419/ EE 619: Biomedical Optics          ME 407/ME 607: Bio-fluid Mechanics</p>	<p>CH 402: Chemistry in Industry           CH 404: Chemical Physics           CH 406: Nuclear Science</p>	<p>HS 418/ 618: Sustainability Studies          IHS 422 / HS 622: Development Economics          IHS 425: Money and Banking          HS 426: Economics of Innovation          HS 424/ HS 624 Econometrics-I          HS 431: Innovation and Intellectual Property Rights</p>	<p>IHS 402: Twentieth Century World History: Critical Perspectives          HS 412/ 612: Contemporary Indian Thought          HS 442/ HS 642: Language and Mind          IHS 443/ HS 643: Contemporary Short Fiction          IHS 444: Literature of the Twentieth Century          IHS 482: Introduction to International Development and Area Studies          HS 446: Music and Literary Modernism          HS 481/ HS 681: Language, Mind and Society</p>	<p>AA 404/ AA 604: Spacecraft and Payload Attitude Dynamics, Control and Pointing          AA 410/ AA 610: Spatial Informatics          AA 412/ AA 612: Microwave Remote Sensing          AA 471N/ AA 671N: Relativity and Cosmology          AA 472N/ AA 672N: Galactic and Extragalactic Astronomy          AA 474 / AA 674: Basics of Radio Astronomy          AA 476/ AA 676: Satellite Based Navigation Systems          AA 478/ AA 678: Space Weather</p>
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**Structure of the Minor programs for AY 2024-25 onwards (For all UG batches admitted in and after AY 2023-24)**

A student has to register and pass at least FIVE courses (three core courses and two elective courses) as prescribed for a minor program in order to get a minor degree in that specialization along with the regular BTech degree in his/her engineering Department. A minor program will run only when at least TEN students register for it. Following minor programs are available from AY 2014-15 onwards.

**1. Minor program in Biosciences and Biomedical Engineering (BSBE):** To get a minor degree in BSBE, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course* BSE 101 Bio-Sciences for successful minor degree in BSBE.

**2. MINOR PROGRAM IN CHEMISTRY:** To get a minor degree in Chemistry, a student needs to register and pass **at least FIVE prescribed** courses *excluding the core course CH 103*. Following are courses for successful minor degree in Chemistry.

**3. Minor Program in Economics:** A student needs to register and pass **at least FIVE prescribed courses of Humanities and Social Sciences** *excluding the core courses* HS 159 and HS 108 for successful minor degree in Humanities or Social Sciences.

**4. Minor Program in Liberal Arts**

**5. Minor Program in Astronomy and Space Engineering (from AY 2022-23):** To get a minor degree in Astronomy, a student needs to register and pass **at least FIVE prescribed** courses. Following are courses for successful minor degree in Astronomy.

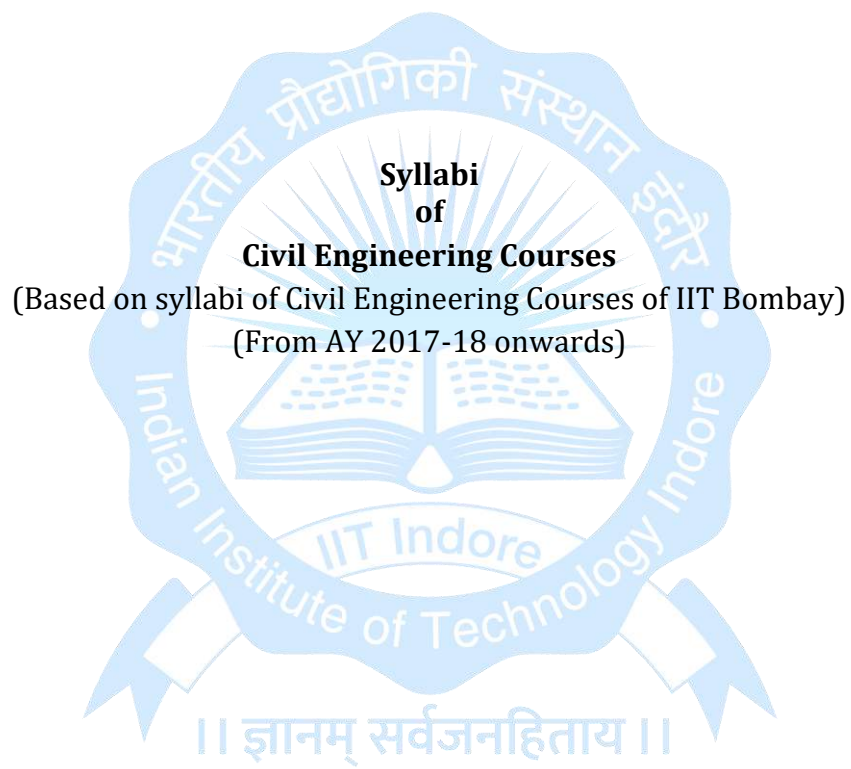
**Course structures of various Minor programs**

Semester: Minor course	Minor Program in BSBE	Minor Program in Chemistry	Minor Program in Economics From AY 2024-25 (Batch Admitted in and after AY 2023-24)	Minor Program in Liberal Arts From AY 2024-25 (Batch Admitted in and after AY 2023-24)	Minor Program in Astronomy From AY 2024-25 (Batch Admitted in and after AY 2023-24)
3 <sup>rd</sup> : Minor1	BSE 201: Biophysics	CH 201: Molecules that Change the World	HS 209: Intermediate Microeconomics	HS 211: German Literature and Culture Studies HS 212: History of India after Independence, 1947- 2000 HS 203: Psychology HS 205: Sociology HS 221 Fundamentals of	AA 201: Introduction to Astronomy

				Linguistics HS 223 Language Variation: Culture and Society	
4 <sup>th</sup> : Minor 2	BSE 202: Biomedical Technologies	CH 202: Chemistry of Transition Metals and Lanthanides &	HS 210: Indian Economy	HS 206: Paradigms and Turning Points HS 214: History of Indian Culture and Civilization HS 213: Cognitive Psychology HS 224 Contemporary Short Fiction HS 226 Sociology of Cinema	AA 202N: Astronomical Techniques AA 204: Introduction to Space Exploration
5 <sup>th</sup> : Minor 3	BSE 301: Introduction to Molecular Biology	CH 301: Functional Materials	HS 323: International Economics HS 321: History of Modern Indian Business	HS 311: Life and Thought of Gandhi HS 327: Mind, Action, and Technology HS 341: Appreciating Indian English Literature	AA 301: High Energy Astronomy AA 303: IoT for Space Applications
6 <sup>TH</sup> : Minor 4			HS 325: Industrial Organization	HS 315: Sociology of Science and Technology HS 328 Philosophy and Film HS 330 Graphic Literature	

7th : (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)	(0-0-4-2) (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)	(0-0-4-2) (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)	(0-0-4-2) (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)	(0-0-4-2) (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)	(0-0-4-2) (minor project/field study/white paper/domain comprehension (Seminar)/Lab course)
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Course Code	<b>CE 201</b>
Title of the Course	<b>Solid Mechanics</b>
Credit Structure	L-T- P-Credits 3-1-0-4
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Rigid and deformable solids; Method of sections for evaluating internal forces in bodies - review of free body diagrams; Axial force, shear and bending moment diagrams; Concept of stress, normal and shear stress; Concept of strain , normal and shear strains; Constitutive relations, Hook's law; Axially loaded members force and deflections; Bending and shearing stresses in beams of symmetrical cross-section concept of shear flow; Inelastic bending of beam; Torsion of circular shafts; Stress in cylindrical and spherical shells; Combined stress; principals of superposition and its limitations; Transformation of plane stress and strain, principal stress and strains, Mohr's circle, strain methods; Bending deflection of simple beams by direct integration methods; Buckling of compression methods.
Suggested Books	<ol style="list-style-type: none"> <li>1. S.M.A. Kazioni, <b>Solid Mechanics</b> (1st revised ed.), Tata McGraw Hill, New Delhi, 1988.</li> <li>2. E.P. Popoo, <b>Introduction to Mechanics of Solids</b>, Prentice Hill of India, New Delhi, 1973.</li> <li>3. S.H. Crandall, N.C. Dahl and T.V. Lardner, <b>Mechanics of Solids: An Introduction</b>, McGraw Hill International, Tokyo, 1994.</li> </ol>

॥ ज्ञानम् सर्वजनहिताय ॥

Course code	CE 102
Title of the course	Computations in Civil Engineering
Course Category	Flexible Elective
Credit Structure	L - T - P - Credits 1-0-0-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NIL
Scope of the course (Objectives)	To provide an overview of the role of computations in Civil Engineering.
Course Outcomes	Exposure to some of the computational techniques required in Civil Engineering.
Course Content	Role of differential equations in Civil Engineering, ordinary and partial differential equations; Role of probability in Civil Engineering, Random events, Random variables; Role of machine learning in Civil Engineering.
Suggested Books	<ul style="list-style-type: none"> <li>• E. Kreyszig, Advanced engineering mathematics, Wiley India Pvt. Ltd, 2015, ISBN: 9788126554232.</li> <li>• Papoulis and S.U. Pillai, Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw Hill, ISBN-10: 0070486581</li> <li>• J.R. Benjamin and C.A. Cornell, Probability Statistics and Decision for Civil Engineers, McGraw Hill, 1975, ISBN-10:0486780724</li> </ul>

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Course Code	<b>CE 202</b>
Title of the Course	<b>Structural Mechanics-I</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Analysis of Statically Determinate Structures: Determination of forces in trusses, frames, arches, and cables; Principle of virtual work; Energy Principle; Maxwell's and Betti's laws; Computation of Displacements - moment area method, conjugate beam method, virtual work methods; Influence Lines - Equilibrium methods, Muller Breslau principle; concepts of flexibility and stiffness.</p> <p>Introduction to statically Indeterminate Structures: Concept of state indeterminacy-determination of static redundancy; concept of compatibility conditions; applications to axially loaded members; single beams.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. H.H. West, <b>Fundamentals of Structural Analysis</b>, John Wiley, New York, 1993.</li> <li>2. C.H. Norns, J.B. Wilbur, S. Utku, <b>Elementary Structural Analysis</b>, 3rd McGraw-Hill International, Tokyo, 1976.</li> <li>3. C.S. Reddy, <b>Basic Structural Analysis</b> (2nd ed.) Tata McGraw Hill, New Delhi, 1996.</li> </ol>

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Course Code	<b>CE 203</b>
Title of the Course	<b>Fluid Mechanics-I</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Definition, properties and classifications of fluids. Kinematics of fluid flow. Generalized continuity equation. Irrotational motion and solutions to Laplace equation.</p> <p>Dynamics of fluid flow. Euler and Bernoulli's theorems. Impulse momentum theory and applications. Flow of fluids in closed conduits.</p> <p>Laminar and turbulent flows in the light of boundary layer concepts. Darcy-Weisbach equation, Moody's diagram. Minor losses. Drag on immersed bodies, concepts of separation, drag force, circulation and lift force. Dimensional Analysis, Model Similitude, theory and applications.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. R.A. Granger, <b>Fluid Mechanics</b>, Holt Reinhart and Winstaw, 1985.</li> <li>2. V.L. Streeter E.B. and Wylie, <b>Fluid Mechanics</b>, McGraw Hill Book Co., 1983.</li> <li>3. R.L. Daugherty, J.B. Franzini, E.J. Finnermore; <b>Fluid Mechanics with Engineering Application</b>, McGraw Hill, International Ed: 1989.</li> <li>4. LP.N. Modi, S.M. Seth, <b>Hydraulics and Fluid Mechanics</b>; Standard Book House, New Delhi</li> </ol>

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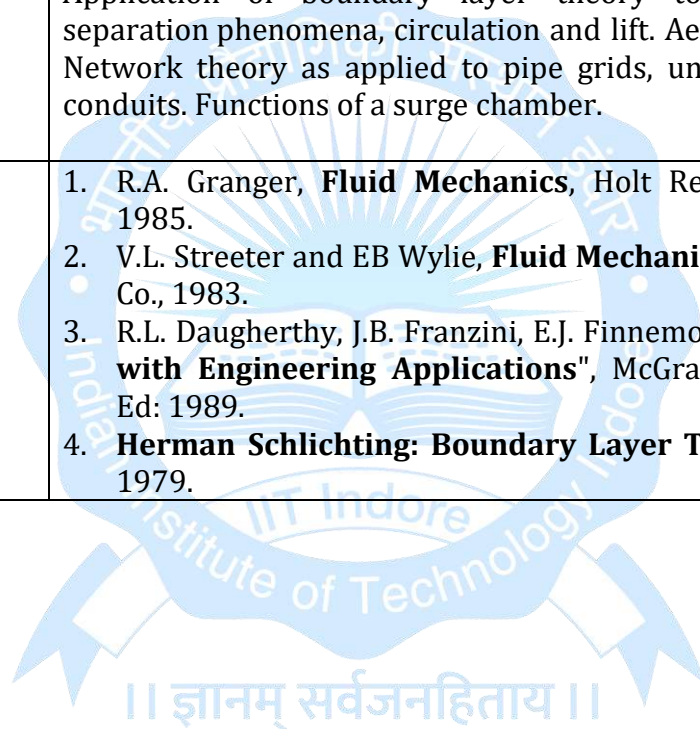
Course code	<b>CE 203N</b>
Title of the course	<b>Fluid Mechanics</b>
Course Category	Core
Credit Structure	L – T – P – Credits 2 – 1 – 0 – 3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	To impart the basic concepts of fluid mechanics and gain knowledge about the methods of solving real life problems involving fluids and gives approaches for flow measurement, fluid flow through pipes and boundary layer theory.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of fluid and pressure properties and their measurement</li> <li>• Analysis of forces on immersed plane and curved plates, frictional losses in laminar and turbulent flows and analyze flow between reservoirs.</li> <li>• Solve flow problems using continuity equations and energy equations.</li> </ul>
Course Content	<p><b>Fluid Statics &amp; Kinematics</b> - Fluid properties, Rheology of fluids, System and control volume, Pascal's law, Pressure and its measurement, Buoyancy and stability, Lagrangian and Eulerian descriptions, Flow visualization, Deformation of fluid elements, Vorticity and rotationality, Velocity potential and stream function.</p> <p><b>Fluid Dynamics</b>- Euler's equation of motion, Conservation of mass, Bernoulli's equation, Linear and angular momentum equations – their applications.</p> <p><b>Dimensional Analysis</b>- Buckingham's pi-theorem, Rayleigh's method, Dimensionless numbers, Model similarities, Distorted models.</p> <p><b>Flow Through Pipes</b>- Reynolds experiment, Laminar and turbulent flow in pipes, Darcy-Weisbach equation, Moody's diagram, Head loss computation, Hydraulic and energy grade lines, Analysis of multi-pipe systems.</p> <p><b>Flow Measurement</b>- Conventional and advanced flow measuring devices.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. M.K. Goyal , <b>Fluid Mechanics and Hydraulic Machines</b> , PHI Learning Pvt. Ltd. , 2015 , ISBN: 978-81-203-5117-2</li> <li>2. G.L. Asawa , <b>Fluid Flow in Pipes and Channels</b> , CBS Publishers , 2008, ISBN: 978-8123917238</li> </ol> <p>Reference books:</p> <ol style="list-style-type: none"> <li>3. Y.A. Cengel, and J.M. Cimbala , <b>Fluid Mechanics (4<sup>th</sup> Edition)</b></li> </ol>

, McGraw-Hill , 2019 , ISBN: 978-9353166212

4. V.L. Streeter, E.B. Wylie and K.W. Bedford , **Fluid Mechanics (9<sup>th</sup> Edition)** , McGraw-Hill , 2014 , ISBN: 978-0070625372



Course Code	<b>CE 204</b>
Title of the Course	<b>Fluid Mechanics-II</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Introduction to Navier-Stokes equations. Exact solutions for simple cases of flow, plane Poiseuille flow. Couette flow. Hydro-dynamics of lubrications problems. Problems of flow through porous media. Application of boundary layer theory to concepts of flow separation phenomena, circulation and lift. Aerofoil characteristics. Network theory as applied to pipe grids, unsteady flow in close conduits. Functions of a surge chamber.
Suggested Books	<ol style="list-style-type: none"> <li>1. R.A. Granger, <b>Fluid Mechanics</b>, Holt Reinhart and Winstaw, 1985.</li> <li>2. V.L. Streeter and EB Wylie, <b>Fluid Mechanics</b>, McGraw Hill Book Co., 1983.</li> <li>3. R.L. Daugherty, J.B. Franzini, E.J. Finnemore, "<b>Fluid Mechanics with Engineering Applications</b>", McGraw Hill, International Ed: 1989.</li> <li>4. <b>Herman Schlichting: Boundary Layer Theory</b>: McGraw Hill, 1979.</li> </ol>



Course Code	<b>CE 205</b>
Title of the Course	<b>Strength of Materials</b>
Course Category	Core
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the Course	To develop fundamental knowledge of the mechanics of Civil Engineering Structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of the concept of stress and strain.</li> <li>• Knowledge of the behavior of structural elements like beams and columns under compression, tension, shear, bending, and torsion.</li> </ul>
Course Syllabus	<p><b>Rigid and Deformable Solids-</b> Method of sections for evaluating internal forces in bodies - review of free body diagrams, Constitutive relations, Hook's law.</p> <p><b>Shear Force and Bending Moment-</b> Axial force, shear force, and bending moment diagrams.</p> <p><b>Simple Stress and Strain-</b> Concept of normal and shear stress, Concept of normal and shear strains, Transformation of plane stress and strain, principal stress and strains, Mohr's circle.</p> <p><b>Theory of Column-</b> Axially loaded members force and deflections, Buckling of compression members.</p> <p><b>Bending and Shear Stress-</b> Bending and shearing stresses in beams of symmetrical cross-section concept of shear flow, Shear Centre, Inelastic bending of a beam.</p> <p><b>Torsion and Pressure Vessels-</b> Torsion of circular shafts, Stress in cylindrical and spherical shells.</p> <p><b>Deflection of Beams-</b> Bending deflection of simple beams by direct integration methods, Strain Energy methods, Combined stress, Principals of superposition and its limitation.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. S. Timoshenko , <b>Strength of Materials, Part I and II</b> , CBS Publishers and Distributors , 2021 , ISBN:978-8123910307</li> <li>2. R. C. Hibbeler , <b>Mechanics of Materials</b>, Pearson Prentice Hall , 2022 , ISBN:978-9354492259</li> <li>3. E. P. Popov , <b>Engineering Mechanics of Solids</b> , Prentice Hall , 2009 , ISBN:978-8120321076</li> </ol>

Reference books:

4. S.H. Crandall, N.C. Dahl and T.V. Lardner , ***Mechanics of Solids, An Introduction*** , McGraw Hill International , 2017 , ISBN: 978-0071070034
5. L. S. Srinath , ***Advanced Mechanics of Solids*** , Tata McGraw-Hill , 2017 , ISBN: 978-0070139886



Course Code	<b>CE 206</b>
Title of the Course	<b>Geodesy-I</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Design data surveys: Control surveys- horizontal and vertical; Topographic Mapping; route surveys. Traversing-compass, theodolite and plane table; Levelling-spirit and trigonometrical; Tacheometry and subtense measurements; Areas and Volumes; Setting out works.
Suggested Books	<ol style="list-style-type: none"> <li>1. B.C. Punmia, A.K. Jain and A.K. Jain, <b>Surveying, Vol. 1 and II</b>, Laxmi Publications (P) Ltd., New Delhi, 1996.</li> <li>2. K.R. Arora, <b>Surveying, vol. I and II</b>, Standard Book House, Delhi, 1998.</li> <li>3. R.E. Davis, F.s. Foote and J.w. Kelly, <b>Surveying; Theory and Practice</b>, McGraw Hill Book Company, New York, 1966.</li> <li>4. D. Clark and J. Clendinning, <b>Plane and Geodetic Surveying, Vol. I and II</b>, Constable and Company, London, 1958.</li> </ol>



Course Code	<b>CE 207</b>
Title of the Course	<b>Building Materials</b>
Course Category	Core
Credit Structure	L - T - P - Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the Course	This course aims to introduce different materials and their properties that can be used for civil engineering applications.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge about different materials available for use in building construction.</li> <li>• Understanding of mechanical behavior of building materials.</li> <li>• Awareness about green building materials.</li> </ul>
Course Syllabus	<p><b>Introduction:</b> Classification, characterization, engineering properties of building materials and comparative analyses.</p> <p><b>Aggregate, Cement and Bricks-</b> Cement, cement composition, types of cement and its comparative analysis, Aggregate, Admixtures, Lime, Bricks and blocks.</p> <p><b>Concrete-</b> Water for concrete making and curing, Concrete and its types, Design mix of concrete.</p> <p><b>Metals and Alloys-</b> Steel, ferrous metals, Aluminum and Copper.</p> <p><b>Other Load-bearing Materials-</b> Timber, Laminates, Ceramics, Refractories, Glass, Asphalt.</p> <p><b>Other Non-load Bearing Materials-</b> Rubber, Plastic, Asbestos, Paints and varnishes, Adhesives.</p> <p><b>Alternative Materials-</b> Bamboo, Geopolymer.</p> <p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• To determine the normal consistency, setting time, fineness, specific gravity and soundness of cement.</li> <li>• To determine the compressive strength test of hydraulic cement.</li> <li>• To perform Slump test, Compaction factor test, and Vee-bee consistometer.</li> <li>• To determine the compressive, flexural, and tensile strength of cubic concrete specimens.</li> <li>• To perform particle size distribution of fine and coarse aggregates.</li> <li>• Determination of specific gravity of fine and coarse aggregates.</li> <li>• To determine the flakiness index, elongation index, and angularity</li> </ul>

	<p>number test of aggregates.</p> <ul style="list-style-type: none"> <li>• To perform aggregate impact value, crushing value, and abrasion value tests.</li> <li>• To perform tile abrasion test.</li> <li>• To perform water absorption and efflorescence test on bricks</li> </ul>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. S.K. Duggal, <b>Building Materials</b> , CRC Press , 2017 , ISBN: 9781351462976</li> <li>2. N. Subramanian, <b>Building Materials – Testing and Sustainability</b> , Oxford University Press , 2019 , ISBN: 9780199497218</li> <li>3. P.C. Varghese, <b>Building Materials</b> , PHI Learning , 2015 , ISBN: 978-8120350915</li> </ol> <p>Reference Books</p> <ol style="list-style-type: none"> <li>4. B. Cather and D. Doran, <b>Construction Materials Reference Book</b> , CRC Press , 2013 , ISBN: 978-0750663762</li> <li>5. M.L. Gambhir, <b>Concrete Technology</b> , McGraw Hill , 2013 , ISBN: 9781259062551</li> </ol>



Course Code	<b>CE 208</b>
Title of the Course	<b>Water and Wastewater Engineering</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Essentials of water, Quantity of water, Domestic water standards; Sources of water and their yield, population forecast, Design period; Intakes, pumping and Transportation of water; Water distribution systems and analysis; Appurtenances of water transport and distribution systems.</p> <p>Essentials of waste water engineering, Quantities of Waste water and storm water, waste water characteristics; Water and waste water plumbing systems, Waste water collection systems, Design of Sewerage systems, Pumping of waste water; Unit operations; Processes of water treatment, sedimentation and flocculation; slow and rapid sand filters; chlorination and other disinfecting methods; primary and secondary waste water treatment, activated sludge trickling filters, sludge digestion, drying and disposal.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. G.M. Fair, J.C. Geyer, D.A. Okan, <b>Elements of Water Supply and Wastewater Disposal</b>, John Wiley and Sons Inc., 1971.</li> <li>2. Terence, J. McGhee <b>Water Supply and Sewerage</b>, McGraw Hill Book Co., 1991.</li> <li>3. M.J. Hammer, <b>Water and Waste Water Technology</b>, John Wiley and Sons, New York, 1986.</li> <li>4. CPHEEO: <b>Manual on water supply and treatment</b>, Ministry of Urban Development, 1991.</li> <li>5. CPHEEO: <b>Manual on Sewerage and Sewage Treatment</b>, Ministry of Works and Housing, New Delhi, 1980.</li> </ol>

Course code	<b>CE 209</b>
Title of the course	<b>Surveying</b>
Course Category	Core
Credit Structure	L - T - P - Credits 2 - 1 - 0 - 3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	This course aims to understand the basics of field surveying and to be able to execute mapping and setting out of the different civil engineering projects.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of planning a survey, taking accurate measurements, booking the field, plot, and adjusting the traverse for civil engineering applications.</li> <li>• Knowledge to utilize a variety of conventional instruments involved in surveying about accuracy and utility.</li> </ul>
Course Content	<p><b>Basic Concepts of Surveying-</b> Control surveys - horizontal and vertical, Topographic Mapping, Route surveys.</p> <p><b>Plane Table Surveying-</b> Plane table, Plane and Geodetic surveying.</p> <p><b>Compass and Theodolite Surveying-</b> Compass traversing, Theodolite traversing, Open and closed traversing.</p> <p><b>Levelling and Contouring-</b> Levelling-spirit, Trigonometric levelling, Tachometric levelling, Precise levelling, Triangulation and trilateration.</p> <p><b>Total Station-</b> Total station, Errors and adjustments, Global Navigation Satellite System (GNSS).</p> <p><b>Application of Geoinformatics tools-</b> Geographic Information System (GIS), Global Positioning System (GPS) mapping, Unmanned Aerial Vehicles (UAVs).</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. N.N.Basak, <b>Surveying &amp; Levelling</b>, McGraw Hill Education (2<sup>nd</sup> Edition), 2017, ISBN: 9789332901537</li> <li>2. P.V.Rao and V.Akella, <b>Textbook of Surveying</b>, PHI Learning, 2015, ISBN: 9788120349919.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. J. M. Anderson and E. M. Mikhail, <b>Surveying Theory and Practice</b>, McGraw Hill Ltd., 7th Edition , 2017 , ISBN : 978-1259025648.</li> <li>2. B. Kavanagh and T. Mastin , <b>Surveying Principles and Applications</b>, Pearson , 2013 , ISBN , 9780137009404</li> </ol>

Course code	<b>CE 210</b>
Title of the course	<b>Structural Analysis I</b>
Course Category	Core
Credit Structure	L-T- P-Credits 2 -1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Exposure to the basics of the Strength of materials
Objective of the course	To introduce the analysis of determinate structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of the analysis of determinate structures.</li> </ul>
Course Content	<p><b>Statically Determinate Structures-</b> Determination of forces in trusses, frames, arches, and cables.</p> <p><b>Deflection in Structures-</b> Principle of virtual work, Energy Principle, Maxwell's and Betti's laws.</p> <p><b>Computation of Displacements-</b> Moment area method, Conjugate beam method, Virtual work methods.</p> <p><b>Influence Line Diagrams and Rolling Loads-</b> Equilibrium methods, Muller Breslau principle, Concepts of flexibility and stiffness.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. C.S. Reddy , <b>Basic Structural Analysis</b> , Tata McGraw Hill , 1996 , ISBN , 978-0074623664.</li> <li>2. R.C. Hibbeler , <b>Structural Analysis</b> , Pearson/Prentice Hall , Upper Saddle River, N.J , 2006 , ISBN: 978-9332586147</li> <li>3. H.H. West , <b>Fundamentals of Structural Analysis</b> , John Wiley , New York , 1993 , ISBN: 9788126531295</li> </ol> <p>Reference books:</p> <ol style="list-style-type: none"> <li>4. J.C. McCormac , <b>Structural Analysis</b>, Using Classical and Matrix Methods, 4th Edition , Hoboken , 2007 , ISBN: 978-0470036082</li> <li>5. D. Menon , <b>Structural Analysis</b> , Narosa Publishing House , 2018 , ISBN: 978-81-7319-939-4</li> </ol>

Course code	<b>CE 211</b>
Title of the course	<b>Smart Cities</b>
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	The objective of the course is to provide an understanding of the impact that Civil Engineering has on society at large and in the global arena including the impacts of Civil Engineering projects on infrastructure, energy consumption and generation, and sustainability of the environment.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding of the impacts of Civil Engineering in Urbanization.</li> <li>• Knowledge of the sustainability of structures and the Environment.</li> <li>• Awareness of global environmental issues and mitigation strategies.</li> </ul>
Course Content	<p><b>Introduction-</b> Recent major Civil Engineering breakthroughs and innovations, Present day world and future projections, concept of smart cities, dimensions, standards and performance benchmarks, Smart city mission in India.</p> <p><b>Smart Buildings-</b> Planning aspects of Green and energy efficient buildings, Green building ratings, Zero Carbon cities, Conservation, repairs and rehabilitation of structures and heritage structures.</p> <p><b>Futuristic Transportation:</b> Tunnels, Multi-modal Transport systems, Hyper Loop.</p> <p><b>Environmental Impacts and Control-</b> Innovations in solid waste management, Water purification, Wastewater treatment, Atmospheric pollution and mitigation measures, Environmental Impact Assessment, Smart water projects</p> <p><b>Disaster Resilient Cities-</b> Flood Control, Earthquake Resistant Structures, Climate Smart Infrastructure.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. A. Kumar, <i>Introduction to Smart Cities</i>, Pearson India, 2019, ISBN: 978-9353439576</li> <li>2. R. John Glasson, A. Theriveland and R. Chandwic, <i>Introduction to Environmental Impact Assessment</i>, Taylor and Francis,</li> </ol>

2011, ISBN: 978-0415664707

Reference Books:

3. S. Wang, *Intelligent Buildings and Building Automation*,  
Routledge, 2009, ISBN: 978-0415475716



Course code	<b>CE 212</b>
Title of the Course	<b>Soil Mechanics-I</b>
Course Category	Core
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Prerequisite, if any	None
Objective of the course	To provide a fundamental understanding of soils' physical and mechanical properties. Students will acquire basic knowledge of the engineering design of geotechnical systems.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of properties of soil.</li> <li>• Understanding the compaction, consolidation and shear strength parameters of soil.</li> </ul>
Course Content	<p><b>Origin of Soils and Rocks-</b> Introduction and basic inter-relationships.</p> <p><b>Index Properties-</b> Index properties of soil and aggregates, Atterberg limits.</p> <p><b>Soil Structure and Clay Mineralogy-</b> Soil structure, Mineralogy of soils, IS soil classification.</p> <p><b>Soil Compaction-</b> Laboratory compaction, Factors affecting soil compaction, Field compaction, Soil-water statics.</p> <p><b>Concept of Effective Stress-</b> Effective stress, Capillarity phenomenon in soil, Flow through soils, Quicksand condition.</p> <p><b>Permeability-</b> Permeability and methods for its determination, Construction of flownets.</p> <p><b>Vertical Stress Distribution in Soil from Surface-</b> Boussinesq theory, Westergard theory, Newmark's chart, Contact pressures.</p> <p><b>Consolidation of Soils-</b> Settlement of compressible soil layers, Terzaghi's 1D consolidation theory.</p> <p><b>Shear Strength of Soils-</b> Mohr-Coulomb theory, Failure theories.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. V. N. S. Murthy, <i>Geotechnical Engineering, Principles and Practices of Soil Mechanics and Foundation Engineering</i>, CRC Press, 2003 , ISBN: 978-0824708733</li> <li>2. T. W. Lambe and R. V. Whitman, <i>Soil Mechanics</i>, Wiley , 2010, ISBN: 978-8126517794</li> </ol> <p>Reference books</p> <ol style="list-style-type: none"> <li>3. K. Terzaghi, R.B. Peck, G. Mesri, <i>Soil Mechanics in Engineering Practice</i>, Wiley, 2009, ISBN: 978-8126523818.</li> <li>4. J. Knappett and R.F. Craig, <i>Craig's Soil Mechanics</i>, CRC Press, 2012, ISBN: 978-0415561266</li> </ol>

Course code	<b>CE 213</b>
Title of the course	<b>Optimization Methods for Civil Engineering</b>
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Objective of the course	The course aims to teach students the fundamentals of classical and non-classical optimization techniques and their application in solving real-world civil engineering optimization problems.
Course Outcomes	<ul style="list-style-type: none"> <li>• Define the concept of a system and outline the steps involved in applying a systems approach to water resources engineering.</li> <li>• Utilize optimization techniques, including linear programming and the simplex method.</li> <li>• Create simulation models for deterministic and stochastic reservoir operating policies.</li> </ul>
Course Content	<p><b>System Concepts-</b> Definition, classification, and characteristics of systems, Scope and steps in systems engineering, Need for systems approach to water resources and irrigation.</p> <p><b>Linear Programming-</b> Introduction to operations research - linear programming, Problem formulation, Graphical solution, Solution by simplex method - sensitivity analysis, Application to design and operation of reservoir, Case studies.</p> <p><b>Dynamic Programming-</b> Bellman's optimality criteria, Problem formulation and solutions, Application to design and operation of reservoirs, Case studies.</p> <p><b>Simulation,</b> Basic principles and concepts, Random variant and random process, Monte Carlo techniques, Model development - inputs and outputs, Case studies.</p> <p><b>Advanced Optimization Techniques-</b> Integer and parametric linear programming, Goal programming, Discrete differential and incremental dynamic programming, Linear decision rule models, Stochastic dynamic programming models.</p>

Suggested Books

Textbooks:

1. K. Deb, **Optimization for Engineering Design- Algorithms and Examples**, Prentice, 2012, India, ISBN: 978-8120346789
2. S. Vedula and P.P. Majumdar, **Water Resources Systems – Modeling Techniques and Analysis**, Tata McGraw Hill, 2010, ISBN: 9780070590892

Reference books:

3. A. Ravindran, G.V. Reklaitis, and K.M. Ragsdell, **Engineering optimization, methods and applications**. John Wiley and Sons, 2006, ISBN: 978-0-471-55814-9
4. S.S. Rao, **Engineering optimization, theory and practice**, John Wiley and Sons, 2019, ISBN: 978-0470274835



Course Code	<b>CE 214</b>
Title of the Course	<b>Engineering Geology</b>
Course Category	Core
Credit Structure	L - T - P - Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the Course	To provide the student with the practical applications of geological knowledge for engineering projects, geological and geotechnical recommendations.
Course Outcomes	<ul style="list-style-type: none"> <li>• Identify and classify various minerals and rocks based on their engineering properties.</li> <li>• Assessment and mitigation of geological hazards.</li> <li>• Develop a native construction plan incorporating all relevant geology aspects using seismic and electrical methods.</li> </ul>
Course Syllabus	<p><b>Introduction-</b> Origin, Age, Development and interior of Earth, Plate tectonics, Continental drift, Sea floor spreading, Evolution of the Himalaya.</p> <p><b>Mineralogy-</b> Physical and chemical properties of rocks and minerals, Optical mineralogy.</p> <p><b>Rock Classification-</b> Igneous, Sedimentary and Metamorphic, Ternary diagrams, IUGG classification of intrusive and extrusive rocks, Metamorphism Causes, Textural classification of rocks.</p> <p><b>Structural Geology-</b> Folds, Faults, Joints, Subsurface exploration, Geologic investigations for site selection of engineering structures, Instrumentation in engineering geology.</p> <p><b>Geological Hazards and Mitigation-</b> Seismic zones and seismotectonics of India, Major geological hazards, Effect of earthquakes on infrastructure, Geotechnical and structural considerations in earthquake hazard mitigation.</p> <p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• To prepare geological maps and mapping, outcrops, apparent and true dips.</li> <li>• To study three-point problems, depth and thickness problems, joints, faults.</li> <li>• To conduct megascopic and microscopic identification of minerals and rocks.</li> <li>• To study engineering properties of rocks, refraction and resistivity methods.</li> <li>• A guided tour through representative geological formations and structures.</li> </ul>

Suggested Books

Textbooks:

1. L. G. de Vallejo and M. Ferrer, **Geological Engineering**, CRC Press, 2011, ISBN: 9780415413527
2. Gangopadhyay, **Engineering Geology**, Oxford Publication, 2013, ISBN: 9780198086352

Reference books

3. C. Mclean and C. D. Gribble, **Geology for Civil Engineers**, CRC Press, 2017, ISBN: 978-1138465824

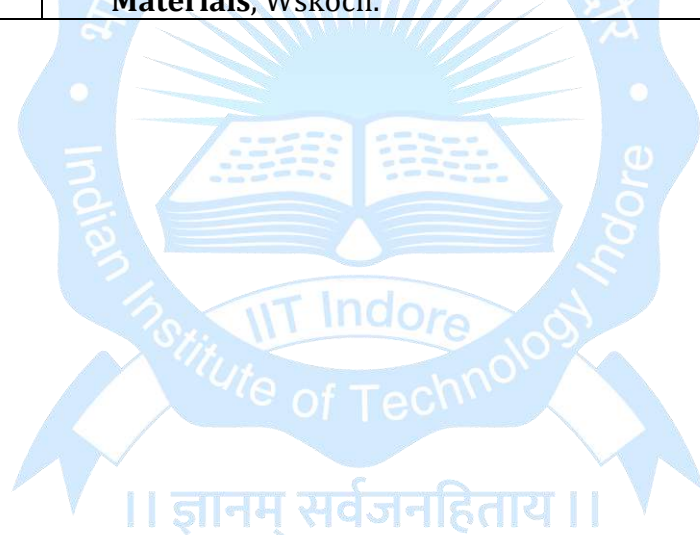


Course code	<b>CE 218</b>
Title of the course	<b>Environmental Engineering</b>
Course Category	Core
Credit Structure	L - T - P Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Objective of the course	To provide students with a strong background on processes and operations used to address major environmental issues and to understand the role of unit processes in water and wastewater treatment systems and in air and noise pollution systems.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding the basics of water supply, treatment methods, and distribution networks and gather overview on wastewater treatment processes.</li> <li>• Knowledge of solid waste management and developing vision for a waste-free world and sustainable options for living.</li> </ul>
Course Content	<p><b>Water Supply Engineering-</b> Sources, quality standards, and testing of water and its treatment, Characteristics of water, Pollutants in water and their effects, Estimation of water demand, Water treatment units, Water distribution networks.</p> <p><b>Wastewater Engineering-</b> Planning and design of domestic wastewater systems, Sewage collection, and disposal, Plumbing systems. Components and layout of sewerage system, Sludge management, Industrial waste waters and Effluent treatment plants.</p> <p><b>Solid Waste Management-</b> Sources and classification, Planning and design of solid waste disposal and management system, Beneficial aspects of waste and its utilization.</p> <p><b>Air and Noise pollution-</b> Concepts, Measurement techniques, General methodology and control measures.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. H.S. Peavy, D.R. Rowe, and G. Tchobanoglous, <b>Environmental Engineering</b> , McGraw Hill ,2013, ISBN: 9789351340263.</li> <li>2. N.N.Basak, <b>Environmental Engineering</b>, McGraw Hill, 2017, ISBN: 978-0070494633</li> </ol> <p>Reference books:</p> <ol style="list-style-type: none"> <li>3. Metcalf and Eddy, F. L. Burton, H. D. Stensel, and G. Tchobanoglous , <b>Wastewater Engineering, Treatment and Reuse</b> , McGraw Hill , 2003 , ISBN: 978-0070418783</li> </ol>

Course code	<b>CE 220</b>
Title of the course	<b>Water Resources Planning and Management</b>
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Objective of the course	The course objective is to cover history, economics, uncertainty, systems analysis, flood mitigation, and sustainable water resource management, providing a well-rounded foundation for careers in water resources and related fields.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding water resource history and challenges</li> <li>• Learning economic planning and uncertainty analysis</li> <li>• Acquiring skills in systems analysis and optimization</li> </ul>
Course Content	<p><b>Introduction-</b> History of water resources development, Water resources of India, Problems and perspectives.</p> <p><b>Economics of Water Resources Planning-</b> Cost-benefit analysis of water resources projects, Water pricing and water allocation, Principles of planning and financing water resources projects.</p> <p><b>Uncertainty Concepts-</b> Methods for uncertainty analysis and applications in water resources planning.</p> <p><b>Systems Analysis-</b> Systems concepts, Conventional and evolutionary optimization techniques, Interfacing optimizers with process simulators for design and management applications.</p> <p><b>Flood Mitigation and Management-</b> Structural and nonstructural measures, Optimal flood mitigation plan, Flood damage estimation, Flood control systems, Decision support systems, Coastal zone management.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. S.K. Jain and V.P. Singh, <b><i>Water resources systems planning and management</i></b>. Elsevier, 2003, ISBN: 9780444514295</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>2. D.P. Loucks and E. van Beek , <b><i>Water resource systems planning and management</i></b>, An introduction to methods, models, and applications. Springer, 2017, ISBN: 978-3-319-83017</li> </ol>

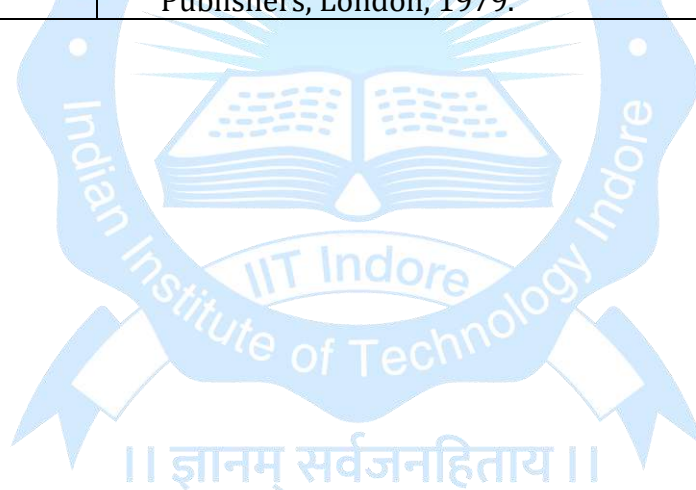
Course code	<b>CE 222</b>
Title of the Course	<b>Estimation and Costing</b>
Course Category	Departmental Elective
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite if any	Nil
Objective of the course	To impart knowledge about estimation and costing, which is essential for the planning, execution, and economic viability of any civil engineering project.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding different types of estimation techniques.</li> <li>• Knowledge about different types of building items and their costing.</li> <li>• Knowledge about the valuation of the building assets.</li> </ul>
Course Content	<p><b>Introduction-</b> Importance of estimation, Different types of estimates, General and detailed specifications.</p> <p><b>Methods of Estimation-</b> Items of work for estimates, units, and measurement of items.</p> <p><b>Detailed Estimation of Buildings-</b> Detailed estimates, Analysis of rates, material, and other cost considerations, Resource planning through analysis of rates, market rates, Schedule of rates, non-scheduled items, and cost indices for building material and labor.</p> <p><b>Valuation of Assets-</b> Standard terminology, Factors affecting the values of property, Methods of valuation, years purchase, capitalized value, sinking fund, depreciation.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. B.N. Dutta, <i>Estimating and Costing in Civil Engineering</i>, Theory and Practice, CBS Publishers and Distributors , 2022 , ISBN: 9788174767707</li> <li>2. J. Williams and S. Gedes, <i>Estimating for Building and Civil Engineering Work</i> , CRC Press, 2013 , ISBN: 9780750627979</li> </ol> <p>Reference books:</p> <ol style="list-style-type: none"> <li>3. SP 27, 1987 (Reaffirmed 2003), <b>Handbook of Method of Measurement of Buildings Work</b>,1987, ISBN: 81-7061-002-8</li> </ol>

Course Code	<b>CE 251</b>
Title of the Course	<b>Solid Mechanics Lab.</b>
Credit Structure	L-T- P-Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Experiment on axial tension of mild steel and cast iron; compression on concrete; bending of beams; buckling of columns. Experiments on shear centre; continuous and interconnected beams; unsymmetrical bending of angle sections; buckling of columns of various cross-section and end conditions.
Suggested Books	1. David, Troxell, <b>Inspection and Testing of Engineering Materials</b> , Wskocil.



Course code	<b>CE 252</b>
Title of the Course	<b>Soil Mechanics Lab-I</b>
Course Category	Core
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Prerequisite, if any (for the students)	None
Objective of the course	To acquire hands-on experience in measuring and interpreting soil properties.
Course Outcomes	<ul style="list-style-type: none"> <li>• Practical Knowledge on different properties of soil.</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• Determination of moisture content of the given soil sample.</li> <li>• Determine the in situ density of natural or compacted soils using sand pouring cylinders.</li> <li>• To study particle size distribution using sieve analysis and hydrometer analysis.</li> <li>• To find out the specific gravity of soil.</li> <li>• To determine the relative density of given coarse grained Material.</li> <li>• To study Atterberg limit.</li> <li>• To conduct compaction of soil.</li> <li>• To determine the coefficient of permeability of a soil using constant head method.</li> <li>• To determine the coefficient of permeability of a soil using falling head method.</li> <li>• To conduct consolidation of soil.</li> <li>• To perform shear tests.</li> </ul>
Suggested Books	<p>Reference books</p> <ol style="list-style-type: none"> <li>1. V. N. S. Murthy, <b><i>Geotechnical Engineering, Principles and Practices of Soil Mechanics and Foundation Engineering</i></b>, CRC Press, 2003, ISBN: 978-0824708733</li> <li>2. T. W. Lambe and R. V. Whitman, <b><i>Soil Mechanics</i></b>, Wiley , 2010, ISBN: 978-8126517794</li> <li>3. K. Terzaghi, R.B. Peck, G. Mesri, <b><i>Soil Mechanics in Engineering Practice</i></b>, Wiley, 2009, ISBN: 978-8126523818.</li> <li>4. J. Knappett and R.F. Craig, <b><i>Craig's Soil Mechanics</i></b>, CRC Press, 2012, ISBN: 978-0415561266</li> </ol>

Course Code	<b>CE 253</b>
Title of the Course	<b>Fluid Mechanics Lab-I</b>
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Ideal fluid motion past a two dimensional circular cylinder by means of an electrical analog; study of boundary layer growth in a wind tunnel. Drag on a circular cylinder, Minor transition losses in pipes. Determination of friction factor of pipes. Flow measurement by Orifices, venturimeter and notches; computations of various coefficients involving jet flow through orifice. Demonstration experiments. Bernoulli apparatus, Reynolds apparatus, Magnus effect.
Suggested Books	1. Lamox W.r., <b>Laboratory work in Hydraulics</b> , Granada Publishers, London, 1979.



Course code	<b>CE 253N</b>
Title of the course	<b>Fluid Mechanics Lab</b>
Course Category	Core
Credit Structure	L – T – P – Credits 0 – 0 – 3 – 1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Objective of the course	To acquire hands-on experience in measuring and interpreting various phenomenon for the fluid.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understand the basic fluid properties.</li> <li>• Understand different flow measurement techniques and procedures.</li> <li>• Verify the basic principles of fluid flow.</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• Determination of the metacentric height of a given vessel under unloaded and loaded conditions.</li> <li>• Visualization of streamlines and path lines using flow visualization channel.</li> <li>• Determination of coefficient of discharge using a Venturi meter.</li> <li>• Demonstrate Bernoulli's theorem using Bernoulli's apparatus.</li> <li>• To study the free and forced vortex apparatus.</li> <li>• To study the impact of jets.</li> <li>• To observe the phenomenon of cavitation.</li> <li>• Determination of coefficient of discharge using orifice, notches, and weir.</li> <li>• Determination of friction factors of pipes using the concept of the Darcy-Weisbach equation.</li> <li>• Determination of minor losses in pipes.</li> <li>• Analyzing laminar and turbulent flow conditions on a Reynolds apparatus.</li> </ul>
Suggested Books	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. G.L. Asawa , <b>Laboratory Work in Hydraulic Engineering</b> , New Age International Private Limited , 2006 , ISBN: 978-8122418101</li> <li>2. S. Singh , <b>Experiments in Fluid Mechanics</b> , Prentice Hall India Learning Private Limited , 2012 , ISBN: 978-8120345119</li> </ol>

Course Code	<b>CE 254</b>
Title of the Course	<b>Fluid Mechanics Lab-II</b>
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Application of Hele-Shaw Model to compute dam seepage. Deformation of fluid viscosity for Hagen Poiseuille flow conditions. Electric analog for the pipe solution networks. Flow net studies around circular cylinder. Verification of Darcy's law.
Suggested Books	<ol style="list-style-type: none"> <li>1. Lamox W.R. <b>Laboratory Work in Hydraulics</b> Granada Publishers, London 1979.</li> <li>2. S. Narasimhan (Ed.) <b>Engineering Fluid Mechanics</b> Vol. II, Orient Longmans Ltd., New Delhi, 1973.</li> <li>3. V.L. Streeter, E.B. Wylie, <b>Fluid Mechanics</b>, McGraw Hill, 1985.</li> </ol>



Course code	<b>CE 255</b>
Title of the course	<b>Strength of Materials Lab</b>
Course Category	Core
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	To develop experimental knowledge of the mechanics of Civil Engineering Structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of various experiments to understand the deformation behavior of materials and simple structural components.</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• To determine the axial tension of mild steel and cast iron.</li> <li>• To study the compression of concrete, bending of beams, and buckling of columns.</li> <li>• To conduct experiments on the shear centre.</li> <li>• To study continuous and interconnected beams.</li> <li>• To analyse the unsymmetrical bending of angle sections.</li> <li>• To study buckling of columns of various cross-section and end conditions.</li> <li>• To study deflection in a curved ring beam using Castigliano's Theorem.</li> </ul>
Suggested Books	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. S. Timoshenko , <b><i>Strength of Materials, Part I and II</i></b> , CBS Publishers and Distributors , 2021 , ISBN: 978-8123910307</li> <li>2. R. C. Hibbeler , <b><i>Mechanics of Materials</i></b>, Pearson Prentice Hall , 2022 , ISBN: 978-9354492259</li> <li>3. E. P. Popov , <b><i>Engineering Mechanics of Solids</i></b>: Prentice Hall , 2009 , ISBN, 978-8120321076</li> <li>4. L. S. Srinath , <b><i>Advanced Mechanics of Solids</i></b> , Tata McGraw-Hill , 2017 , ISBN: 978-0070139886</li> </ol>

Course Code	<b>CE 256</b>
Title of the Course	<b>Geodesy Lab-I</b>
Credit Structure	L-T- P-Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Horizontal control-compass, plane table and theodolite traversing; plotting traverses and mapping details; vertical control-spirit levelling, tacheometry and trigonometric levelling; curve setting.
Suggested Books	Same as CE 206



Course Code	<b>CE 257</b>
Title of the Course	<b>Civil Engineering Drawing</b>
Credit Structure	L-T- P-Credits 1-0-3-2.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Scope of the course	The course provide students with a basic understanding of civil engineering drawings. It also enables students to understand the details of construction of different building elements and envision the completed form of the building infrastructure.
Course Syllabus	Drawing of various details of residential buildings, framed buildings in steel and concrete. Industrial and laboratory buildings. Principles of planning. Relation of frame work details, floors and roofing systems, masonry, load bearing and non-load bearing walls. Working drawings of building.
Suggested Books	<ol style="list-style-type: none"> <li>1. Malik R S and Meo G S, <b>Civil Engineering Drawing</b>, Cengage India Private Limited, Delhi, 2016, ISBN-9788131526132</li> <li>2. G. Singh. Craig, <b>Civil Engineering Drawing</b>, Standard Publishers &amp; distributors, New Delhi, 2009, ISBN-13-978-8180140044</li> <li>3. M G Shah, C M Kale, S Y Patki, <b>Building drawing with an integrated approach to Built Environment Drawing</b>, Tata Mc Graw Hill Publishing co. Ltd, New Delhi, 2007, ISBN-13-978-0071077873</li> </ol>

Course code	<b>CE 258</b>
Title of the course	<b>Environmental Engineering Lab</b>
Course Category	Core
Credit Structure	L - T - P-Credits 0 - 0 - 2 - 1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Objective of the course	It will impart Practical Knowledge on different chemical, physical and biological properties
Course Outcomes	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• Determination of pH using pH meter, electrical conductivity using EC meter, and temperature using Temperature meter for water and wastewater samples.</li> <li>• Determination of alkalinity and acidity.</li> <li>• Determination of hardness.</li> <li>• Determination of turbidity and optimum dose of alum.</li> <li>• Determination of solids.</li> <li>• Determination of dissolved oxygen and bio-chemical oxygen demand.</li> <li>• Determination of chemical oxygen demand.</li> <li>• Determination of Most Probable Number (MPN)</li> <li>• Determination of nutrients / heavy metals.</li> <li>• Determination of ambient air quality/measurement of noise levels.</li> </ul> <p>Site visit to Water treatment plant/ Sewage Treatment Plant/ Effluent Treatment Plant</p>
Suggested Books	<p>Reference Books</p> <ol style="list-style-type: none"> <li>1. American Public Health Association, <b><i>Standard Methods for the Examination of Water and Wastewater</i></b>, American Public Health Association,, 2017, ISBN: 978-0875532875</li> <li>2. Metcalf and Eddy, F. L. Burton, H. D. Stensel, and G. Tchobanoglous, <b><i>Wastewater Engineering, Treatment and Reuse</i></b>, McGraw Hill, 2003, ISBN: 978-0070418783</li> </ol>

Course code	<b>CE 259</b>
Title of the course	<b>Surveying Lab</b>
Course Category	Core
Credit Structure	L - T - P - Credits 0 - 0 - 2 - 1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	The course will provide exposure to various laboratory instruments such as levels, theodolite, total station, GNSS.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of controlling the accumulation of errors in survey projects.</li> <li>• Understanding use of survey instruments in carrying out survey, collect data, write reports and able to perform required calculations to achieve the objective for different types of surveying for different engineering projects.</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• Surveying of an area by chain, and compass survey (closed traverse) and plotting.</li> <li>• Determine the distance between two inaccessible points with a compass.</li> <li>• Radiation method, intersection methods by plane table survey.</li> <li>• To study levelling - longitudinal and cross-section and plotting.</li> <li>• To study measurement of horizontal and vertical angles by theodolite.</li> <li>• To study trigonometric leveling using theodolite.</li> <li>• Determination of height, remote elevation, and distance between inaccessible points using a total station.</li> <li>• To study the Global Positioning System instrument and its accessories.</li> <li>• To study differential global positioning systems.</li> <li>• To study mapping using a Geographic Information System.</li> </ul>
Suggested Books	<p>Reference Books</p> <ol style="list-style-type: none"> <li>1. N.N.Basak, <b>Surveying &amp; Levelling</b>, McGraw Hill Education (2<sup>nd</sup> Edition), 2017, ISBN: 978-9332901537</li> <li>2. P.V.Rao and V.Akella, <b>Textbook of Surveying</b>, PHI Learning, 2015, ISBN: 9788120349919.</li> <li>3. B. Kavanagh and T. Mastin , <b>Surveying Principles and Applications</b>, Pearson , 2013 , ISBN: 9780137009404.</li> <li>4. J. M. Anderson and E. M. Mikhail, <b>Surveying Theory and Practice</b>, 7th Edition , 2017 , ISBN: 978-1259025648</li> </ol>

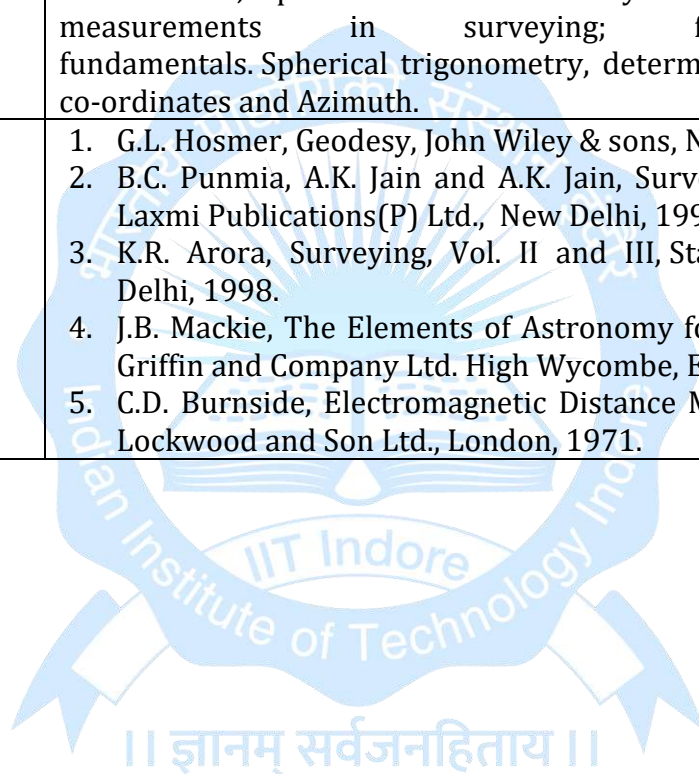
<b>Course code</b>	<b>CE 301</b>
<b>Title of the course</b>	<b>Hydrology</b>
Credit Structure	L - T - P – Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Scope of the course	<p>Hydrology is the study of the physical processes that illustrate how water is transferred from oceans to atmosphere, to land surface, and then back to oceans.</p> <p>Students are exposed to the basic principles and processes that govern the hydrologic cycle, with a special attention to the processes that happen over the land surfaces, since these are directly related to our survival and are fundamental drivers of landscape changes.</p> <p>The course is designed for learning physical principals of hydrology as well as techniques to solve many practical hydrologic problems, including flood routing, flood frequency estimation, surface runoff estimation.</p>
Course Syllabus	<p><b>Introduction:</b> Definition and scope, Hydrologic cycle, Hydrologic systems, Water budget</p> <p><b>Precipitation:</b> Forms and formation, Point measurements, Areal estimation</p> <p><b>Evaporation and Evapotranspiration:</b> Mechanisms and measurements, Classification of evapotranspiration processes, Transpiration, Interception losses, Potential and actual evapotranspiration, Reference-crop evapotranspiration.</p> <p><b>Infiltration:</b> Processes and measurement, Sorption, Infiltration capacity, formulations, Catchment scale infiltration.</p> <p><b>Overland flow and runoff:</b> Streamflow generation, measurement, and formulations, watershed and stream network, Streamflow response: Hydrographs, Unit Hydrograph theory, Convolution, S-curve hydrograph, Flow duration curve, Mass curve, Flood routing, Simple rainfall-runoff models</p> <p><b>Flood frequency analysis:</b> Random variables, Extreme value distributions, Return period, Risk and Reliability, Intensity-Duration curves</p> <p><b>Groundwater Hydrology:</b> Properties of porous materials, Aquifers, Darcy's law, Basic principles of saturated and unsaturated subsurface flow.</p>
Suggested Books	1. P. B. Bedient, W. C. Huber, B. E. Vieux, <i>Hydrology and</i>

**Floodplain Analysis**, Pearson Education Limited, Harlow, Essex, England, 2018:0134751973

2. S. L. Dingman, **Physical Hydrology**, Waveland Press, Inc, Long Grove, Illinois, USA, 2014, 1478611189
3. G. M. Hornberger, P. L. Wiberg, J. P. Raffensperger, P. D`odorico, **Elements of Physical Hydrology**, Johns Hopkins University Press, Baltimore, Maryland, USA, 2014, 1421413736
4. V. T. Chow, D. Maidment, L. Mays, **Applied Hydrology**, McGraw-Hill Professional, New York, USA, 2013, 007174391X

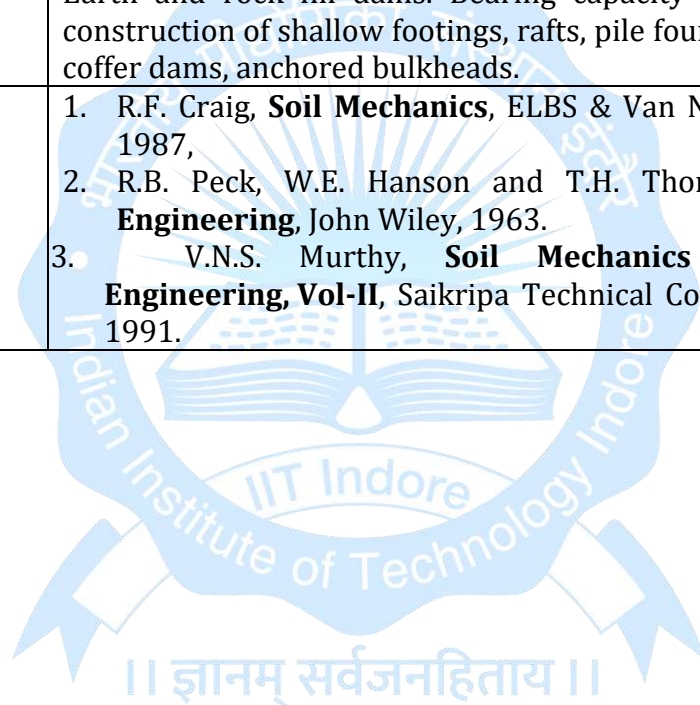


Course Code	<b>CE 302</b>
Title of the Course	<b>Geodesy-II</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure to Geodesy-I
Objectives of the course	
Course Syllabus	Geodetic surveying; triangulation and precise levelling, theory of errors; method of least squares, adjustment of surveying observations; precision and accuracy evaluation; electronic measurements in surveying; field astronomy fundamentals. Spherical trigonometry, determination of terrestrial co-ordinates and Azimuth.
Suggested Books	<ol style="list-style-type: none"> <li>1. G.L. Hosmer, Geodesy, John Wiley &amp; sons, New York, 1946.</li> <li>2. B.C. Punmia, A.K. Jain and A.K. Jain, Surveying, Vol. II and III, Laxmi Publications(P) Ltd., New Delhi, 1997.</li> <li>3. K.R. Arora, Surveying, Vol. II and III, Standard Book House, Delhi, 1998.</li> <li>4. J.B. Mackie, The Elements of Astronomy for surveyors, Charles Griffin and Company Ltd. High Wycombe, England, 1985.</li> <li>5. C.D. Burnside, Electromagnetic Distance Measurement, Crosby Lockwood and Son Ltd., London, 1971.</li> </ol>

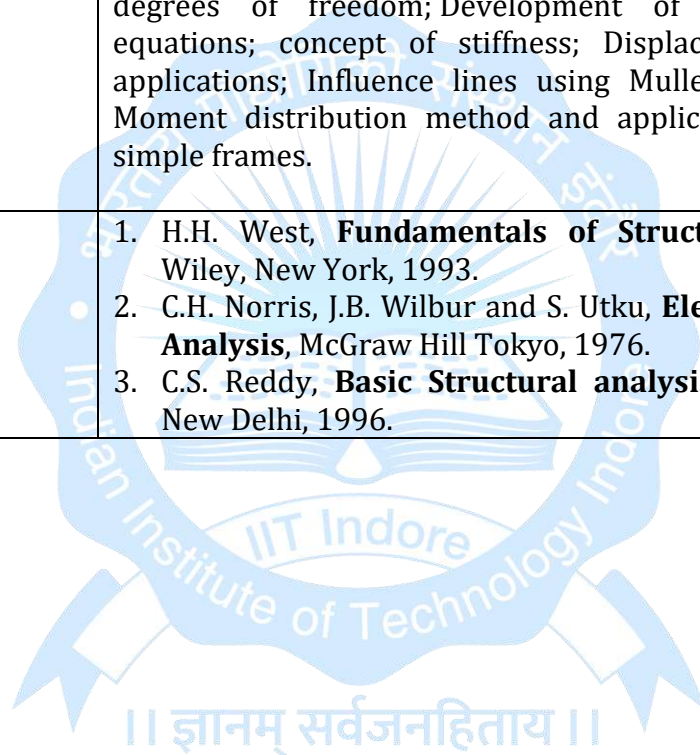


Course Code	<b>CE 303</b>
Title of the Course	<b>Soil Mechanics-I</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Scope of the course	Soil mechanics deals with the engineering behavior of soil. The subject provides fundamental understanding of physical and mechanical properties of soils. Students will acquire basic knowledge in engineering design of geotechnical systems.
Course Syllabus	Origin, Particle Size Analysis, Soil Characteristics- Atterberg's limit, Soil classification, surface tension, capillary attraction. Effective stress Principle, flow through soils, flow nets. Compaction of soils. Stresses in soil, contact pressure. Consolidation of soils, settlement of compressible layers. Shear strength of soils, Mohr Coulomb Theory, Failure theories.
Suggested Books	<p><b>Text Books</b></p> <ol style="list-style-type: none"> <li>1. B. M. Das and K. Shobhan, <i>Principles of Geotechnical Engineering with Mind Tap</i>, Cengage India Private Limited, Delhi, 2016, ISBN, 9788131526132</li> <li>2. J.A. Knappett and R.F. Craig, <i>Soil Mechanics</i>, CRC Press, New York, 2012, ISBN-13, 978-0415561266</li> <li>3. V.N.S. Murthy, <i>Textbook of Soil Mechanics and Foundation Engineering</i>, Geotechnical Engineering series, CBS Publishers, New Delhi, 2008, ISBN-13-9788123913629</li> <li>4. S.K. Shukla, <i>Core Concepts of Geotechnical Engineering</i>, ICE Publishing, London, UK, 2015, ISBN-13, 978-0727758590</li> </ol> <p><b>Reference Books</b></p> <ol style="list-style-type: none"> <li>5. B. M. Das and N.Sivakugan, <i>Fundamentals of Geotechnical Engineering</i>, Cengage India Private Limited, Delhi, 2017, ISBN: 9789386858139</li> </ol>

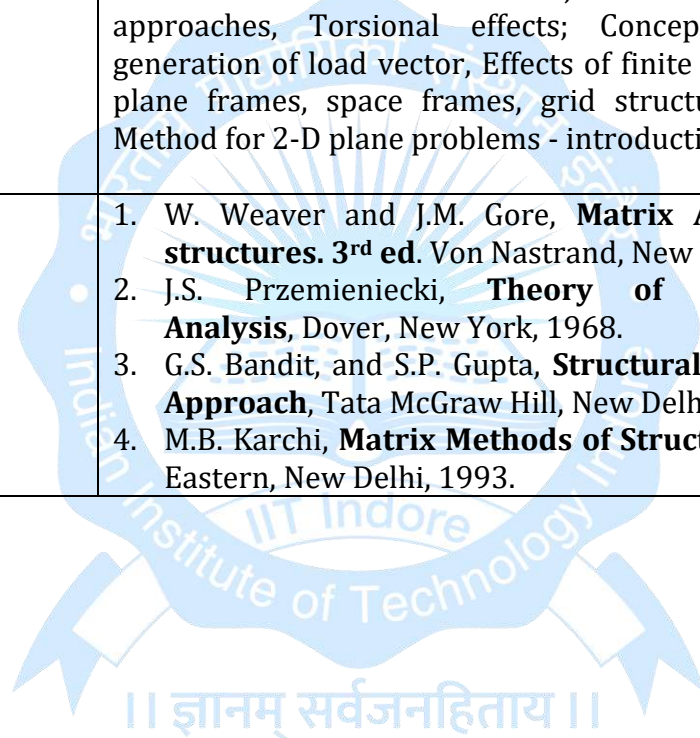
Course Code	<b>CE 321 (Earlier CE 304)</b>
Title of the Course	<b>Soil Mechanics II</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposer to Soil Mechanics-I
Objectives of the course	
Course Syllabus	Surface and subsurface investigations. Boring and sampling. Fieldtests, introduction to airphoto interpretation. Theories of earth pressure and retaining walls excavation, bracing, stability of slopes. Earth and rock fill dams. Bearing capacity of soils. Design and construction of shallow footings, rafts, pile foundations, caisson and coffer dams, anchored bulkheads.
Suggested Books	<ol style="list-style-type: none"> <li>1. R.F. Craig, <b>Soil Mechanics</b>, ELBS &amp; Van Nestrand, 4th Edition, 1987,</li> <li>2. R.B. Peck, W.E. Hanson and T.H. Thornburn, <b>Foundation Engineering</b>, John Wiley, 1963.</li> <li>3. V.N.S. Murthy, <b>Soil Mechanics and Foundation Engineering, Vol-II</b>, Saikripa Technical Consultants, Bangalore, 1991.</li> </ol>



Course Code	<b>CE 305</b>
Title of the Course	<b>Structural Mechanics-II</b>
Credit Structure	L-T- P-Credits 2 -1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure to Structural Mechanics-I
Objectives of the course	
Course Syllabus	Analysis of Statically Indeterminate Structures: Review of Statical Indeterminacy; Force Method - application to trusses, beams, frames, arches; concept of kinematic indeterminacy - degrees of freedom; Development of slope - deflection equations; concept of stiffness; Displacement method and applications; Influence lines using Muller Breslau principle; Moment distribution method and application to beams and simple frames.
Suggested Books	<ol style="list-style-type: none"> <li>1. H.H. West, <b>Fundamentals of Structural analysis</b> John Wiley, New York, 1993.</li> <li>2. C.H. Norris, J.B. Wilbur and S. Utku, <b>Elementary Structural Analysis</b>, McGraw Hill Tokyo, 1976.</li> <li>3. C.S. Reddy, <b>Basic Structural analysis</b> Tata McGraw Hill, New Delhi, 1996.</li> </ol>



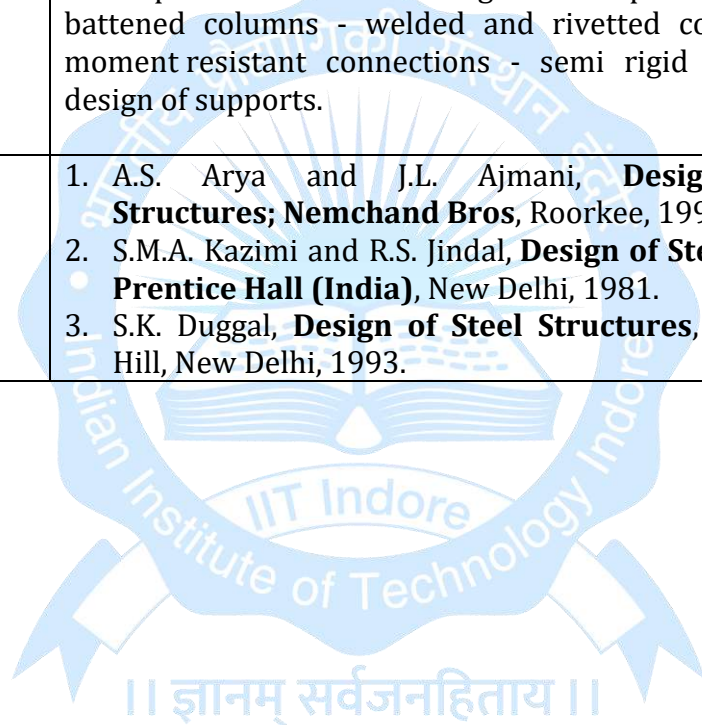
Course Code	<b>CE 306</b>
Title of the Course	<b>Structural Mechanics-III</b>
Credit Structure	L-T- P-Credits 2-0-1-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure to Structural Mechanics-I and Structural Mechanics-III
Objectives of the course	
Course Syllabus	Matrix formulation of force and displacement methods: Solution of simultaneous equations; Stiffness matrix approach with reference to computer application; generation of 1-dimensional frame element stiffness matrix, flexibility and displacement approaches, Torsional effects; Concept of local effects, generation of load vector, Effects of finite joints; Application to plane frames, space frames, grid structures, Finite Element Method for 2-D plane problems - introduction.
Suggested Books	<ol style="list-style-type: none"> <li>1. W. Weaver and J.M. Gore, <b>Matrix Analysis of framed structures. 3<sup>rd</sup> ed.</b> Von Nastrand, New York, 1990.</li> <li>2. J.S. Przemieniecki, <b>Theory of Matrix Structural Analysis</b>, Dover, New York, 1968.</li> <li>3. G.S. Bandit, and S.P. Gupta, <b>Structural analysis - a Matrix Approach</b>, Tata McGraw Hill, New Delhi 1994.</li> <li>4. M.B. Karchi, <b>Matrix Methods of Structural analysis</b>, Wiley Eastern, New Delhi, 1993.</li> </ol>



Course Code	<b>CE 307</b>
Title of the Course	<b>Design of Structures-I</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Design basis of reinforced concrete structures-slab design; simply supported, continuous and two way - Beam design; rectangular; tee, ell, doubly reinforced, continuous - column; Concentric, eccentric, short and long columns - Footing: simple, combined - staircases - joint detailing.
Suggested Books	<ol style="list-style-type: none"> <li>1. J. Krishna, and O.P. Jain, <b>Plain and Reinforcement Concrete - Vol. I &amp; II</b>, Nemchand Bros, Roorkee, 1968</li> <li>2. IS-456-1983 <b>Code of Practice for Plain and Reinforced Concrete.</b></li> <li>3. P.Dayaratnam: <b>Design of Reinforced Concrete Structures, Third Edition</b>, Oxford-IBM Publications, New Delhi 1989.</li> <li>4. S.N. Sinha: <b>Reinforced Concrete Design</b>, Tata McGraw Hill New Delhi, 1990.</li> </ol>



Course Code	<b>CE 308</b>
Title of the Course	<b>Design of Structures-II</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Basic of designing steel structures - Rivetted, bolted and welded connections - tension and compression members - built up members - beam design - built up beams - laced and battened columns - welded and rivetted column bases - moment resistant connections - semi rigid connections - design of supports.
Suggested Books	<ol style="list-style-type: none"> <li>1. A.S. Arya and J.L. Ajmani, <b>Design of Steel Structures; Nemchand Bros</b>, Roorkee, 1990.</li> <li>2. S.M.A. Kazimi and R.S. Jindal, <b>Design of Steel Structures Prentice Hall (India)</b>, New Delhi, 1981.</li> <li>3. S.K. Duggal, <b>Design of Steel Structures</b>, Tata McGraw Hill, New Delhi, 1993.</li> </ol>



<b>Course code</b>	<b>CE 309</b>
<b>Title of the course</b>	<b>Engineering Geology</b>
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Scope of the course	Engineering geology is a subject for practical applications of geological knowledge to engineering projects. Engineering geologists provide geological and geotechnical recommendations, analysis, and design associated with various types of structures.
Course Syllabus	Introduction, Origin, Age and development, Interior and composition of the earth, Plate tectonics, Continental drift, Sea floor spreading, Evolution of the Himalaya, Mineralogy, Chemical analysis of rocks and minerals, Rock and soil minerals, Physical properties of minerals, Susceptibility of minerals to alteration, Basics of optical mineralogy, Instrumentation in engineering geology (SEM, SRD), Classification of Rock, Types of rock and origin: Igneous (extrusive and intrusive), Sedimentary and Metamorphic, ternary diagrams, definitions (structure, texture), Igneous Rock Agents, structure, texture, IUGG classification of intrusive and extrusive rocks, Metamorphic Rock Causes of metamorphism (stress, temperature, tectonism, pore fluid), recrystallization, phase change, structure and texture, Sedimentary Rock Sedimentation environments, structure, textural classification of siliclastic and carbonate rock, Structures: Folds, Faults, Joints, Subsurface exploration geologic investigations for site selection of dams, reservoirs, tunnels, bridges and highways, Geologic and seism tectonic setting of India Geologic provinces of India and their surficial and subsurface geology, seismo-tectonics of the Indian plate, seismic zones of India, Geological Hazards Major geological hazards, Geological considerations in design of constructed facilities and infrastructure, causes and classification of landslides, stability assessment for soil and rock slopes, mitigation of landslide hazard, effect of earthquakes on constructed facilities and infrastructure, geotechnical and structural considerations in mitigation of earthquake hazard.
Suggested Books	<ol style="list-style-type: none"> <li>1. L. G. de Vallejo and M. Ferrer, <b>Geological Engineering</b>, CRC Press (Tayler and Francis), Balkema, 2011, 9780415413527, CAT# SW3524</li> <li>2. S. Gangopadhyay, <b>Engineering Geology</b>, Oxford Publication, 2013, 9780198086352</li> <li>3. A. C. Mclean and C. D. Gribble, <b>Geology for Civil Engineers</b>, E&amp;FN Spon, 1995, 13, 978-0419160007</li> <li>4. P. Singh, <b>Text Book of Engineering and General Geology</b>, S.K. Kataria and Sons, New Delhi, 2013, ISBN-13, 978-9350142677</li> </ol>

Course Code	<b>CE 310</b>
Title of the Course	<b>Transportation Engineering-I</b>
Credit Structure	L-T- P-Credits 3-0-2-4
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p><b>Transportation Systems Engineering:</b> Definition and Objectives of Transportation Systems - Various fields of transportation engineering; Role of transportation in society - economical, social, political and environmental significance; Different modes of travel and their coordination with respect to Indian conditions; Introduction to transportation planning process - planning models and mass transit systems; Terminals - passenger and freight; Transportation demand and supply; Transportation costs; Vehicle motion - resistances, vehicle performance relationships, work, energy and fuel consumption;</p> <p><b>Highway Engineering:</b> Highway planning - basic principles, road development and planning in India; Highway alignment; Geometric design of highways - design of cross-section, horizontal and vertical elements, IRC specifications;</p> <p><b>Highway Pavements:</b> Pavement materials; Requirements and tests on pavement materials; Classification of pavements and design factors; Design of flexible pavements - traffic factors, failure criteria, empirical mechanistic method of design, IRC-CBR design method, Asphalt institute method and AASHTO method; Design of rigid pavements - stresses in plain CC pavements, IRC method of plain CC pavement design, Joints in CC pavement, joint spacing and reinforcement across joints, tie bars and dowel bars; Pavement construction and maintenance; Stabilised roads; Drainage.</p> <p><b>Traffic Engineering:</b> Traffic characteristics; Traffic studies and their use; Traffic control devices; Intersections.</p> <p><b>Transportation Engineering Lab:</b> Laboratory testing of subgrade soils, aggregates, bituminous binders and mixes for their suitability in road construction with reference to BIS; Traffic studies; Pavement evaluation tests.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. E.R. Morlok, <b>An Introduction to Transportation Engineering and Planning</b>, McGraw Hill International, 1970.</li> <li>2. W.W. Hay, <b>Introduction to Transportation Engineering (2<sup>nd</sup> Ed)</b>. John Wiley and Sons, New York, 1988</li> </ol>

3.	C.S. Papacostas, <b>Fundamentals of Transportation Engineering</b> , Prentice Hall of India, New Delhi, 1987
4.	B.G. Hutchinson, <b>Principles of Urban transportation Planning</b> , McGraw Hill Book Company, 1974.
5.	S.K. Khanna, C.E.G. Justo, <b>Highway Engineering</b> , Nemchand Bros., Roorkee, 1991
6.	P.H. Wright, <b>Highway Engineering</b> , John Wiley and Sons, New York, 1996
7.	L.R. Kadiyali, <b>Traffic Engineering and Transportation Planning</b> . Khanna Publishers, New Delhi, 1987
8.	Y.H. Huang, <b>Pavement analysis and Design</b> . Prentice Hall, Englewood Cliffs, New Jersey, 1993



Course Code	<b>CE 352</b>
Title of the Course	<b>Geodesy Lab-II</b>
Credit Structure	L-T- P-Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Based on CE 302
Suggested Books	Same as CE 302



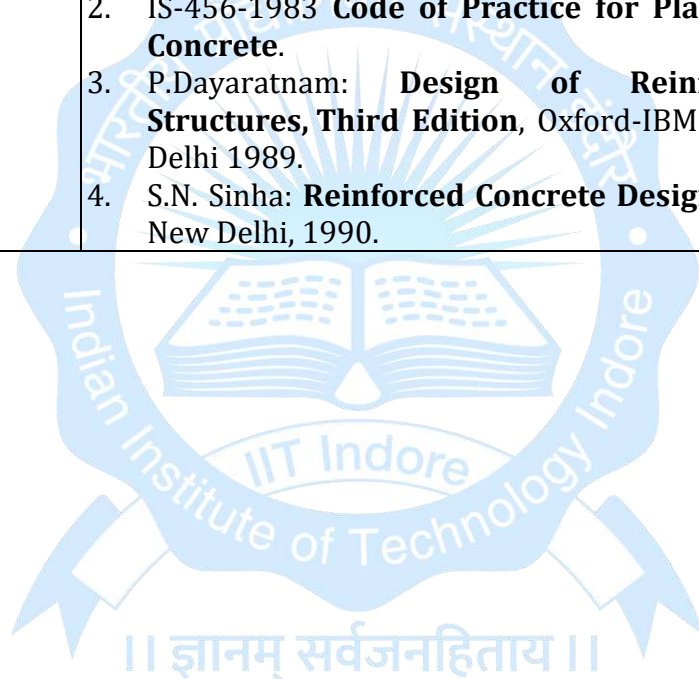
Course Code	<b>CE 353</b>
Title of the Course	<b>Soil Mechanics Laboratory-I</b>
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	To acquire hands on experience of measuring and interpreting soil properties.
Course Syllabus	Identification of soils, Determination of physical properties, Consistency limits, Determination of soil permeability and compaction, characteristics of soils, Consolidation, Unconfined compression test, direct shear test, Vane shear test, Triaxial test, California bearing ratio test
Suggested Books	<ol style="list-style-type: none"> <li>1. Relevant Indian Codes of practice</li> <li>2. J.E. Bowles, <b>Physical and Geotechnical Properties of soils</b>, McGraw Hill International Editions, 1990, 0070067724</li> <li>3. T.W. Lambe, <b>Soil Testing for Engineers</b>, Wiley, 1960, 0471511838</li> <li>4. B M Das, <b>Soil mechanics laboratory manual</b>, Oxford University Press, 2012, 0199846375</li> <li>5. T.W. Lambe, <b>Soil Mechanics</b>, John Wiley &amp; Sons, 1969, 0471511927</li> <li>6. 6. Head, K. H., <b>Manual of soil laboratory testing</b>, Volume 1, 2 and 3, Pentech press, 1980, 1904445365.</li> </ol>



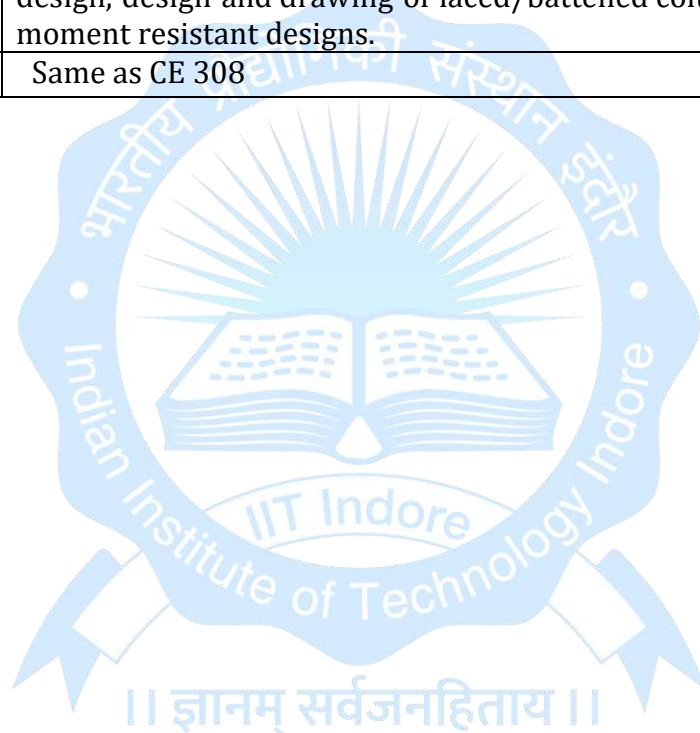
Course Code	<b>CE 354</b>
Title of the Course	<b>Soil Mechanics Laboratory-II</b>
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	To acquire hands on measuring strength soil properties through invasive and non invasive field tests.
Course Syllabus	Field Tests: Standard Penetration test, Plate Load, Dynamic Cone Penetration test, Multichannel analysis of surface wave test, Ground penetration radar, Electrical resistivity tomography
Suggested Books	<ol style="list-style-type: none"> <li>1. Relevant Indian Codes of practice</li> <li>2. J.E. Bowles, <i>Physical and Geotechnical Properties of soils</i>, McGraw Hill International Editions, 1990, 0070067724</li> <li>3. T.W. Lambe, <i>Soil Testing for Engineers</i>, Wiley, 1960, 0471511838</li> <li>4. B M Das, <i>Soil mechanics laboratory manual</i>, Oxford University Press, 2012, 0199846375</li> <li>5. T.W. Lambe, <i>Soil Mechanics</i>, John Wiley &amp; Sons, 1969, 0471511927</li> <li>6. Head, K. H., <i>Manual of soil laboratory testing</i>, Volume 1, 2 and 3, Pentech press, 1980, 1904445365.</li> </ol>



Course Code	<b>CE 357</b>
Title of the Course	<b>Design Lab-I</b>
Credit Structure	L-T- P-Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Design and drawing of continuous or two way slabs; continuous beam; column with a footing; joint details beam-slab; beam-column and column-footing.
Suggested Books	<ol style="list-style-type: none"> <li>1. J. Krishna, and O.P. Jain, <b>Plain and Reinforcement Concrete - Vol-I &amp; II</b>, Nemchand Bros, Roorkee, 1968</li> <li>2. IS-456-1983 <b>Code of Practice for Plain and Reinforced Concrete</b>.</li> <li>3. P.Dayaratnam: <b>Design of Reinforced Concrete Structures, Third Edition</b>, Oxford-IBM Publications, New Delhi 1989.</li> <li>4. S.N. Sinha: <b>Reinforced Concrete Design</b>, Tata McGraw Hill New Delhi, 1990.</li> </ol>



Course Code	<b>CE 358</b>
Title of the Course	<b>Design Lab-II</b>
Credit Structure	L-T- P-Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Design and drawing of built-up compression members; plate girder design, design and drawing of laced/battened columns with base plate; moment resistant designs.
Suggested Books	Same as CE 308



<b>Course code</b>	<b>CE 359</b>
<b>Title of the course</b>	<b>Engineering Geology Laboratory</b>
Credit Structure	L - T - P - Credits 0-0-3-1.5
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Scope of the course	To learn geological mapping, interpretation of Geological data and Physical and Mechanical characterization of Minerals and Rocks.
Course Syllabus	Geological Maps, Geological Mapping, outcrops, apparent and true dips, three point problems, depth and thickness problems, joints, faults, Megascopic and Microscopic identification of Minerals and Rocks, Engineering properties of rocks, refraction and resistivity methods, Guided tour through representative geological formations and structures.
Suggested Books	<ol style="list-style-type: none"> <li>1. M.P. Billings, <b><i>Structural Geology</i></b>, PHI Learning Private Ltd., New Delhi, 2010, 8120300590</li> <li>2. P.K. Mukerjee, <b><i>A Text Book of Geology</i></b>, World Press Pvt. Ltd., Kolkatta, 2013, 8187567546</li> <li>3. M.S. Krishnan, <b><i>Geology of India and Burma</i></b>, CBS Pub., Delhi, 1999, 8123900120</li> <li>4. T. Ramamurty, <b><i>Engineering in Rocks for Slopes, Foundations and Tunnels</i></b>, PHI Learning Pvt. Ltd., Delhi, 2014, 9788120348790</li> </ol>



Course Code	<b>CE 361</b>
Title of the Course	<b>Design of Open Channel Flow</b>
Credit Structure	L-T- P-Credits 1-0-2-2
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Open channel flow. Energy, momentum and pressure correction factors of momentum and energy equations. Specific force. Properties of critical flow.</p> <p>Uniform flow, its properties, design of channels for uniform flow. Gradually varied flow theory, profile computation and use in design of channels. Rapidly varied flow, flow over spillways, hydraulic jump, its location, control and stabilization. Unsteady flow, basic equations, uniformly progressive flow, velocity of flood wave discharge for unsteady flow, flood routing (reservoir and stream flow).</p> <p>Computation of surface profiles in gradually varied flow, location of hydraulic jump and flood routing. Channel Design and Transitions - Energy Dissipators, spillways.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. V. T. Chow, <b>Open Channel Hydraulics</b>, McGraw Hill, 1975.</li> <li>2. K.G. Rangaraju, <b>Flow in Open Channels</b>, Tata McGraw Hill Publication Co. Ltd., New Delhi, 1993.</li> <li>3. K. Subramanya, <b>Flow in Open Channels</b>, Tata McGraw Hill Publication Co. Ltd., New Delhi, 1992.</li> <li>4. R.H. French, <b>Open Channel Hydraulics</b>, McGraw Hill Book Co., New York 1986.</li> </ol>

<b>Course Code</b>	<b>CE 401/ CE 601</b>
<b>Title of the Course</b>	<b>Mechanics of Advanced Composite Materials and Structures</b>
Course Category	Core
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Department of Civil Engineering
Pre-requisite, if any	Nil
Course Objective	To understand the mechanics, analysis, and design of composite 2D structural elements.
Course Outcomes	<ul style="list-style-type: none"> <li>• To be able to apply shear deformation models for analysis of composite structures.</li> <li>• To be able to formulate geometrically nonlinear equilibrium equations of composite structural elements.</li> <li>• To be able to formulate nonlinear code for hygrothermal analysis of composite structural elements.</li> </ul>
Course Content	<ol style="list-style-type: none"> <li>1. Introduction of composites, constituent materials, constitutive relationships for varying stackings,</li> <li>2. Nonlinear analysis of composite 2D structural elements,</li> <li>3. Nonlinear hygrothermal analysis,</li> <li>4. Shear deformation theories for composite structures,</li> <li>5. Nonlinear numerical analysis of composite structures.</li> </ol>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. M. Mukhopadhyay: <i>Mechanics of Composite Materials and Structures</i>: Universities Press: 2005: ISBN: 9788173714771</li> <li>2. R. M Jones: <i>Mechanics of Composite Materials</i>: CRC Press: 2018: ISBN: 9781498711067</li> <li>3. J.N Reddy: <i>Mechanics of Laminated Composite Plates and Shells</i>: CRC Press: 2003: ISBN: 9780203502808.</li> <li>4. A.N. Palazotto and S.T. Dennis: <i>Nonlinear Analysis of Shell Structures</i>: AIAA Education Series: 1992: ISBN: 9781600860911.</li> <li>5. Laszlo P. Kollar and George S. Springer: <i>Mechanics of Composite Structures</i>: Cambridge University Press: 2003: ISBN: 9781139439596.</li> </ol> <p>Reference Books:</p>

1. Yi-Ming Fu: *Nonlinear Analyses of Laminated Plates and Shells with Damage*, WIT Press: 2013: ISBN: 9781845646905.
2. E. Carrera, F. A. Fazzolari, M. Cinefra: *Thermal Stress Analysis of Composite Beams, Plates and Shells: Computational Modelling and Applications*, Academic Press: 2015: ISBN: 9780124200937.
3. M. Amabili: *Nonlinear Vibrations and Stability of Shells and Plates*, Cambridge University Press: 2008: ISBN: 9781139469029.
4. F. Tornabene, M. Baccocchi, *Anisotropic Doubly Curved Shells Higher-Order Strong and Weak Formulations for Arbitrarily Shaped Shell Structures*, Società Editrice Esculapio: 2019: ISBN: 9788835328995.



Course Code	<b>CE 402/ CE 602</b>
Title of the Course	<b>Water Resources Engineering</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure of Hydrology
Objectives of the course	
Course Syllabus	Rainfall and runoff, hydrograph analysis, peaks flows. Reservoir planning and operation, run-of the river schemes, storage schemes. Dams and spillways, intakes, water-conductor systems, tunnels, surge-tanks, penstocks and anchor blocks. Hydro-electric power classification and investigations. Turbines, powerhouse, irrigation, crop requirements and yields, water planning. Weirs on permeable foundations. Canals layout, stable channels, and silt control, canal losses and water-logging.
Suggested Books	<ol style="list-style-type: none"> <li>1. R.K. Linsley and J.L.H. Paulhus, <b>Water Resources Engineering</b>, McGraw Hill Book Co., 1992.</li> <li>2. W.P. Creager and J.D. Justin, <b>Hydroelectric Handbook</b>, John Wiley, 1968.</li> <li>3. Bharat Singh, <b>Fundamentals of Irrigation Engineering</b>, Nemchand Bros., Roorkee, 1957.</li> <li>4. P.N. Modi, <b>Irrigation water Resources and Water Power Engineering</b>, Standard Book House, New Delhi, 1990.</li> </ol>

Course Code	<b>CE 404</b>
Title of the Course	<b>Design of Structures-III</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Design of RCC water tanks, silos, bunkers and simple bridges - Design of steel roof trusses, steel frames - Design of industrial buildings - Design of residential buildings- Design of arches and shells.
Suggested Books	<ol style="list-style-type: none"> <li>1. J. Krishna and O.P. Jain, <b>Plain and Reinforced Concrete, Vol. I and II</b>, Nemchand Bros. Roorkee, 1968.</li> <li>2. IS 456, 1978. <b>Code of Practice for Plain and Reinforced concrete.</b></li> <li>3. <b>Design Aids for R.C. to IS 456-1978</b>, ISI-SP-16-sand-T, 1980.</li> <li>4. S.M.A. Kazimi and R.S. Jindal, <b>Design of Steel Structures</b>, Prentice Hall (India), New Delhi, 1981.</li> <li>5. S.K. Duggal, <b>Design of Steel Structures</b>, Tata McGraw Hill, New Delhi, 1993.</li> <li>6. P. Dayaratnam, <b>Design of Reinforced Concrete Structures</b>, Third Edition, Oxford - IBM Publishing Co, New Delhi, 1989.</li> <li>7. S.N. Sinha, <b>Reinforced Concrete Design</b>, Tata McGraw Hill, New Delhi, 1990.</li> </ol>

॥ ज्ञानम् सर्वजनहिताय ॥

Course Code	<b>CE 406</b>
Title of the Course	<b>Transportation Engineering-II</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure to Transportation Engineering-II
Objectives of the course	
Course Syllabus	<p><b>Airport Planning and Design:</b> Aircraft characteristics related to airport design; Airport configuration - runway configurations, relation of terminal area to runways, runway orientation; Geometric design of the airfield - ICAO and FAA design standards, runways, taxiways, holding aprons and aprons; Planning and design of the terminal area - apron-gate system, size and number of gates, aircraft parking configurations, the passenger terminal system; airport lighting and marking; air traffic control; airport planning and air travel demand forecasting; Structural design of airfield pavements.</p> <p><b>Railway Engineering:</b> Indian Railway Track - different gauges, cross sections, coning of wheels; Tractive resistances; Track components - rails, rail failures, sleepers, rail fixtures and fastenings and ballast; Geometric design of the track; Points and crossings Track junctions; Stations and yards; Signalling and interlocking; Track stresses; Track construction and maintenance.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. R. Horonjeff, F.X. Mckelvey, <b>Planning &amp; Design of airports</b>, Mc Graw Hill, New York, 1994</li> <li>2. S.K. Khanna, M.G. Arora, S.S. Jain, <b>Airport Planning and Design</b>, Nemchand Bros., Roorkee, 1994</li> <li>3. N. Ashford, P.H. Wright, <b>Airport engineering</b>, John Wiley, New York, 1979</li> <li>4. S.C. Sexena, S.P. Arora, <b>A text Book of Railway Engineering</b>, Dhanpat Rai &amp; Sons, New Delhi, 1990</li> <li>5. J.S. Munday, <b>Railway Track Engineering</b>, Tata McGraw Hill, New Delhi.</li> <li>6. M.M. Agarwal, <b>Indian Railway Track</b>, Sachdeva Press, Mayapuri, New Delhi, 1991</li> <li>7. W.W. Hay, <b>Railroad Engineering</b>, John Wiley and Sons, New York, 1988</li> <li>8. S.K. Khanna, C.E.G. Justo, <b>Highway Material Testing - a Laboratory Relevant IRC and BIS standards</b>, 1991.</li> </ol>

Course Code	<b>CE 408</b>
Title of the Course	<b>Foundation Engineering</b>
Credit Structure	L-T- P-Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Explorations, sampling geophysical investigations. Bearing capacity, settlement. Design of footings and rafts. Foundations subjected to eccentric loads and moments. Footings on slopes. Contact pressure distributions. Subgrade modulus. Earth pressure theories. Pile Foundations, driving stresses, load tests, pile groups, pile caps, lateral loads. Bridge foundations caissons, coffer dams. Excavation; and dewatering for foundations. Failures and strengthening. Foundations on weak soils, reclaimed areas, swelling soils etc. Machine foundations.
Suggested Books	<ol style="list-style-type: none"> <li>1 R.B. Peck W.E. Hanson and T.H. Thornburn, <b>Foundation Engineering</b>, John Wiley, 1963.</li> <li>2 Gopal Ranjan and A.S.R. Rao, <b>Basic and Applied soil Mechanics</b>, Wiley Eastern, 1991.</li> <li>3 V.N.S. Murthy, <b>Soil Mechanics and Foundation Engineering</b>, Vol-II, Saikripa Technical Consultants, Bangalore, 1991.</li> <li>4 M.R. Hausmann, <b>Engineering Principles of Ground Modification</b>, McGraw Hill International Edition, 1990.</li> </ol>

॥ ज्ञानम् सर्वजनहिताय ॥

Course Code	<b>CE 410/ CE 610</b>
Title of the Course	<b>Offshore engineering</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Linear theory of waves, brief description of higher order wave theories, random waves, probability theories. Morison? equation, wave forces on fixed and floating structures and fluid structure interaction. Soil exploration beneath seabed, criteria of foundation design in offshore environment, pile behaviour under cyclic lateral loading, development of p-y curves. Analysis of piles and foundations of gravity platforms, soil liquefaction under cyclic stresses.</p> <p>Various types of offshore structures and evaluation of their environmental loads. Structural idealization and analysis of forces due to wind, waves and for linear static behaviour. Wave force on inclined members, analysis of joints in offshore structures, stress concentration and fatigue life prediction. Elementary aspects of dynamic analysis and response.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1 T. Sarapkaya and M. Isaacson, <b>Mechanics of Wave Forces on Offshore Structures</b>, Van Nostrand, Reinhold Co., N.Y., 1981.</li> <li>2 C.A. Brebbia and S. Walker, <b>Dynamic analysis of Offshore Structures</b>, Newnes Butterworth, London, 1979.</li> </ol>

<b>Course code</b>	<b>CE 412/ CE 612</b>
<b>Title of the course</b>	<b>Sustainable Construction</b>
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic understanding of Building Materials and Building Construction
Scope of the course	This course aims to expose the students to the environmental challenges associated with the construction industry, and their management through the use of sustainable construction practices. This course will cover the use of alternate/green materials and the benefits associated with it. Students will also be exposed to emerging concepts like Life Cycle Assessment, Circular Economy, and Building Information Modelling. It is expected by the end of this course students will be able to understand and appreciate the concept of Sustainability in Construction Practices.
Course Syllabus	<p>Sustainability in Construction: Concept of sustainability in construction, Carbon footprint, Embodied energy, Resource Management, Zero waste, 3R concept in construction</p> <p>Waste Utilization in Construction: Circular Economy, Value addition, local materials, Supplementary Cementitious Materials, Blended Cements, Recycled Aggregates, Refuse Derived Fuel</p> <p>Building Products: Fly Ash Bricks, Hollow Blocks, Precast Walls, Products for modular construction</p> <p>Biomaterials: Bamboo, Straw Bale, Bio Cementing, Plant-based Natural Fibers, Durability of Bio-Based Building Materials</p> <p>Green Building Design: Introduction to Green Building, Low Energy/ Energy Efficient Building Units, Landscape Management, Building Information Modelling (BIM)</p> <p>Assessment Methods: Life Cycle Assessment (LCA), Leadership in Energy &amp; Environmental Design (LEED), Green Rating for Integrated Habitat Assessment (GRIHA).</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. C. J. Kibert, <b><i>Sustainable Construction, Green Building Design and Delivery</i></b>, John Wiley &amp; Sons, Inc, New Jersey, 2016, 9781119055174.</li> <li>2. F. Dodds, L. Beg, K. Hardcastle, M. Campbell, R. Fairclough and T. Callanan, <b><i>Eco-efficient construction and building materials</i></b>, Woodhead Publishing India Private Limited, New Delhi, 2014,9780857097675</li> <li>3. G. M. Sabnis, <b><i>Green Building with Concrete, Sustainable Design and Construction</i></b>, CRC Press, Florida, 2015, 9781498704113</li> <li>4. BIS, <b><i>Coarse and Fine Aggregate for Concrete, Specification</i></b>, Bureau of Indian Standards, New Delhi, 2016</li> </ol>

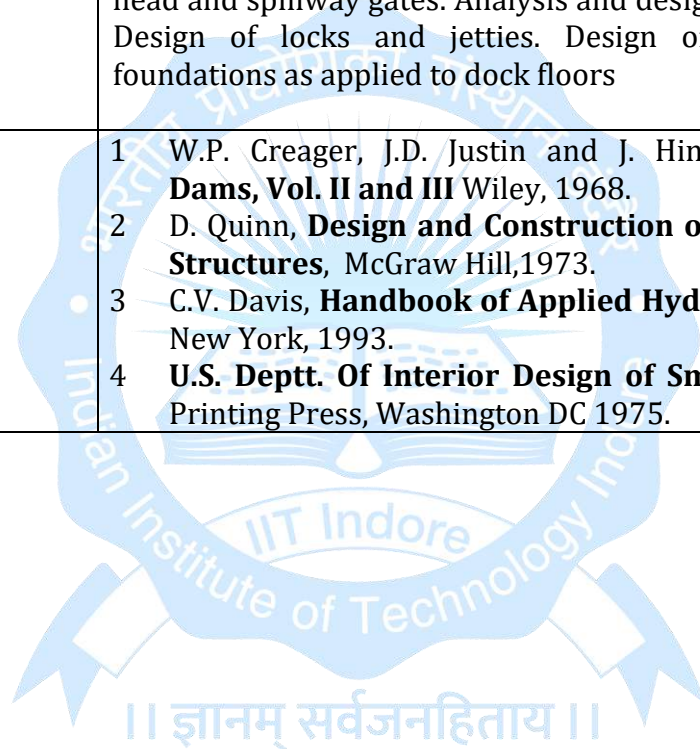
Course Code	CE 414/ CE 614
Title of the Course	<b>Design of Short and Medium Span Bridges</b>
Credit Structure	L-T-P- Credits 2-1-0-3
Name of the Concerned Discipline	Civil Engineering
Pre-requisite, if any	Design of concrete structures and design of steel structures
Objectives of the course	To provide the students a thorough understanding on the analysis and design of different types of short and medium span bridges.
Course Syllabus	<ul style="list-style-type: none"> <li>• Introduction-Definition, components of a bridge, classification of bridges, selection of site, and economical span. Standard specifications for road and railways bridges, width of carriage way, clearances, types of bridges and their suitability, Indian Road Congress (IRC) loading, Indian Railway Standard (IRS) Loads and permissible stresses.</li> <li>• Design of RCC and PSC slab culvert bridges.</li> <li>• Design of RCC and PSC T-beam bridges.</li> <li>• Design of single span steel truss bridges and plate girder bridges.</li> <li>• Design of bearings, pier and pier cap.</li> </ul>
Suggested Books	<p><b>Text Books:</b></p> <ul style="list-style-type: none"> <li>• D. J. Victor, <b>Essentials of Bridge Engineering</b>, 6th Edition, Oxford &amp; IBH Publishing Co. Pvt. Ltd., New Delhi, 2008</li> <li>• N. K. Raju, <b>Design of Bridges</b>, 3rd Edition, Oxford &amp; IBH Publishing Co. Pvt. Ltd., New Delhi, 2006</li> <li>• N. Rajgopal, <b>Bridge Superstructure</b>, Narosa Publishing House, New Delhi, 2006</li> <li>• V. K. Raina, <b>Concrete bridge Practice, Analysis: Design and Economics</b>, TMH, 2002</li> </ul> <p><b>Reference Books:</b></p> <ul style="list-style-type: none"> <li>• E. Ellobody, <b>Finite Element Analysis and Design of Steel and Steel-Concrete Composite Bridges</b>, Elsevier Science, 2014,</li> <li>• J. Romo, <b>High-speed Railway Bridges - Concept Design Guideline</b>, Wiley, 2023.</li> <li>• H. Xia, N. Zhang, W. Guo, <b>Dynamic Interaction of Train-Bridge Systems in High-Speed Railways - Theory and Applications</b>, Springer Berlin Heidelberg, 2017.</li> </ul>

<b>Course Code</b>	<b>CE 618/ CE 418</b>
<b>Title of the Course</b>	<b>Disaster Management</b>
<b>Credit Structure</b>	L-T- P-Credits 2-1-0-3
<b>Name of the Concerned Department</b>	Civil Engineering
<b>Pre-requisite, if any</b>	None
<b>Objectives of the course</b>	To understand different types of disaster, their forecasting, prevention and mitigation methods. The course is intended to create scientific awareness amongst graduates.
<b>Course Syllabus</b>	Terminology-Disaster;Hazard;Vulnerability;Risk;disaster management. Types, Causes and Consequences- Geological, hydro-meteorological, biological, technological, anthropogenic, climate change and urban disasters. Disaster management cycle- pre-disaster (risk assessment, mapping, zonation, prevention and mitigation, early warning, preparedness, awareness); during disaster (evacuation, communication, search and rescue, command system, relief and rehabilitation); post disaster (damage and needs assessment, restoration, recovery, reconstruction, hyogo framework). Disaster Management in India – Disaster profile, disaster management act, national policy, national guidelines, role of government, role of agencies. Applications of Science and Technology- GIS, GPS, RS; Early warnings and communication; Planning and development; disaster safe designs; Institutions In India.
<b>Suggested Books</b>	<ol style="list-style-type: none"> <li>1. Coppola D P, 2007. <b><i>Introduction to International Disaster Management</i></b>, Elsevier Science (B/H), London.</li> <li>2. <b><i>An overview on natural &amp; man-made disasters and their reduction</i></b>, R K Bhandani, CSIR, New Delhi</li> <li>3. <b><i>Manual on natural disaster management in India</i></b>, M C Gupta, NIDM, New Delhi</li> <li>4. <b><i>Encyclopedia of disaster management, Vol I, II and III</i></b> <b><i>Disaster management policy and administration</i></b>, S L Goyal, Deep &amp; Deep, New Delhi, 2006</li> <li>5. <b><i>Disasters in India Studies of grim reality</i></b>, Anu Kapur &amp; others, 2005, 283 pages, Rawat Publishers, Jaipur</li> <li>6. <b><i>Natural Disasters</i></b>, David Alexander, Kluwer Academic London, 1999, 632 pages</li> <li>7. <b><i>High Power Committee Report</i></b>, 2001, J.C. Pant</li> <li>8. <b><i>World Disasters Report</i></b>, 2009. International Federation of Red Cross and Red Crescent, Switzerland</li> <li>9. <b><i>Encyclopedia of Disasters – Environmental Catastrophes and Human Tragedies</i></b>, Vol. 1 &amp; 2, Angus M. Gunn, Greenwood Press, 2008</li> <li>10. <b><i>Disaster Management Act 2005</i></b>, Publisher by Govt. of India</li> <li>11. <b><i>Management of Natural Disasters in developing countries</i></b>, H.N. Srivastava &amp; G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages</li> </ol>

	12. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
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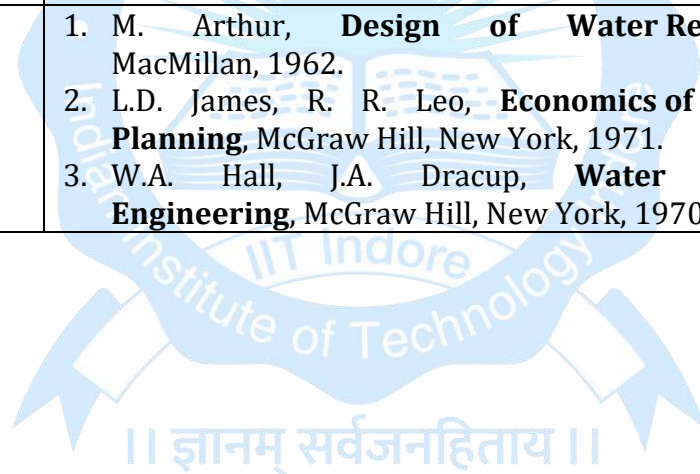


Course Code	<b>CE 422</b>
Title of the Course	<b>Hydraulic Structures</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Detailed stress analysis of gravity dam, stress concentration around openings. Principles of design of outlets and galleries. Design of pen stocks and anchor blocks. Detailed design of high head and spillway gates. Analysis and design of surge chambers. Design of locks and jetties. Design of beams on elastic foundations as applied to dock floors
Suggested Books	<ol style="list-style-type: none"> <li>1 W.P. Creager, J.D. Justin and J. Hinds, <b>Engineering for Dams, Vol. II and III</b> Wiley, 1968.</li> <li>2 D. Quinn, <b>Design and Construction of Ports and Marine Structures</b>, McGraw Hill, 1973.</li> <li>3 C.V. Davis, <b>Handbook of Applied Hydraulics</b>, McGraw Hill, New York, 1993.</li> <li>4 <b>U.S. Deptt. Of Interior Design of Small Dams</b>, U.S. Govt. Printing Press, Washington DC 1975.</li> </ol>



Course Code	<b>CE 424</b>
Title of the Course	<b>Ground Water Hydrology</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Occurance of groundwater aquifer types. Exploration of groundwater. Groundwater budget. Resistivity methods. Darcy's law and its limitations. Formulation of governing equations for groundwater movement. Flow nets and its uses. Hydraulics of flow towards wells. Aquifer unsteady flow. Theis, Jacob and Chow's methods multiple well system.</p> <p>Artificial recharge. Infiltration. Mechanics of recharge, stream aquifer interaction. Water logging. Theory of subsurface drainage. Seawater intrusion and its control, Approximate solution. Digital, Analog and Simple finite difference models for groundwater flow. Groundwater quality, Groundwater development and management.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1 H.M. Raghunath, <b>Groundwater, 2nd Edition</b> Wiley Eastern Ltd., 1987.</li> <li>2 D.K. Todd, <b>Groundwater Hydrology</b>, John Wiley and Sons, 1980.</li> <li>3 D.B. McWhorteer, D.K. Sundada, <b>Ground-Water Hydrology and Hydraulics</b>, Water Resources Publications, Fort Collins Colorado, U.S.A. 1977.</li> <li>4 C.W. Fetter, <b>Applied Hydrogeology, 2nd Edition</b>, CBS Publishers and Distributors, New Delhi, 1990.</li> </ol>

Course Code	<b>CE 426</b>
Title of the Course	<b>Water Resources System</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Objective of water resources development, economic analysis and discounting techniques, conditions of project optimality, graphic optimization techniques for multipurpose projects, analytical optimization techniques for water resources projected by linear programming, non-linear programming and dynamic programming, optimization by simulation, mathematical models for large scale multipurpose projects, different case studies, stochastic optimization techniques, water quality subsystems, optimum operation model for reservoir systems by incremental dynamic programming, sequencing of multipurpose project.
Suggested Books	<ol style="list-style-type: none"> <li>1. M. Arthur, <b>Design of Water Resources Systems</b>, MacMillan, 1962.</li> <li>2. L.D. James, R. R. Leo, <b>Economics of Water Resources Planning</b>, McGraw Hill, New York, 1971.</li> <li>3. W.A. Hall, J.A. Dracup, <b>Water Resources Systems Engineering</b>, McGraw Hill, New York, 1970.</li> </ol>



Course Code	<b>CE 428/ CE 628</b>
Title of the Course	<b>Theory of Plates and Shells</b>
Course Category	Departmental Elective
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Department of Civil Engineering
Pre-requisite, if any	Nil
Course Objective	To understand the basic concept, mathematical modeling, behavior and analysis of plate and shell structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• To be able to compute stresses and strains on thin plates and shells.</li> <li>• To be able to formulate the buckling loads of plates and shells.</li> <li>• To be able to formulation finite element code for solution of plate and shell equations.</li> </ul>
Course Content	<ol style="list-style-type: none"> <li>1. Thin plates and shells - Kirchoff theory, strains and stresses, constitutive relations, equilibrium equations, buckling, and numerical solutions.</li> <li>2. Thick plates and shells - Reissner-Mindlin-Naghadi theories, shear correction factors, equilibrium equations, buckling, and numerical solutions.</li> <li>3. Membrane and bending theories; shallow shell theory; equilibrium equations for simple shell forms considering membrane.</li> <li>4. Finite Element formulations of plate and shell elements.</li> </ol>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. S.P Timoshenko and S.W. Krieger: <i>Theory of Plates and Shells</i>, Tata McGraw-Hill Edition: 2010: 9780070701250</li> <li>2. J.N Reddy: <i>Theory and Analysis of Elastic Plates and Shells</i>, CRC Press: 2006: 9780849384165</li> <li>3. G.S Ramaswamy: <i>Design and Construction of Concrete Shell Roofs</i>, CBS Publishers and Distributors Pvt. Ltd: 2005: 9788123909905</li> <li>4. Robert Millard Jones: <i>Buckling of Bars, Plates, and Shells</i>, Bull Ridge Publishing: 2006: ISBN: 9780978722302.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. M. Reza Eslami: <i>Buckling and Postbuckling of Beams, Plates, and Shells</i>, Springer International Publishing: 2017: ISBN: 9783319623689.</li> <li>2. E. Carrera, S. Brischetto, P. Nali: <i>Plates and Shells for Smart</i></li> </ol>

*Structures - Classical and Advanced Theories for Modeling and Analysis*, Wiley: 2011: ISBN: 9781119951124.

3. M. S. Qatu: *Vibration of Laminated Shells and Plates*, Elsevier Science: 2004: ISBN: 9780080474762.

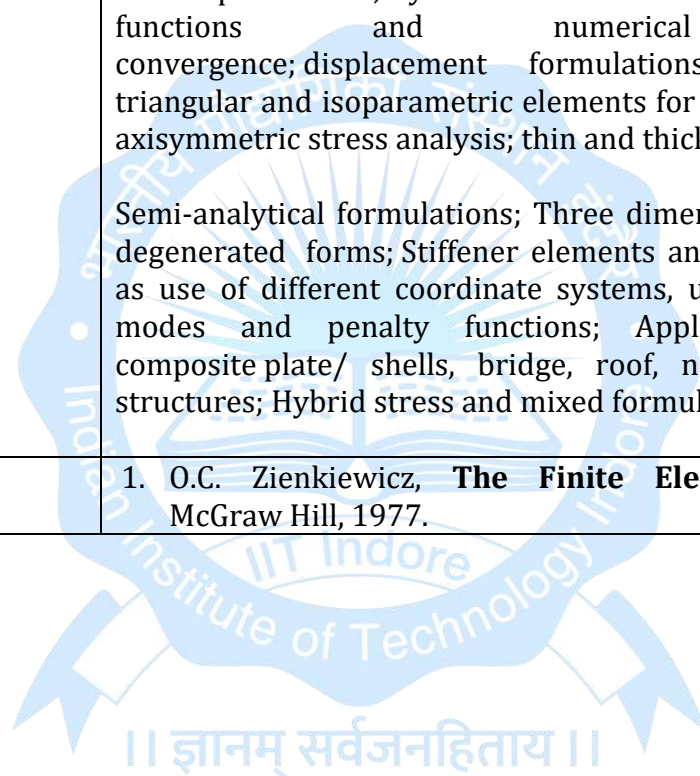


<b>Course Code</b>	<b>CE 430/ CE 630</b>
<b>Title of the Course</b>	<b>Elastic Stability</b>
Course Category	Departmental Elective
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Department of Civil Engineering
Pre-requisite, if any	NIL
Course Objective	To understand different states of structural stability and solution approaches for the critical loads
Course Outcomes	<ul style="list-style-type: none"> <li>• To be able to compute bifurcation points on the equilibrium path.</li> <li>• To be able to calculate buckling loads of beam-column, truss, frame, and plates.</li> <li>• To be able to solve stability equations using different numerical approaches.</li> </ul>
Course Content	<ol style="list-style-type: none"> <li>1. Definition, bifurcation of equilibrium, types of buckling,</li> <li>2. Stability analysis of structural problems - beam-column, truss, plates and frames.</li> <li>3. Approximate methods - Rayleigh, Timoshenko, and Ritz methods.</li> <li>4. Numerical approaches to solve the non-linear stability problems.</li> </ol>
Suggested Books	<p><b>Textbooks:</b></p> <ol style="list-style-type: none"> <li>1. NGR Iyengar: <i>Elastic Stability of Structural Elements</i>: Macmillan India: 2007: ISBN: 9780230631861</li> <li>2. S.P. Timoshenko, J.M. Gere: <i>Theory of Elastic Stability</i>: Dover Publications: 2012: ISBN: 9780486134802</li> <li>3. A. Kumar: <i>Stability of Structures</i>: McGraw-Hill Education: 1998: ISBN: 978-0074515167.</li> <li>4. George J. Simitses: <i>An Introduction to the Elastic Stability of Structures</i>: Krieger Publishing Company: 1986: ISBN: 978-0898749144</li> </ol> <p><b>Reference Books:</b></p> <ol style="list-style-type: none"> <li>1. D. Bushnell: <i>Computerized Buckling Analysis of Shells</i>, Springer Netherlands: 2012: ISBN: 9789400950634.</li> <li>2. S. Jerath: <i>Structural Stability Theory and Practice Buckling of Columns, Beams, Plates, and Shells</i>, Wiley: 2020: ISBN: 9781119694496.</li> <li>3. M. Pignataro, N. Rizzi, A. Luongo: <i>Stability, Bifurcation and Postcritical Behaviour of Elastic Structures</i>, Elsevier Science: 2013: ISBN: 9781483290836.</li> <li>4. G. Simitses, D. H Hodges, <i>Fundamentals of Structural Stability</i>, Elsevier Science: 2006: ISBN: 9780750678759.</li> </ol>

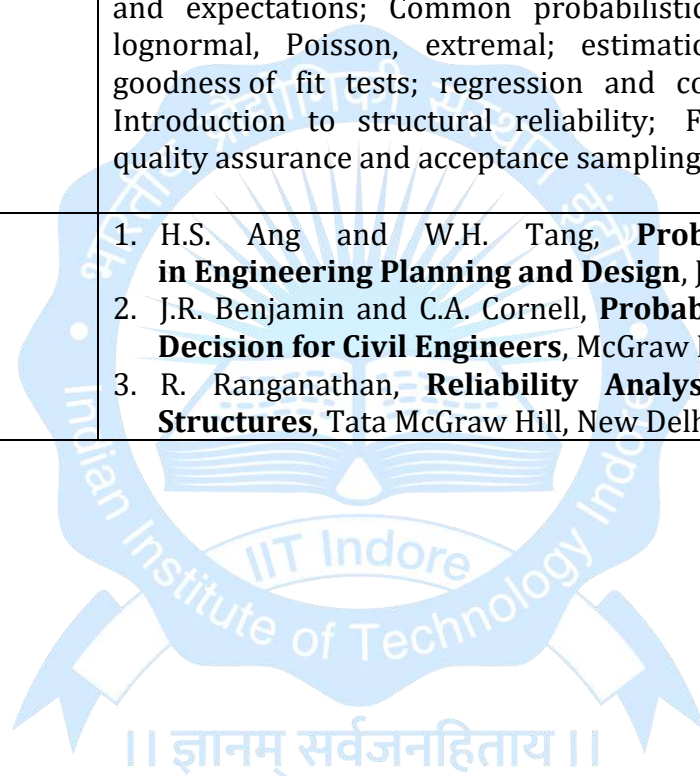
Course Code	<b>CE 432/ CE 632</b>
Title of the Course	<b>Plastic Analysis and Design</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Yield conditions and concepts of simple plastic collapse, collapse criterion, virtual work in elasto-plastic state, theorems of plastic collapse, methods of analysis and design. Graphical method, method of combining mechanisms, computer aided elasto-plastic analysis, interaction diagrams, applications to planar and space structures – multi-bay frames,, multistoried frames, grids, arches, virendeel girders, deflection at collapse, incremental collapse, minimum weight analysis, variable repeated loads, shakedown analysis, combined stress problems.
Suggested Books	<ol style="list-style-type: none"> <li>1 J. Heyman, <b>Beams and Framed Structures</b>, Second ed., Pergmon Press, Oxford.</li> <li>2 B.G. Neal, <b>Plastic Methods of Structural analysis</b>, Chapman and Hall.</li> <li>3 M.R. Horne, <b>Plastic theory of structures</b>, 2nd Ed., Pergamon Press, 1979.</li> <li>4 H.B. Harrison, <b>Structural analysis and Design</b>, 2ndf Ed., Pergman Press.</li> <li>5 P.G. Hodge, (Jr.), <b>Plastic Analysis of Structures</b>, McGraw Hill.</li> <li>6 J.A. Koing, <b>Shakedown of Elastic-Plastic Structures</b>, Elsevier, 1987.</li> <li>7 A.A. Cyras, <b>Mathematical Models for the analysis and Optimization of Elasto Plastic Structures</b>, Ellis Horwood Ltd., 1983.</li> <li>8 J. Baker and J. Heyman, <b>Plastic Design of Frames</b>, Cambridge University Press, 1969.</li> <li>9 B.P.Parikh, J.H. Daniels and L. Lu, <b>Plastic Design of Multi-story frames Design aids</b>, Lehigh University, Bethlhem Pennsylvania.</li> </ol>

Course code	CE 434/ CE 634
Title of the course	Numerical Methods in Civil Engineering
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	NA
Scope of the course	This course is designed for mainly engineering students to enhance their numerical techniques. In engineering, many complex problems do not have explicit analytical solutions, and in these cases, numerical techniques are extremely beneficial. In addition to providing basic numerical strategies, this course introduces some advanced concepts for solving non-linear differential and integral equations, which are expected to be helpful in B Tech, M Tech, and Ph.D. thesis works.
Course Syllabus	Computer applications in Civil Engineering, typical problem categories, techniques for linear problems, techniques for nonlinear problems. Iterative solutions for linear and non linear systems. Algorithms in time domain using Runge - Kutta methods. Newmark B-method and finite-difference approaches, concept of stability of algorithm, propagation of errors in different algorithms. Numerical Differentiation, Difference operators (forward, backward and central difference). Stability and accuracy of solutions. Application of finite difference operators to solve initial and boundary value problems. Numerical solutions of integral equations, Types of integral equations. Fredholm integral equations of the first and second kind. Fredholm's Alternative theorem. Collocation and Galerkin methods for solving integral equations. Use of commercial software for Civil Engineering Problems
Suggested Books	<ol style="list-style-type: none"> <li>1. A. Jennujs, <b>Matrix computations for Engineers and Scientists</b>, John Wiley &amp; Sons, Rumford, ME, USA, 1977, 978-0471994213</li> <li>2. S.D. Conte and C-de Boor, <b>Elementary Numerical Analysis, An algorithmic approach</b>, McGraw Hill, New York, USA , 1980 , 978-0070662285</li> <li>3. G. Dahlquist and Å. Bjorck, <b>Numerical Methods</b>, Dover Books, NY, USA , 2003 , 978-0486428079</li> <li>4. S.Guha and R. Srivastava, <b>Numerical Methods</b>, Oxford University Press, 2010, 019-569348-5</li> </ol>

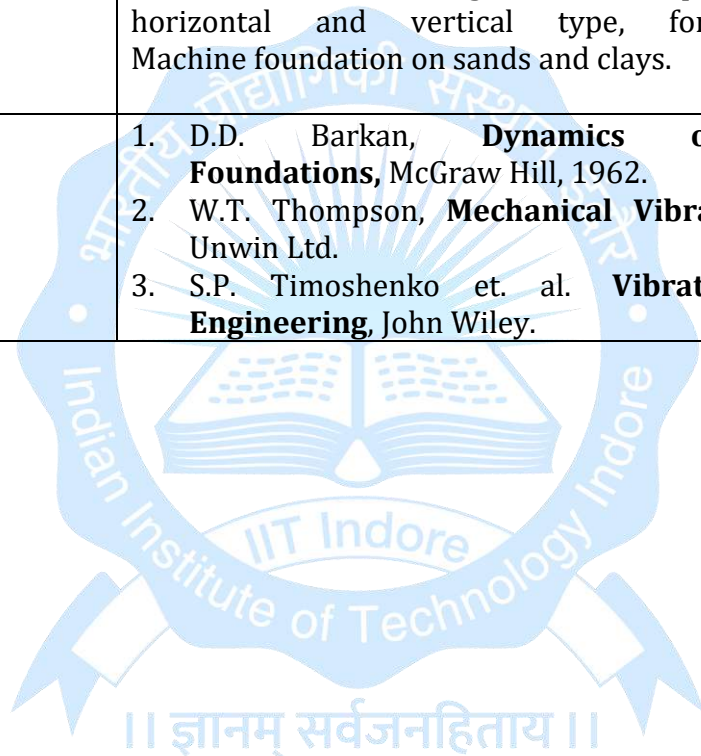
Course Code	<b>CE 436</b>
Title of the Course	<b>Finite Element Analysis</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Principles of discretization; Element stiffness mass formulation based on direct, variational and weighted residual techniques and displacements, hybrid stress and mixed approaches, shape functions and numerical integrations, convergence; displacement formulations for rectangular, triangular and isoparametric elements for two dimensional and axisymmetric stress analysis; thin and thick plates and shells;</p> <p>Semi-analytical formulations; Three dimensional elements and degenerated forms; Stiffener elements and modifications such as use of different coordinate systems, use of nonconforming modes and penalty functions; Application to layered composite plate/ shells, bridge, roof, nuclear and offshore structures; Hybrid stress and mixed formulations for plates.</p>
Suggested Books	1. O.C. Zienkiewicz, <b>The Finite Element Method</b> , Tata McGraw Hill, 1977.



Course Code	<b>CE 438</b>
Title of the Course	<b>Probabilistic and Statistical Methods in Civil Engineering</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Role of probability in Civil Engineering; Random events, Random variables; functions of random variables; moments and expectations; Common probabilistic models - normal, lognormal, Poisson, extremal; estimation of parameters; goodness of fit tests; regression and correlation analyses, Introduction to structural reliability; FORM; elements of quality assurance and acceptance sampling.
Suggested Books	<ol style="list-style-type: none"> <li>1. H.S. Ang and W.H. Tang, <b>Probability Concepts in Engineering Planning and Design</b>, John Wiley, 1975.</li> <li>2. J.R. Benjamin and C.A. Cornell, <b>Probability Statistics and Decision for Civil Engineers</b>, McGraw Hill, 1975.</li> <li>3. R. Ranganathan, <b>Reliability Analysis and Design of Structures</b>, Tata McGraw Hill, New Delhi, 1990.</li> </ol>

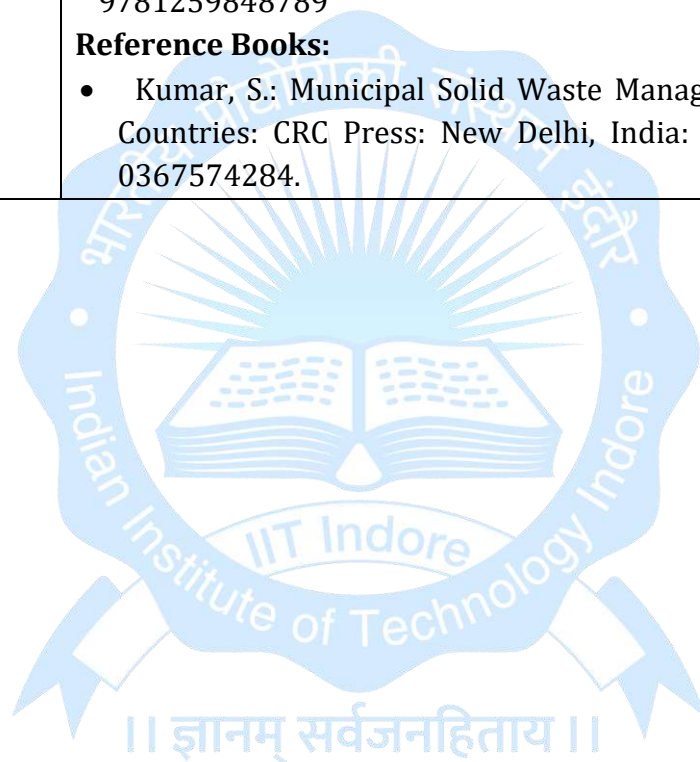


Course Code	<b>CE 442</b>
Title of the Course	<b>Machine Foundations</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Principles of SHM, forced and damped vibrations in soil media. Tests for evaluation of dynamic coefficients. Design of simple foundations for turbo-generators, reciprocating engines of horizontal and vertical type, forge hammer etc. Machine foundation on sands and clays.
Suggested Books	<ol style="list-style-type: none"> <li>1. D.D. Barkan, <b>Dynamics of Bases and Foundations</b>, McGraw Hill, 1962.</li> <li>2. W.T. Thompson, <b>Mechanical Vibrations</b>, George Allen Unwin Ltd.</li> <li>3. S.P. Timoshenko et. al. <b>Vibration Problems in Engineering</b>, John Wiley.</li> </ol>

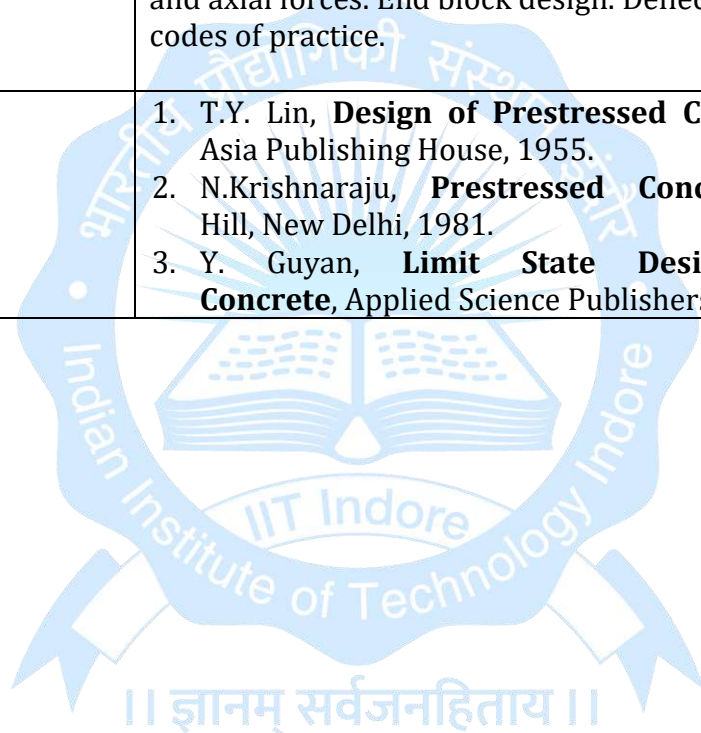


<b>Course code</b>	<b>CE 444/ CE 644</b>
<b>Title of the course</b>	<b>Solid Waste Engineering and Management</b>
Credit Structure	L-T-P-Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite if any	NA
Scope of the course	This course aims to impart knowledge regarding various elements of waste management, including Municipal and Industrial sources highlighting the related engineering principles, processes, and treatment.
Course Outcomes	Understanding the impact of professional engineering solutions in societal and environmental contexts and demonstrating the knowledge of and need for sustainable development.
Course Syllabus	<ol style="list-style-type: none"> <li>1. <b>Introduction to Solid Waste Management:</b> Definitions; Classification of Wastes; Different waste streams and their sources; Waste generation rates and its Quantification; Waste Composition; Solid waste management system in India.</li> <li>2. <b>Solid Waste Management Strategies &amp; Technologies:</b> Concept of 3R's, Municipal Solid Waste Management functional system, Biological Treatment (Anaerobic digestion, Composting), Thermal Treatment (Pyrolysis, Incineration), Refused derived fuels, Sanitary Landfilling; Lifecycle Assessment approach in Solid Waste Management Systems.</li> <li>3. <b>Engineering Aspects of Solid Waste Management:</b> Concept of Circular Economy, Appropriate Waste Processing Technology Selection techniques, Sampling and Physico-chemical characterization of Solid Wastes; Design of Reactors/Engineering systems for treatment of Organic waste streams viz composting, biomethanation, RDF and Gasification, Kinetics of organic waste degradation, Site Selection for landfills, Design aspects of Sanitary Engineered landfills.</li> <li>4. <b>legislations for Solid Waste Management:</b> Salient features of Indian Legislations on management and handling of different waste streams, Overview of various Government Initiatives including Swachh Bharat Mission, GOBAR-dhan (Galvanizing Organic Bio-Agro Resources) Scheme, Jal Shakti Abhiyaan, Waste to Energy.</li> </ol>

	<p>5. <b>Practical Demonstrations:</b> Real-time practical demonstration of solid waste sampling techniques, Characterization, and Treatment of solid waste.</p> <p>6. <b>site Visits:</b> Case studies of different cities of India, Visiting Operational Waste to Energy plants/Biogas plants/Composting plants/ Waste Recycling plants/Sanitary Landfill sites.</p>
Suggested Books	<p><b>Textbooks:</b></p> <ul style="list-style-type: none"> <li>• Tchobanoglous, G., Theisen, H., &amp; Vigil, S. A.: Integrated Solid Waste Management: Engineering Principles and Management Issues: McGraw-Hill Education: New York, USA: 2019: 9781259848789</li> </ul> <p><b>Reference Books:</b></p> <ul style="list-style-type: none"> <li>• Kumar, S.: Municipal Solid Waste Management in Developing Countries: CRC Press: New Delhi, India: 2020: ISBN-13: 978-0367574284.</li> </ul>

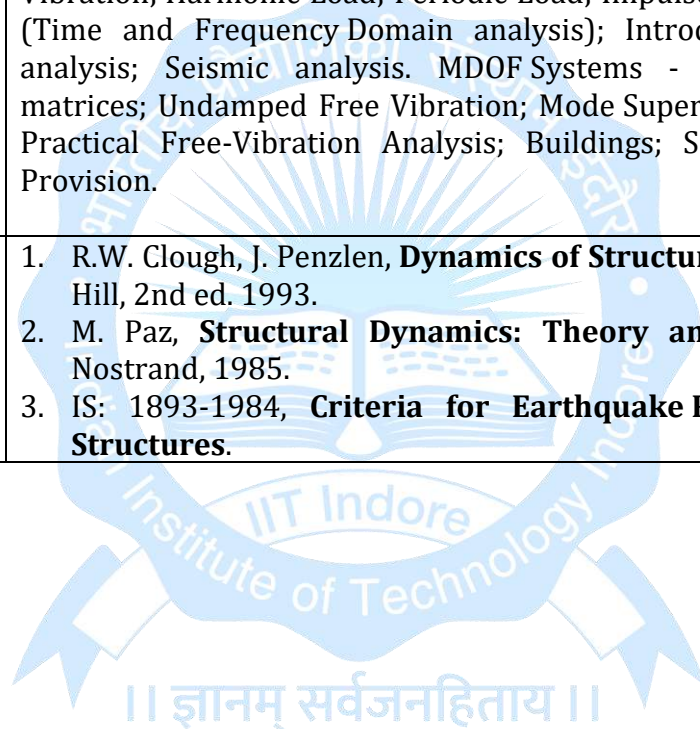


Course Code	<b>CE 448</b>
Title of the Course	<b>Prestressed Concrete Design</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Pre-stressing concepts, materials, systems of prestressing and losses. Introduction to working stress method, limit state analysis and design of members for bending. Shear torsion and axial forces. End block design. Deflections, use of relevant codes of practice.
Suggested Books	<ol style="list-style-type: none"> <li>1. T.Y. Lin, <b>Design of Prestressed Concrete Structures</b>, Asia Publishing House, 1955.</li> <li>2. N.Krishnaraju, <b>Prestressed Concrete</b>, Tata McGraw Hill, New Delhi, 1981.</li> <li>3. Y. Guyan, <b>Limit State Design of Prestressed Concrete</b>, Applied Science Publishers, 1972.</li> </ol>



Course Code	<b>CE 648/ CE 448</b>
Title of the Course	<b>Prestressed Concrete Design</b>
Course Category	Core
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Department of Civil Engineering
Pre-requisite, if any	Nil
Course Objective	To study the effect of initial stresses in the concrete for structural engineering applications.
Course Outcomes	<ul style="list-style-type: none"> <li>• Learning of initial stress effect into the concrete</li> <li>• Stress and strain behavior of Prestressed concrete</li> <li>• Design of prestressed structural elements</li> </ul>
Course Content	<ol style="list-style-type: none"> <li>1. Introduction of prestressing, Materials required Prestressing systems and methods of prestressing, Analysis of prestressed concrete sections, and prestress losses.</li> <li>2. Prestressed concrete slabs, beams, tank, and pipes, Prediction of long-term deflections due to creep and shrinkage, use of relevant codes of practice,</li> <li>3. Partial prestressing, Methods of achieving partial prestressing, Merits and demerits of partial prestressing.</li> </ol>
Suggested Books	<p>Textbook</p> <ol style="list-style-type: none"> <li>1. Prestressed Concrete by N. Krishna Raju, 2018, Edition: 6th Publisher: McGraw Hill Education. ISBN: 978-9387886209</li> <li>2. Design Of Prestressed Concrete by H. Nilson 1987, Edition: 2nd Publisher: John Wiley &amp; Sons, ISBN: 978-0471830726</li> </ol> <p>Reference Book</p> <ol style="list-style-type: none"> <li>3. Design of Prestressed Concrete Structures by Tung-Yen Lin, 2010 Edition: 3rd, Publisher: John Wiley &amp; Sons, ISBN: 978-9812531179</li> </ol>

Course Code	<b>CE 462/ CE 662</b>
Title of the Course	<b>Structural Dynamics</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	SDOF System - Equation of Motion; Generalized SDOF system; Free Vibration; Harmonic Load; Periodic Load; Impulse Load; General Loads (Time and Frequency Domain analysis); Introduction of Nonlinear analysis; Seismic analysis. MDOF Systems - Systems - Property matrices; Undamped Free Vibration; Mode Superposition Techniques ; Practical Free-Vibration Analysis; Buildings; Seismic analysis; Code Provision.
Suggested Books	<ol style="list-style-type: none"> <li>1. R.W. Clough, J. Penzlen, <b>Dynamics of Structures (2<sup>nd</sup> Ed.)</b>, McGraw Hill, 2nd ed. 1993.</li> <li>2. M. Paz, <b>Structural Dynamics: Theory and Computation</b>, Van Nostrand, 1985.</li> <li>3. IS: 1893-1984, <b>Criteria for Earthquake Resistant Design of Structures.</b></li> </ol>

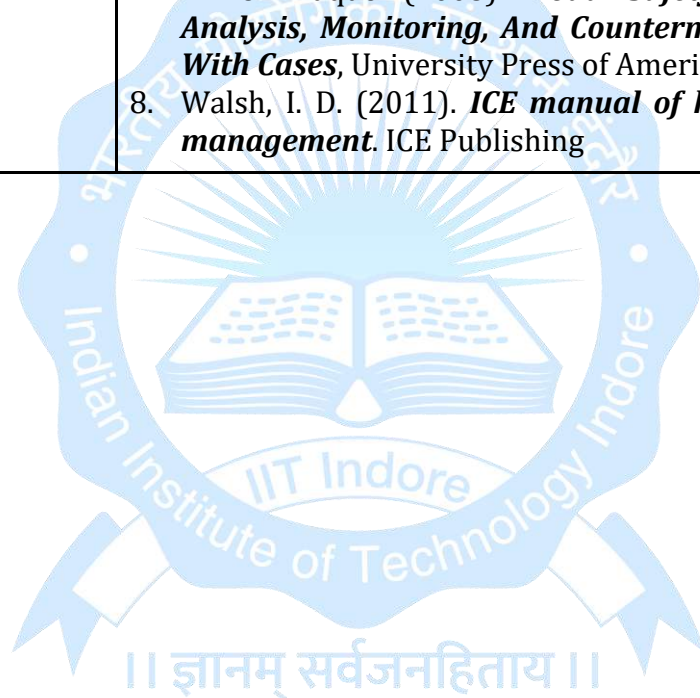


Course Code	<b>CE 664/ CE 464</b>
Title of the Course	<b>Advanced Solid Mechanics</b>
Course Category	<b>Core</b>
Credit Structure	L-T-P-Credits2-1-0-3
Name of the Concerned Department	Department of Civil Engineering
Pre-requisite, if any	Nil
Scope of the course (Objectives)	To provide fundamental and advanced structures with reference to applications. Concepts of mechanics.
Course Outcomes	<ul style="list-style-type: none"> <li>• To be able to derive generalized balance laws using tensorial notations.</li> <li>• To be able to incorporate different material behaviors in the continuum equations.</li> <li>• To be able to solve using analytical techniques and interpretation of the results.</li> </ul>
Course Syllabus	<ol style="list-style-type: none"> <li>1. Introduction to tensors and indicial notation, Divergence theorem. Elementary measures of strain. Deformation gradient, Polar decomposition, Cauchy-Green, and Lagrangian strain tensors. Mass, momentum, and energy balance.</li> <li>2. Constitutive relation for small deformation, St. Venant-Kirchoff materials. Hyperelastic and viscoelastic solids, uniaxial stretch, pure bending of a beam, torsion of a structural member.</li> <li>3. Exact solutions for bending and stretching of a rectangular elastic block. Linearized elasticity: bending and torsion.</li> </ol>
Suggested Books	<p>Text Books:</p> <ol style="list-style-type: none"> <li>1. L. E. Malvern (1969), Introduction to the mechanics of a continuous medium, Prentice Hall Inc. Englewood Cliffs, N J., ISBN: 0134876032.</li> <li>2. C. S. Jog (2015), Continuum Mechanics, Vol. 1, Cambridge University Press, ISBN: 9781316134054.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. M. E. Gurtin (1982), Introduction to continuum mechanics, Vol. 158, 1st Edition, Academic Press, ISBN: 9780123097507.</li> <li>4. A. E. Green and W. Zerna (1968), Theoretical elasticity, 2nd Edition, Dover Publications, ISBN: 9780486670768.</li> </ol>

Course Code	<b>CE 470</b>
Title of the Course	<b>Transportation Planning</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Development objectives and goals, five year plans, levels of planning (urban and regional), regional planning and development theories and techniques, types and delineation of regions. Human settlement patterns.</p> <p>Role of transport in national development. Social, economic and political functions.</p> <p>Transport system and its subsystems. Transport modes and technologies. Family of modes; vehicles, travel ways, stops, stations and garages, operational performance, cost, energy, present and future roles.</p> <p>Road transport, rail transport, air transport, water transport new and future modes.</p> <p>Transport economics, theories, techniques, costs and benefits. Transport systems planning. Travel demand forecasting methods and models. Intermodel mix network optimization theories and techniques. Decision making. Transport and energy type and quantity of energy, efficiency, constrains, transport and environment transport management (policy, organisation, legal provisions), integration and coordination, information systems, data base.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. Prakash Rao and Sundaram, <b>Regional Development Planning in India</b>, Vikas Publishing House, 1974.</li> <li>2. B.G. Hutchinson, <b>Introduction to Urban Transportation Systems Planning</b>, McGraw Hill, 1974.</li> <li>3. Vukan R. Vuchic, <b>Urban Public Transportation Systems and Technology</b>, Prentice Hall Inc., N.J., 1981.</li> <li>4. G.E. Gray and L.A. Hoel, <b>Public transportation Planning Operations and Management</b>, Prentice Hall Inc., N.J., 1979.</li> </ol>

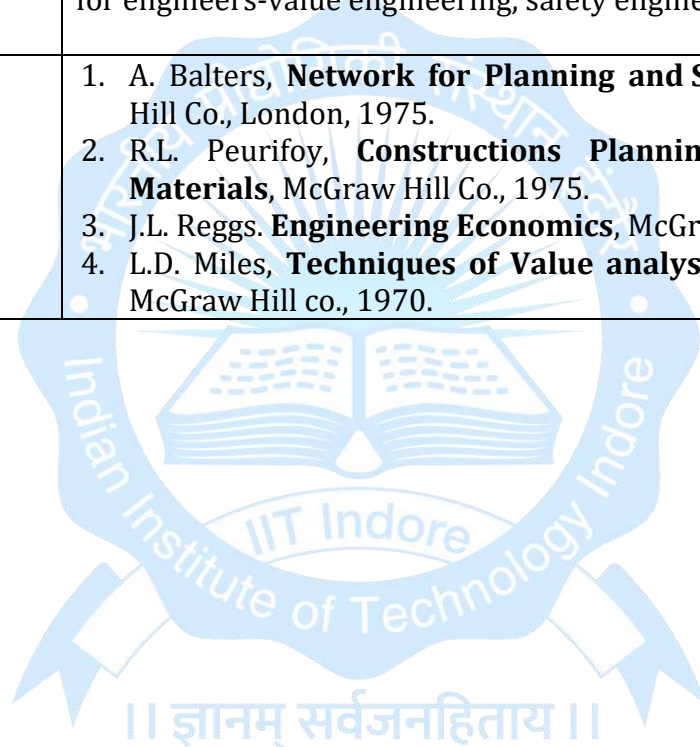
<b>Course Code</b>	<b>CE 674/ CE 474</b>
<b>Title of the Course</b>	<b>Road Safety</b>
Credit Structure	L-T-P-Credit 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Course Objective	The course is designed to provide an overview on road safety of engineering and behavioural aspects. Through his course students will gain basic understanding of the road environment, road safety issues, role of human errors (road users) and the application of this knowledge, knowledge concerning the causes, analysis and consequences of accidents, road safety measures and audit.
Course Syllabus	<i>Introduction to Road Safety Engineering:</i> accidents, causes of crash, characteristics and type of road crashes, road safety issues, road safety scenario of India, factors contributing to road accidents, contribution and consequences of speeding; <i>Driver Cognition and Automotive User-Experience:</i> situation awareness, distracted driving, fatigue, stress, in-vehicle and out-vehicle information processing, human-machine collaborations for automated driving, road rage & aggressive driving, aging & driving, emergency Response Support, drugs & alcohol; <i>Accident Data Collection &amp; Management;</i> <i>Crash Investigation &amp; Analysis;</i> <i>Accident Remedial Schemes:</i> process, detailed site analysis, measuring the effectiveness of accident remedial schemes; <i>Road Safety Measures and Culture:</i> road alignments, road sign and pavements markings, street lighting and traffic signal, pedestrian facilities, training, education, awareness of traffic rules, rehabilitation, law-enforcement; Road Safety Audit (RSA).

Suggested Books	<ol style="list-style-type: none"> <li>1. B. E. Porter (2011). <b>Handbook of Traffic Psychology</b>, Elsevier Science Academic Press. ISBN: 9780123819857, 0123819857.</li> <li>2. D. Shinar (2017). <b>Traffic Safety and Human Behavior</b>, Emerald Publishing Limited. ISBN: 9781786352217, 1786352214.</li> <li>3. E. Rune, H. Alena, V. Truls (2009) <b>The Handbook of Road Safety Measures</b> by Emerald Group Publishing, 2nd Edition.</li> <li>4. Highway safety manual (2010). American Association of State Highway and Transportation Officials: Washington, DC, USA.</li> <li>5. IRC:SP:88 (2010). Manual on road Safety Audit, Indian Roads Congress New Delhi, India: IRC.</li> <li>6. M. Belcher, P. Steve, P. Cook (2008). <b>Practical Road Safety Auditing</b> by Thomas Telford Publishing.</li> <li>7. M. O. Haque (2008). <b>Road Safety: Data Collection, Analysis, Monitoring, And Countermeasure Evaluations With Cases</b>, University Press of America.</li> <li>8. Walsh, I. D. (2011). <b>ICE manual of highway design and management</b>. ICE Publishing</li> </ol>
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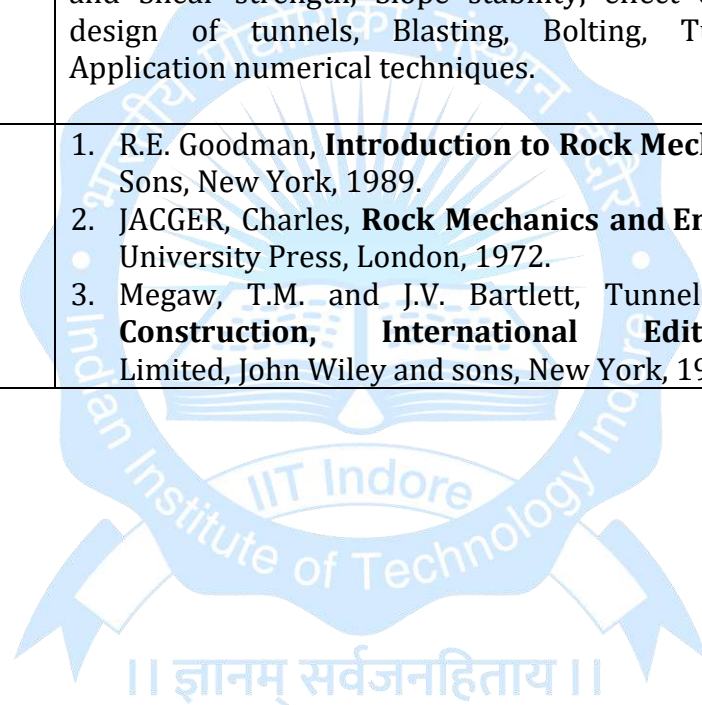
Course Code	<b>CE 480</b>
Title of the Course	<b>Computer-Aided Design of Civil Engineering Systems</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	<p>Essential features in a design software, User-machine interface, Computer graphics - coordinate systems and transformations, automatic generation of input-mapping techniques, display of response quickness, Use of object oriented programming.</p> <p>Software for various design tasks, Heuristic approaches in Civil Engineering. Tools for developing programmes involving heuristic search Expert system shells and object oriented languages, Rule based systems, Neural networks.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. Newman W.M., and Sproull, R.F. <b>Principles of Interactive Computer Graphics</b>, McGraw Hill, N.Y. 1988.</li> <li>2. Adeli H., <b>Interactive Microcomputer-aided structural steel design</b>, A New Generation, Prentice Hall, N.J., 1990.</li> <li>3. Adeli H., and Balasubramanyam, K.V., <b>Expert Systems for Structural Design</b>, Prentice Hall, N.J., 1991.</li> <li>4. Schildt H., <b>Using C++</b>, Borland-Osborne/ McGraw Hill, 1991.</li> </ol>

Course Code	<b>CE 482</b>
Title of the Course	<b>Construction Management</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Basic of construction industry organization structure. Engineering economy in construction projects-personnel, monitoring and control work study in constructions -contracting. Bidding and law for engineers-value engineering, safety engineering etc.
Suggested Books	<ol style="list-style-type: none"> <li>1. A. Balters, <b>Network for Planning and Scheduling</b>, McGraw Hill Co., London, 1975.</li> <li>2. R.L. Peurifoy, <b>Constructions Planning Equipments and Materials</b>, McGraw Hill Co., 1975.</li> <li>3. J.L. Reggs. <b>Engineering Economics</b>, McGraw Hill Co., 1976.</li> <li>4. L.D. Miles, <b>Techniques of Value analysis and Engineering</b>, McGraw Hill co., 1970.</li> </ol>



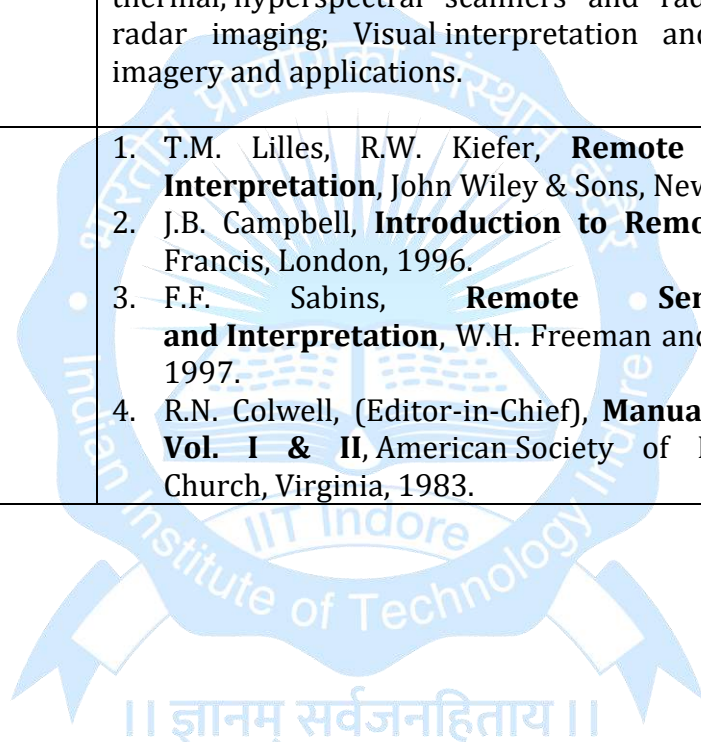
Course Code	<b>CE 484/ CE 684</b>
Title of the Course	<b>Advanced Concrete Technology</b>
Credit Structure	L-T- P-Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic knowledge of Building Materials and Concrete
Scope of the course	This course aims to develop the understanding of properties, advances and findings in the field of multifunctional concretes, focusing on the principles, design and fabrication, test and characterization, performance and mechanism, and their applications in infrastructures. It's designed to discuss the challenges in the development and application of multifunctional concretes, providing useful theory, ideas and principles.
Course Syllabus	<p><b><u>Durability of Concrete:</u></b> Early-age and the long-term performance of concrete, including issues such as its ability to be placed and compacted, properties and performance characteristics, structural movements, strength development, fire resistance and durability performance.</p> <p><b><u>Testing, Quality Assurance, Repair and Maintenance of Concrete:</u></b> Quality concepts and quality control of concretes, and test methods used both in laboratories and on site for measuring physical and chemical properties of concrete in fresh and hardened states.</p> <p><b><u>Multifunctional Concrete Production:</u></b> Types of concretes that can be used for different applications. Concepts for self-compacting concrete, functionally graded concrete, self-healing concrete, 3-D printed concrete, high performance concrete, fibre reinforced concrete, geopolymer concrete.</p>
Suggested Books	<ol style="list-style-type: none"> <li>1. Zongjin Li , <i>Advanced Concrete Technology</i>, John Wiley and Sons, 2011, 9780470437438</li> <li>2. Mark Alexander, Arnon Bentur and Sidney Mindess, <i>Durability of Concrete: Design and Construction</i>, CRC Press, 2011, 9781138746749</li> <li>3. John Newman and B S Choo <i>Advanced Concrete Technology 4</i>, Butterworth-Heinemann, 2003, 9780080489995</li> </ol>

Course Code	<b>CE 486</b>
Title of the Course	<b>Rock Mechanics and Tunnelling Technology</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Engineering properties of rocks, Surface and sub-surface investigation in rock including geophysical studies, Weathering of rocks, Discontinuities, Field and laboratory testing of rocks and rock masses, Stress-strain characteristics, Deformability of rocks, Friction and Shear strength, Slope stability, effect of water, analysis and design of tunnels, Blasting, Bolting, Tunnelling techniques, Application numerical techniques.
Suggested Books	<ol style="list-style-type: none"> <li>1. R.E. Goodman, <b>Introduction to Rock Mechanics</b>, John Wiley and Sons, New York, 1989.</li> <li>2. JACGER, Charles, <b>Rock Mechanics and Engineering</b>, Cambridge University Press, London, 1972.</li> <li>3. Megaw, T.M. and J.V. Bartlett, <b>Tunnels: Planning, Design, Construction, International Edition</b>, Ellis Horwood Limited, John Wiley and sons, New York, 1983.</li> </ol>

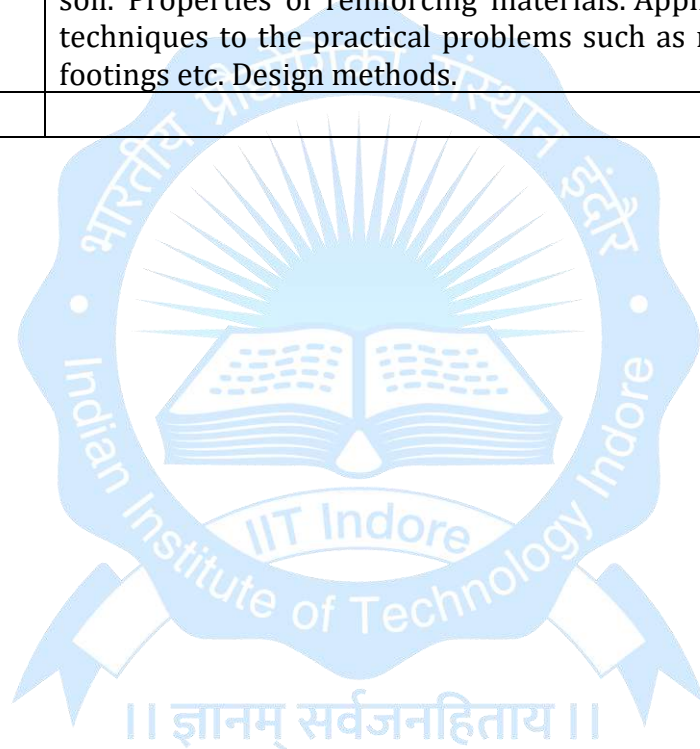


Course Code	<b>CE 488</b>
Title of the Course	<b>Environmental Geotechnics</b>
Credit Structure	L-T- P-Credits 2-0-2-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Hazardous wastes, Physical, Chemical and Mineralogical characterization, Geoenvironmental hazards: Natural and man made, Recycle and Reuse of Industrial waste(s). Role of Geotechnical engineering in environmental protection, Surface and subsurface contamination, Characterization of contaminated ground, Geoenvironmental site investigation and site assessment technologies.
Suggested Books	<ol style="list-style-type: none"> <li>1. Y.B. Acar, D.E. Daniel, <b>Geoenvironmental 2000: Characterization, Containment, Remediation &amp; Performance in Environmental Geotechnics,</b> ASCE, NY.</li> <li>2. D.S. Hari, R.R. Krishna <b>Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies,</b> Wiley. USA</li> <li>3. I.S. Oweis, R.P. Khera, <b>Geotechnology of Waste Management"</b> 2nd Ed, PSW Publishing Company, USA.</li> <li>4. J.F. Rees, <b>Contaminated Land Treatment Technologies</b> SCI, Elsevier Applied Science, NY, USA.</li> </ol>

Course Code	<b>CE 490</b>
Title of the Course	<b>Elements of Remote Sensing</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Radiation principles and interactions; Photography, photogrammetry, photo interpretation elements and applications; Satellite imaging; Multispectral, thermal, hyperspectral scanners and radiometers; Microwave radar imaging; Visual interpretation and digital analysis of imagery and applications.
Suggested Books	<ol style="list-style-type: none"> <li>1. T.M. Lilles, R.W. Kiefer, <b>Remote Sensing and Image Interpretation</b>, John Wiley &amp; Sons, New York, 1994.</li> <li>2. J.B. Campbell, <b>Introduction to Remote Sensing</b>, Taylor &amp; Francis, London, 1996.</li> <li>3. F.F. Sabins, <b>Remote Sensing: Principles and Interpretation</b>, W.H. Freeman and Company, New York, 1997.</li> <li>4. R.N. Colwell, (Editor-in-Chief), <b>Manual of Remote Sensing, Vol. I &amp; II</b>, American Society of Photogrammetry, Falls Church, Virginia, 1983.</li> </ol>



Course Code	<b>CE 492</b>
Title of the Course	<b>Reinforced Earth</b>
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	None
Objectives of the course	
Course Syllabus	Principle of reinforcement of ground. Various reinforcing methods such as sand drain soil nailing, geotextiles, geocones and geosynthetic materials. Mechanics of interaction between reinforcing element and soil. Properties of reinforcing materials. Applications of reinforcing techniques to the practical problems such as retaining walls, slopes, footings etc. Design methods.
Suggested Books	



Course code	CE 494/ CE 694
Title of the course	Earthquake Engineering
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic Knowledge of Structural Dynamics and Soil Mechanics
Scope of the course	This course introduces the fundamental concepts of earthquake engineering.
Course Syllabus	Importance of Earthquake Engineering, Fundamentals of Earthquake Engineering, Introduction to geotechnical earthquake engineering, Damaging Effects of Earthquakes, Earthquake Ground Motions, Seismic hazard analysis: probabilistic seismic hazard analysis (PSHA) and deterministic seismic hazard analysis (DSHA), Seismic Regions of the World, Earthquake Genesis, Characterization of Strong Ground Motions, Seismic Vulnerability Assessment of Building, Geotechnical Earthquake Engineering.
Suggested Books	<ol style="list-style-type: none"> <li>1. R. Villaverde, <b><i>Fundamental Concepts of Earthquake Engineering</i></b>, Taylor &amp; Francis, New York, 2009, 978-1-4200-6495-7</li> <li>2. S. L. Kramer, <b><i>Geotechnical Earthquake Engineering</i></b>, Prentice Hall, United States of America, 1996, 978-0133749434</li> <li>3. Sucuoğlu, Halûk, Akkar, Sinan, <b><i>Basic Earthquake Engineering</i></b>, Springer, Switzerland, 2014, 978-3-319-01026-7</li> <li>4. M. Beer, I. A. Kougoumtzoglou, E. Patelli, I. Siu-Kui Au, <b><i>Encyclopedia of Earthquake Engineering</i></b>, Springer, Brazil, 2015 : 978-3-642-35345-1</li> </ol>

॥ ज्ञानम् सर्वजनहिताय ॥

<b>Course code</b>	<b>CE 496/ CE 696</b>
<b>Title of the course</b>	<b>Safety of Dams and Reservoirs</b>
Credit Structure	L-T-P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic knowledge of water resources engineering
Objective of the course	<p>The non-availability of water in the right place at the right time has lead the civilization to store surplus water in man-made reservoirs by constructing dams--large barriers in the flow path of rivers. Historically, these reservoirs have been used to supply water for drinking purposes, agriculture, and to generate hydroelectricity. Although vital assets, the management of such large water resources systems remains challenging.</p> <p>Dam failures pose significant threats to life, environment, and the local economy. Such failures may result from multiple reasons, large-magnitude floods being the most common and perhaps the least predictable. Over the last few decades, studies have found increasing trends in the frequency and magnitude of floods over the globe. The situation is expected to exacerbate with the changing climate over the next few decades.</p> <p>The aim of the course is to provide basic knowledge to manage and safeguard dams and reservoirs. This course provides introductory technical aspects of planning, design, operation, and maintenance of dams and reservoirs. In addition, topics covering risk management under a changing climate are introduced.</p>
Course Syllabus	<p>Introduction to planning, design, operation and maintenance of dams and reservoirs.</p> <p>Types of dams; causes of dam failures, flood failures and overtopping, backwater flooding, breaching, slope failure, internal erosion and shear stress in foundations.</p> <p>Principles of design of dams: Design flood, probable maximum floods, geologic and seismological considerations, stability analyses, environmental considerations.</p> <p>Uncertainty, risk, reliability, and resilience analyses of dams and reservoirs.</p> <p>Operation of dams: Modelling dam and reservoir systems. Rule curves and forecast-based policies, a brief introduction to optimization models. Design and operational challenges under a non-stationarity climate.</p> <p>Maintenance of dams: Silt and scouring, monitoring and</p>

	instrumentation; Repair, rehabilitation, and removal of Dams.
Suggested Books	<ul style="list-style-type: none"> <li>• D. P. Loucks, E. V. Beek, <b><i>Water Resources Systems Planning and Management: An introduction to methods, models, and applications</i></b>, Springer International Publishing, Gewerbestrasse, Switzerland, 2017, 978-3-319-44232-7</li> <li>• A. Pepper, <b><i>Maintaining the Safety of our Dams and Reservoirs</i></b>, ICE Publishing, London, United Kingdom, 2014, 9780727760340.</li> <li>• Committee on the Safety of Existing Dams Water Science and Technology Board Commission on Engineering and Technical Systems National Research Council, <b><i>Safety of Existing Dams: Evaluation and Improvement</i></b>, Washington, D.C., USA, 1983, 978-0-309-03387-9</li> </ul>



Course code	CE 311
Title of the course	Structural Analysis II
Course Category	Core
Credit Structure	L-T- P-Credits 2 -1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic understanding of Structural Analysis
Objective of the course (Objective)	The objective of this course is to introduce the analysis of indeterminate structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding Indeterminacy of Different Structures</li> <li>• Knowledge of the analysis of indeterminate structures.</li> </ul>
Course Content	<p><b>Statically Indeterminate Structures-</b> Concept of indeterminacy- static and kinematic, Compatibility conditions, Applications to axially loaded members and beams.</p> <p><b>Slope-Deflection Method-</b> Application to beams and simple frames.</p> <p><b>Moment Distribution Method-</b> Application to beams and simple frames.</p> <p><b>Matrix Method-</b> Formulation for force and displacement methods, Stiffness matrix and force vector formation with reference to computer application, Truss, Frame and grid elements, Torsional effects, Effects of defect, support settlement and Temperature.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. D. Menon, <i>Advanced Structural Analysis</i>, Alpha Science International, 2009, ISBN: 9781842654972</li> <li>2. G. Pandit and S. Gupta, <i>Structural Analysis: A Matrix Approach</i>, McGraw Hill, 2008, ISBN: 978-0070667358.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. A. Kassimali , <i>Matrix Analysis of Structures</i> , Brooks/Cole Publishing Co., 2021, ISBN: 9780357448304</li> <li>4. T.S. Thandavamoorthy, <i>Structural Analysis</i>, Oxford Press, 2011, ISBN: 9780198069188.</li> </ol>

Course code	CE 365
Title of the course	Structural Analysis Lab
Course Category	Core
Credit Structure	L - T - P - Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Exposure to fundamentals of Structural Analysis
Scope of the course (Objectives)	Equip students with skills to analyze forces, displacements, and reactions in trusses, beams, arches, and cable structures. Provide hands-on experience in assessing structural behavior under varied conditions.
Course Outcomes	<ul style="list-style-type: none"> <li>Analyze forces and displacements in determinate and indeterminate structures using engineering principles.</li> <li>Solve complex structural problems through experiments, data interpretation, and modern engineering tools.</li> </ul>
Course Content	<p><b>Students will perform the following representative experiments:</b></p> <ul style="list-style-type: none"> <li>Determination of forces and displacements in statically determinate and indeterminate trusses, Influence Line Diagram for Trusses.</li> <li>Measurement of bending moment and shear forces in beams, Determination of Elastic Properties of Beams.</li> <li>Verification of the Moment Area Theorem, Maxwell Betti Theorem, Influence Line diagram for Displacement, Support Reaction, Shear Force at an Intermediate Section, and Bending Moment.</li> <li>Determination of Carryover Factor, Verification of Carry Over Factor, Determination of displacements in curved members.</li> <li>Analysis of Elastically Coupled Beams.</li> <li>Determination of horizontal reactions in two and three-hinged arches.</li> <li>To analyze the behaviour and characteristics of cable structures under various loading conditions and to determine the tension forces and deflections in the cables.</li> </ul>

Suggested Books

Reference Books:

1. K. Leet, C. M. Uang, A. Gilbert, ***Fundamentals of Structural Analysis***, McGraw Hill, 2018, ISBN: 9781259859507.
2. R.C. Hibbeler, ***Structural Analysis***, Pearson, 2018, ISBN: 9780134610672.
3. C.S. Reddy, ***Basic Structural Analysis***, Tata McGraw Hill Education, 2017, ISBN: 9780070702769.



Course code

CE 313

Title of the Course	Transportation Engineering
Course Category	Core
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	To provide basic knowledge in transportation to solve transportation-related problems and design for highway modes of transportation with a focus on highway users' characteristics, geometric and pavement design, traffic engineering, and transportation planning.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of transportation planning process, geometric design elements, geometric design process, pavement materials, pavement design</li> <li>• Analysis and Design related to traffic engineering, Roads and Signals.</li> </ul>
Course Content	<p><b>Transportation Systems and their Classification-</b> Role of transportation with respect to socio-economic conditions, Transportation planning process, Road user and the vehicle. <b>Geometric Design of Roads-</b> Horizontal alignment, Vertical alignment, Cross-section elements, Relevant geometric design standards.</p> <p><b>Pavements-</b> Flexible and rigid pavements, Characterization of pavement materials, Geosynthetics, Analysis and design of pavement systems, Pavement design specifications, Pavement construction process, Pavement performance.</p> <p><b>Traffic Engineering-</b> Traffic characteristics, Fundamental relationships, Theories of traffic flow, Intersection design, Design of traffic signs and signals.</p>
Suggested Books	<p>Text Books:</p> <ol style="list-style-type: none"> <li>1. W.W. Hay, <i>Introduction to Transportation Engineering</i>, John Wiley and Sons, 1988, ISBN: 978-0471364320.</li> <li>2. P.H. Wright, <i>Highway Engineering</i>, John Wiley and Sons, 2003, ISBN :978-0471826248.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. Y.H. Huang, <i>Pavement Analysis and Design</i>, Pearson India, 2008, ISBN: 978-8131721247.</li> </ol>

Course code	CE 315
Title of the course	Design of Reinforced Concrete Structures
Course Category	Core
Credit Structure	L-T- P-Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Exposure to the basics of Determining forces in trusses, frames and computation of displacements
Objective of the course (Objective)	To impart knowledge about the design of RCC structures using the relevant Indian standard, IS 456, which is essential for most construction projects.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understanding of the Concept of RCC and different design methods.</li> <li>• Knowledge of the design of different types of RCC structural elements.</li> <li>• Knowledge about applicable Indian Standard codes for RCC design.</li> </ul>
Course Content	<p><b>Introduction-</b> Introduction to RCC, Design concepts, Working stress method, Limit state method.</p> <p><b>Design of Flexural Members-</b> Introduction to beams, Flexural design, Moment, shear, Torsion, Different types of beams - rectangular, T-beam, L-beam, Doubly reinforced beam, continuous beam, Development length, Detailing.</p> <p><b>Introduction to Slabs-</b> Design and detailing of one-way and two-way slabs.</p> <p><b>Design of Compression Members-</b> Introduction to columns, Effective length, Principles of design, Columns under-axial compression, Uniaxial loading, Biaxial loading, Short columns, Slender columns, Concrete walls, Detailing.</p> <p><b>Design of Special Elements-</b> Footing and its types, Design principles of footing, Design of isolated, combined, and wall footing, Retaining walls, Design of retaining walls.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. N. Subramanian, <i>Design of Reinforced Concrete Structures</i>, Oxford University Press, 2013, ISBN : 978-0198086949.</li> <li>2. M.L. Gambhir, <i>Fundamentals of Reinforced Concrete Design</i>, PHI Learning, 2010, ISBN : 978-8120330481.</li> <li>3.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. S.U. Pillai and D. Menon , <i>Reinforced Concrete Design</i>, 4th ed. , McGraw-Hill Education, 2021, ISBN : 978-9354601026.</li> </ol>

Course code	CE 363
Title of the Course	Transportation Engineering Lab
Course Category	Core
Credit Structure	L-T- P-Credits 0-0-2-1
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any (for the students)	Exposure to basic understanding of soil properties and aggregates.
Objective of the course	To get familiar with standard quality lab testing procedures for determining the basic properties and engineering behaviour of soil, aggregates, and bitumen on laboratory and field scales.
Course Outcomes	<ul style="list-style-type: none"> <li>• Engineering knowledge, properties of aggregate, grade and properties of bitumen.</li> <li>• Estimating engineering speed parameters of a location.</li> <li>• Estimate and analyze traffic volumes at intersections</li> </ul>
Course Content	<p><b>Students will perform following representative experiments:</b></p> <ul style="list-style-type: none"> <li>• Evaluation of properties of road aggregates through <ul style="list-style-type: none"> <li>▪ Sieve Analysis</li> <li>▪ Los Angeles test</li> <li>▪ Flakiness and Elongation test</li> <li>▪ Impact test</li> <li>▪ Angularity Number test</li> </ul> </li> <li>• Evaluation of Bitumen properties through <ul style="list-style-type: none"> <li>▪ Softening Point test</li> <li>▪ Penetration test</li> <li>▪ Viscosity test</li> <li>▪ Ductility test</li> <li>▪ Stripping test</li> <li>▪ Bituminous mix design</li> </ul> </li> <li>• Carry out traffic surveys for <ul style="list-style-type: none"> <li>▪ Speed study</li> <li>▪ Intersection study</li> </ul> </li> </ul>
Suggested Books	<p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. W.W. Hay, <b><i>Introduction to Transportation Engineering</i></b> , John Wiley and Sons , 1988, ISBN : 978-0471364320.</li> <li>2. Y.H. Huang , <b><i>Pavement Analysis and Design</i></b>, Pearson India, 2003, ISBN: 978-8131721247.</li> </ol>

Course code	CE 312
Title of the course	Design of Steel Structures
Course Category	Core
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basic understanding of Structural Analysis
Objective of the course (Objective)	To impart knowledge about the design of steel structures using the relevant Indian standard, which is essential for many construction projects.
Course Outcomes	<ul style="list-style-type: none"> <li>• Understand the concepts of structural steel design,</li> <li>• Knowledge about the design code IS 800 (Indian Standard),</li> <li>• Designing individual structural members such as, tension members, compression members, beams, and connections etc.</li> </ul>
Course Content	<p><b>Steel Structures-</b> Limit states and design philosophy, Partial safety factors and load combinations, Analysis and design methods.</p> <p><b>Design of Tension Members-</b> Based on net section including shear lag effects, staggered holes and block shear.</p> <p><b>Design of Compression Members-</b> Flexural and flexural-torsional buckling, Column formula, Local buckling and buckling class, End restraints and effective length factor, Role of plate buckling, Plastic hinge.</p> <p><b>Classification of Section-</b> Plastic, compact, semi-compact, slender, Design strength of laterally supported beams, Shear buckling strength, Post-critical method, Shear-moment interaction.</p> <p><b>Design Strength of Laterally Unsupported Beams-</b> Lateral torsional buckling, Effect of restraints and effective length, Effect of axial load on flexure behavior, Cross-section yielding and member instability, Bi-axial bending.</p> <p><b>Design of Bolts and Welds-</b> Strength under combined stresses, Prying action, Common simple and eccentric joints and frame connections, Column bases.</p>

Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"><li>1. N. Subramanian, <b><i>Design of Steel Structures</i></b>, Oxford University Press, 2008, ISBN : 978-0195676815.</li><li>2. S.K. Duggal, <b><i>Limit State Design of Steel Structure</i></b>, Tata McGraw Hill , 2019 , ISBN : 978-9353164874.</li></ol> <p>Reference Books:</p> <ol style="list-style-type: none"><li>3. W.T. Segui, <b><i>Design of Steel Structures</i></b>, Cengage Learning , 2012, ISBN : 978-1111576004.</li><li>4. S.S. Bhavikatti, <b><i>Design of Steel Structures</i></b> (by Limit State Method as Per IS, 800—2007), I.K. International Publishing House, 2012, ISBN : 9789380578132.</li></ol>
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Course code	CE 320
Title of the course	Engineering Hydrology
Course Category	Core
Credit Structure	L – T – P – Credits 2 – 1 – 0 – 3
Name of the Concerned Discipline	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	The course is aimed for learning physical principals of hydrology as well as techniques to solve many practical hydrologic problems, including flood routing, flood frequency estimation, surface runoff estimation.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge on the basic concepts of hydrology and integrate the physical hydrological processes and their measurements.</li> <li>• Understanding runoff and hydrograph estimation and applying it into engineering practices.</li> </ul>
Course Content	<p><b>Introduction-</b> Hydrologic cycle and systems, Water budget, Hydrologic data sources, Surface water resources of India.</p> <p><b>Precipitation-</b> Forms and mechanisms, Point measurements, Missing data, Mass curve and hyetograph, Consistency of rainfall data, Areal rainfall estimation.</p> <p><b>Evaporation and Evapotranspiration-</b> Evaporation, transpiration, Interception losses, Potential and actual evapotranspiration.</p> <p><b>Infiltration-</b> Processes and measurement, Sorption, Infiltration capacity, Infiltration models and indices.</p> <p><b>Streamflow Measurement-</b> Streamflow generation and measurement, Streamflow response.</p> <p><b>Runoff-</b> Runoff - types and affecting factors, Runoff estimation, SCS-CN method, Flow duration curve, Hydrologic models.</p> <p><b>Hydrograph-</b> Hydrographs, Unit hydrograph theory, S-curve hydrograph, Instantaneous unit hydrograph.</p> <p><b>Hydrology Statistics and Flood Frequency Analysis-</b> Random variables and their properties, Extreme value distributions, Return period, risk and reliability, Intensity-duration-frequency curves.</p> <p><b>Flood Routing-</b> Inflow-outflow equations, Hydrological channel routing, Hydraulic routing, Flood control measures.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. M.K. Goyal, <b>Engineering Hydrology</b>, PHI Learning Pvt. Ltd., 2016, ISBN : 978-8120352438.</li> <li>2. K. Subramanya, <b>Engineering Hydrology</b>, McGraw-Hill Education (India) Private Limited, 2020, ISBN : 978-1259029974.</li> </ol>

3. V.T. Chow, D. Maidment and L. Mays, ***Applied Hydrology***, McGraw-Hill Professional, 2013, ISBN : 978-0070702424.

Reference books:

4. P.B. Bedient, W.C. Huber and B.E. Vieux , ***Hydrology and Floodplain Analysis*** , Pearson Education Limited, 2018 , ISBN : 978-0134751979.
5. S.L. Dingma, ***Physical Hydrology***, Waveland Press Inc., 2014, ISBN : 978-1478611189.



Course code	<b>CE 322</b>
Title of the course	<b>Railway Engineering</b>
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	N.A.
Objective of the course	The railway engineering course imparts core principles and practices, covering system components, track design, infrastructure, operations, and safety. It equips students for careers or advanced studies in railway engineering.
Course Outcomes	<ul style="list-style-type: none"> <li>• Proficiency in track alignment, geometry design, and infrastructure sustainability.</li> <li>• Understanding of railway components and their functionality.</li> <li>• Knowledge of rolling stock-track interaction and basic track maintenance.</li> </ul>
Course Content	<p><b>Introduction to Railway Engineering: Role of railways in transportation, Railway systems in India: Broad gauge, Metre gauge, Narrow gauge, Classification of lines: Passenger, Freight, High-speed rail, Railway track structure and its requirements.</b></p> <p><b>Track Components and Materials: Rails: types, welding of rails, rail wear, creep of rails, Sleepers: functions, types, sleeper density, Ballast: functions, requirements, types, Subgrade and formation.</b></p> <p><b>Geometric Design of Railway Track: Alignment: factors influencing alignment, Horizontal curves, vertical curves, gradients, Superelevation, transition curves, widening of gauge, Safe speed on curves.</b></p> <p><b>Track Junctions and Stations: Points and crossings: components, design, types, Layout of turnouts and crossings, Railway stations and yards: types, functions, layouts, Passenger amenities and terminal facilities.</b></p> <p><b>Track Stresses and Maintenance: Stresses in track due to moving loads, Track settlement, track deterioration, Track maintenance: manual, mechanized, modern practices, Modern track structures: ballastless track, slab track.</b></p>

**Signalling, Interlocking and Train Control: Railway signaling: objectives, types, color-light signals, Interlocking: principles, methods, Train control systems: absolute block, automatic block, centralized traffic control, Introduction to train protection and communication systems.**

**Modern Trends in Railway Engineering: High-speed railways: requirements, design considerations, Metro rail systems and urban transit, Electrification of railways, Recent developments in Indian Railways.**

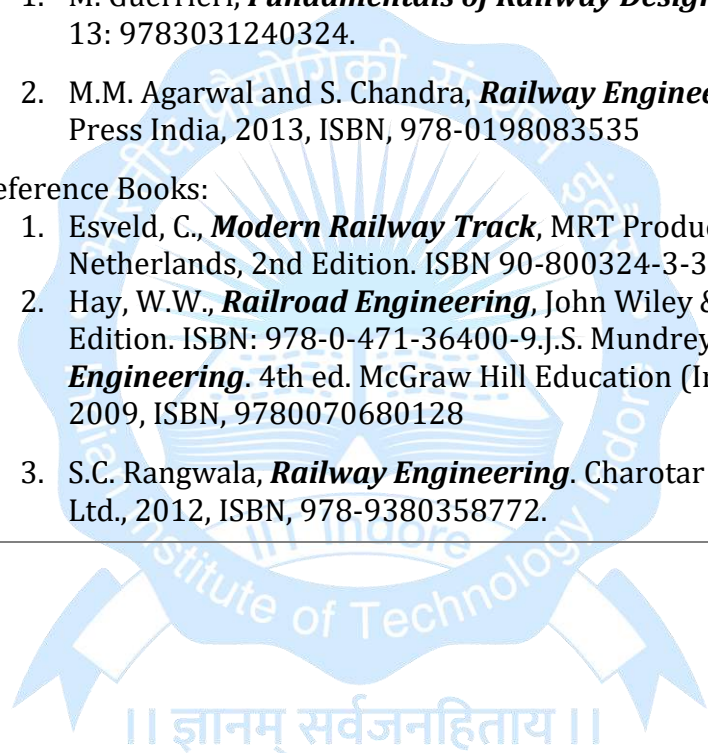
Suggested Books

Textbooks:

1. M. Guerrieri, **Fundamentals of Railway Design**, Springer, 2023, ISBN-13: 9783031240324.
2. M.M. Agarwal and S. Chandra, **Railway Engineering**, Oxford University Press India, 2013, ISBN, 978-0198083535

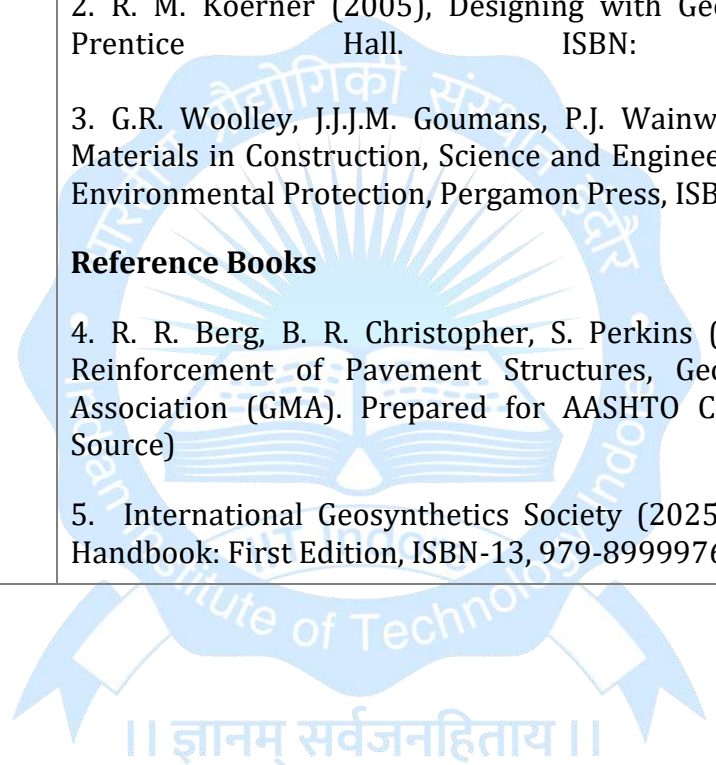
Reference Books:

1. Esveld, C., **Modern Railway Track**, MRT Productions, Zaltbommel, Netherlands, 2nd Edition. ISBN 90-800324-3-3
2. Hay, W.W., **Railroad Engineering**, John Wiley & Sons, New York, Latest Edition. ISBN: 978-0-471-36400-9. J.S. Mundrey, **Railway Track Engineering**. 4th ed. McGraw Hill Education (India) Private Limited, 2009, ISBN, 9780070680128
3. S.C. Rangwala, **Railway Engineering**. Charotar Publishing House Pvt. Ltd., 2012, ISBN, 978-9380358772.



Course code	<b>CE 324</b>
Title of the course	<b>Sustainable Geotechnics</b>
Course category	Departmental Elective
Credit structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Scope of the course	The course introduces sustainable use of industrial by-products in geotechnical works. It focuses on material characterization, stabilization, and application in foundations, slopes, and embankments with sustainability evaluation.
Course outcomes	After completing this course, students will be able to: <ul style="list-style-type: none"> <li>• Identify and characterize industrial by-products for geotechnical use.</li> <li>• Design waste-based and geosynthetic-reinforced systems for infrastructure applications.</li> <li>• Assess sustainability using LCA, carbon footprint, and cost-benefit indicators.</li> </ul>
Course content	<p><b>Module 1:</b> Introduction to Sustainable Geotechnics Industrial by-products in geotechnical engineering—fly ash, GGBS, tailings, and TBM muck. Role of circular economy and relevant standards (IRC 37, IRC SP 89, IS 2720, AASHTO). Environmental and performance perspectives.</p> <p><b>Module 2:</b> Characterization of Waste-Derived Geomaterials Testing for strength, compaction, and permeability. Mineralogical and chemical characterization. Integration of geotechnical and environmental properties for design decisions.</p> <p><b>Module 3:</b> Stabilization and Reinforcement Approaches Soil-waste stabilization using lime, cement, and alkali-activated binders. Introduction to advanced additives (nano-silica, calcined clay, perlite). Role of geosynthetics in enhancing performance and durability.</p> <p><b>Module 4:</b> Applications in Infrastructure Utilization of waste-derived materials in embankments, slopes,</p>

	<p>subgrade improvement, and underground construction.</p> <p><b>Module 5: Sustainability and Case Studies</b> Sustainability evaluation using LCA and embodied energy. Comparative assessment with conventional materials. Case studies on fly ash embankments, slag fills, and tailings reuse. Case illustrations from India and abroad.</p>
Suggested books	<p><b>Text Books</b></p> <ol style="list-style-type: none"> <li>1. B. Caicedo (2019), Geotechnics of Roads: Fundamentals, CRC Press/Balkema, Taylor &amp; Francis Group. ISBN: 978-1-138-60057-7</li> <li>2. R. M. Koerner (2005), Designing with Geosynthetics, Pearson Prentice Hall. ISBN: 0-13-145415-3</li> <li>3. G.R. Woolley, J.J.J.M. Goumans, P.J. Wainwright (2000). Waste Materials in Construction, Science and Engineering of Recycling for Environmental Protection, Pergamon Press, ISBN-10 : 0080437907</li> </ol> <p><b>Reference Books</b></p> <ol style="list-style-type: none"> <li>4. R. R. Berg, B. R. Christopher, S. Perkins (2000), Geosynthetic Reinforcement of Pavement Structures, Geosynthetic Materials Association (GMA). Prepared for AASHTO Committee 4E (Open Source)</li> <li>5. International Geosynthetics Society (2025), IGS Geosynthetics Handbook: First Edition, ISBN-13, 979-8999976918</li> </ol>



<b>Course Code</b>	<b>CE 326</b>
<b>Title of the Course</b>	<b>Intelligent Transportation Systems</b>
<b>Credit Structure</b>	L-T-P-Credits 2-1-0-3
<b>Course Category</b>	Institute elective
<b>Name of the Concerned Discipline</b>	Civil Engineering
<b>Pre-requisite, if any (for the students)</b>	NIL
<b>Scope of the course (Objectives)</b>	This course is designed to provide the students an overview of emerging aspects of the intelligent transportation systems.
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>• Students will learn basic concepts of the Intelligent Transportation Systems (ITS).</li> <li>• ITS structure's knowledge will enable them to come up with smart solution for transportation problems with emerging technologies.</li> <li>• It will provide knowledge on addressing the challenges in implementing ITS applications.</li> </ul>
<b>Course Syllabus</b>	<p><b>Introduction to Intelligent Transportation System:</b> Objectives of ITS; Elements of ITS, Benefits and Challenges in ITS, ITS Architecture: User services and architecture, standards and evaluations.</p> <p><b>Data Collection Techniques:</b> Intrusive (such as loop detectors, pneumatic, etc.) and, non-intrusive (such as video, infra-red, in-vehicle systems: GPS, Mobiles) data collection techniques for ITS, In-vehicle systems, current advancements in data collection techniques (LiDAR, Simulators and VR, crowd source data, etc.).</p> <p><b>Case studies of ITS Applications:</b> ITS in Public Transportation operations, Traffic Management Centers, ITS in Adaptive Traffic Signal Systems, ITS commercial vehicle operations, ITS in vehicle safety and operations, ITS in Road Safety.</p> <p><b>Future of ITS in India:</b> Way forward for ITS applications in mixed traffic context, adaptation of its applications by various road users, emerging ITS related policies in India, potential of AI/ML in ITS applications for unstructured road environment</p>
<b>Suggested books</b>	<p><b>Textbooks</b></p> <ol style="list-style-type: none"> <li>1. Mashrur A. C, and Adel S, <i>Fundamentals of Intelligent Transportation Systems Planning</i>, Artech House, Inc., 2003, ISBN-13. 978-1580531603</li> <li>2. Muhammad A., Joaquim F. and Jose F., <i>Introduction to Intelligent Transportation Systems</i>, Springer, 2016, ISBN: 978-3-319-28181</li> <li>3. Marco P., Stefano B., Michele A, Francesco Z., Gianluigi F., <i>Advanced</i></li> </ol>

*Technologies for Intelligent Transportation Systems*, Springer, 2015; ISBN: 978-3-319-34566-6

4. Sładkowski, A. *Intelligent Transportation Systems – Problems and Perspectives*. Cham: Springer International Publishing. 2016; ISBN: 978-3-319-19150-8

**Reference books:**

5. Ghosh, S., Lee, T.S. *Intelligent Transportation Systems: New Principles and Architectures*, CRC Press, 2005.; ISBN-13. 978-0849300677
6. Asier P., Unai H. J, Enrique, O., Ignacio, J G. Z, *Intelligent Transport Systems: Technologies and Applications*, Wiley, 2015; ISBN-13. 978-1118894781



Course code	<b>CE 356</b>
Title of the course	<b>Computer-Aided Design and Drawing Lab</b>
Course Category	Core
Credit Structure	L-T-P-Credits 0-1-2-2
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Nil
Objective of the course	This course aims at providing practical knowledge of computer-aided design and drawing of civil engineering structures.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of computer-aided design and drawing of civil engineering structures.</li> <li>• Familiarization with useful software.</li> </ul>
Course Content	<p><b>Introduction-</b> Introduction to computer-aided drawing of various architectural details of framed buildings in concrete and steel structures.</p> <p><b>Design, Drawing and Reinforcement-</b> Detailing of simply supported beam, Continuous beam, Short column, Long column, One-way slab, Two-way slab, Flat slab, Staircase, and footing, Computer aided design and drawing of RCC structure.</p> <p><b>Design and drawing of Steel Structures-</b> Boundary wall, Roof truss, Connections, Purlins, Bracings, Columns, Cap plate, Gantry girder and gantry column, Base connection, Computer aided design and drawing of steel structure.</p>
Suggested Books	<p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. R.S. Malik and G.S. Meo, <i>Civil Engineering Drawing</i>, Cengage India Private Limited , 2016 , ISBN : 788131526132.</li> <li>2. P. C. Varghese, <i>Limit State Design of Reinforced Concrete</i>, Prentice-Hall of India Private Limited , 2010, ISBN : 9788120320390.</li> <li>3. N. Subramanian, <i>Design of Steel Structures</i>, Limit State Method, Oxford University Press , 2018 , ISBN : 9780199460915.</li> </ol>

4. S. U. Pillai and D. Menon , ***Reinforced Concrete Design***, Tata McGraw Hill , 2021, ISBN : 978-9354601026.
5. S.K. Duggal , ***Limit State Design of Steel Structures***, McGraw-Hill, 2019, ISBN : 978-9353164874.



Course code	CE 314
Title of the course	Introduction to Finite Element Methods
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Exposure to basic understanding of Strength of Materials and Structural analysis I
Objective of the course	Objective of the course is to introduce Finite Element Method (FEM) starting from its mathematical formulation to applying the technique to solve simple structures in the linear regime.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of the mathematical formulation for FEM,</li> <li>• Knowledge of solving simple structures in the linear regime by writing computer program,</li> <li>• Knowledge of generating interpretable data in the form of stress and deformation profiles.</li> </ul>
Course Content	<p><b>Overview-</b> Introduction to FEM, Comparison with alternative solution methodologies.</p> <p><b>One-Dimensional Problems-</b> Axial deformations of a bar, Strong and weak forms, Essential vs. natural boundary conditions, Integral statements (Principle of the minimum potential energy), Methods of approximations (Ritz and Galerkin methods), Finite element approximation functions (linear, quadratic, and cubic elements), Assembly of element equations, Connection with matrix stiffness method for truss structures.</p> <p><b>Higher-Order Boundary Value Problems-</b> Euler-Bernoulli and Timoshenko beams. Connection with matrix stiffness method for frame structures.</p> <p><b>Two-Dimensional problems-</b> Element types (triangular and quadrilateral elements), Subparametric, isoparametric, and superparametric formulations, Membrane and heat transfer problems, Axisymmetric problems, Bending of thin and thick elastic plates.</p> <p><b>Stress analysis of elastic body-</b> 1D and 2D analysis.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. J. N. Reddy, <i>Introduction to the Finite Element Method</i>, McGraw-Hill Education, 2019, ISBN : 978-0072466850 .</li> <li>2. O.C. Zienkiewicz, R.L. Taylor and J.Z. Zhu, <i>The Finite Element Method, Its Basis and Fundamentals</i>, Elsevier, 2005, ISBN :</li> </ol>

978-1856176330.

Reference books:

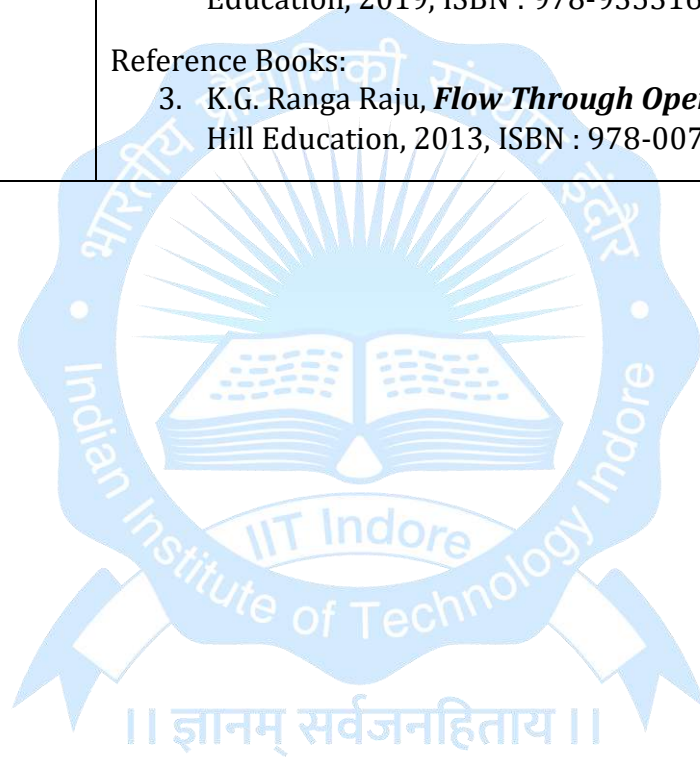
3. K.J. Bathe, ***Finite Element Procedures***, Prentice Hall, 2006, ISBN : 978-0133014587.



Course code	CE 317
Title of the course	Water and Wastewater Engineering
Course Category	Departmental Elective
Credit Structure	L - T - P Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Exposure to basics of Water and Wastewater Engineering
Objective of the course	The course is designed to provide students with knowledge of advanced technologies available to treat water and wastewater and further its reutilization. This course will also aid in understanding the role of microbes in wastewater treatment.
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of advanced physico-chemical and wastewater treatment techniques.</li> <li>• Development of the basics of reactor and the kinetics associated to each batch and continuous treatments.</li> <li>• Knowledge on the role of microbe in treatment processes and wastewater engineering</li> </ul>
Course Syllabus	<p><b>Water Engineering and Treatment-</b> Adsorption Process, Types, factors affecting adsorption, kinetics, and equilibrium – different isotherm equations and their applications. Ion exchange, electro-dialysis, Reverse osmosis, Ultrafiltration, Advanced oxidation and emerging contaminant.</p> <p><b>Wastewater Engineering and Treatment-</b> Theoretical principles and design of treatment units, Kinetics of biological treatment systems - bio-kinetic constants and their determination, Batch and continuous systems, Need and technologies used.</p> <p><b>Microbiology-</b> Microorganisms of importance in water and wastewater environment Principles and applications of microscopy, microscopic flora and fauna of importance.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. Metcalf and Eddy, G. Tchobanoglous, F. Burton and H. D. Stensel, <b>Wastewater Engineering - Treatment and Reuse</b>, Tata McGraw Hill Publishing Co. Ltd., 2017, ISBN : 978-0070495395</li> <li>2. M.J. Pelczar, E.C.S. Chan and N.R. Krieg, <b>Pelczar Microbiology</b>, East-West Publisher, 2023, ISBN : 978-8176711234.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. M.L. Davis, <b>Water and Wastewater Engineering</b>, McGraw Hill Education, 2017, ISBN : 978-1259064838.</li> </ol>

<b>Course code</b>	CE 319
<b>Title of the course</b>	Open Channel Hydraulics
<b>Course Category</b>	Departmental Elective
<b>Credit Structure</b>	L – T – P – Credits 2-0-2-3
<b>Name of the Concerned Department</b>	Civil Engineering
<b>Pre-requisite, if any</b>	Exposure to basic understanding of Fluid Mechanics
<b>Objective of the course</b>	To make the students learn the basic principles of channel hydraulics to analyze the flow in canals and, thus, design the canals for various flow conditions.
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>• Formulate mathematical description of principles governing flow in open channels.</li> <li>• Analyze different flows in open channels.</li> <li>• Synthesize the open channel flow concepts for flood routing applications.</li> <li>• Design the rigid and mobile boundary channels.</li> </ul>
<b>Course content</b>	<p><b>Introduction-</b> Classification of channel flows, Velocity and pressure distribution, and Basic governing equations.</p> <p><b>Uniform Flow-</b> Resistance equations, Normal depth computation, Most efficient channel section, Design of irrigation and stormwater channels.</p> <p><b>Critical Flow-</b> Specific energy concept, Computation of critical depth, Application of specific energy, Control section.</p> <p><b>Gradually Varied Flow-</b> Governing equation of GVF, Analysis of GVF profiles, Computation of GVF profiles.</p> <p><b>Rapidly Varied Flow-</b> Hydraulic jump – momentum equation formulation, types, and characteristics.</p> <p><b>Unsteady Flow-</b> Gradually varied unsteady flow, Saint-Venant equations, Flood routing – Muskingum method, Rapidly varied unsteady flow.</p> <p><b>Fluvial Hydraulics-</b> Sediment properties, Incipient motion, Shields diagram, Regimes of flow, Resistance to flow in mobile bed channels, Design of stable alluvial channels.</p> <p><b>Students will perform following representative experiments</b></p> <ul style="list-style-type: none"> <li>• To calibrate a current meter.</li> <li>• To determine the velocity profile in an open channel.</li> <li>• To determine the roughness coefficient in an open channel.</li> <li>• To construct a specific energy diagram for given flow conditions.</li> <li>• To analyze the flow characteristics in a venturi flume.</li> <li>• To analyze the flow characteristics over a broad crested weir.</li> <li>• To analyze the gradually varied flow profiles for flow over</li> </ul>

	<p>the spillway.</p> <ul style="list-style-type: none"> <li>• To analyze the gradually varied flow profiles for flow under a sluice gate.</li> <li>• To study the pressure distribution along a spillway and determine the design head.</li> <li>• To analyze the hydraulic jump characteristics in a rectangular channel.</li> <li>• To study unsteady flow characteristics in an open channel.</li> </ul>
<b>Suggested Books</b>	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. V. T. Chow, <b><i>Open Channel Hydraulics</i></b>, The Blackburn Press, 2009, ISBN: 9781932846188.</li> <li>2. K. Subramanya, <b><i>Flow in Open Channels</i></b>, McGraw-Hill Education, 2019, ISBN : 978-9353166298.</li> </ol> <p>Reference Books:</p> <ol style="list-style-type: none"> <li>3. K.G. Ranga Raju, <b><i>Flow Through Open Channels</i></b>, McGraw-Hill Education, 2013, ISBN : 978-0074604977.</li> </ol>



Course code	CE 316
Title of the course	Statistical Hydroclimatology
Course Category	Departmental Elective
Credit Structure	L – T – P – Credits 2 – 1 – 0 – 3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	None
Objective of the course	The course imparts basic statistical knowledge to analyze and model hydrological processes for their applications to investigate climate change and climate variability phenomena.
Course Outcomes	<ul style="list-style-type: none"> <li>• Familiarize with the concepts of probability and statistical properties of hydrologic data.</li> <li>• Knowledge about the distributional characteristics of hydrologic data and their applications.</li> <li>• Development of statistical hypothesis tests for time series analysis and development of the relationship between hydrologic variables.</li> </ul>
Course content	<p><b>Probability Analysis-</b> Random variables, Conditional, marginal, and joint probability, Total probability theorem, and Bayes' rule.</p> <p><b>Exploratory Data Analysis-</b> Descriptive statistics, Covariance and correlation, Parameter estimation, Graphical representation of hydrologic data.</p> <p><b>Hydrologic Frequency Analysis-</b> Discrete and continuous probability distributions, Frequency analysis of climate extremes.</p> <p><b>Time Series Analysis and Modelling-</b> Components of a time series, Normality, Stationarity, Homogeneity, Trend analysis, Time series modeling.</p> <p><b>Hydroclimatic Applications-</b> Climate change, Weather extremes, Climate variability and large-scale oscillations, Hydroclimatic forecasting.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. R. Maity, <b><i>Statistical Methods in Hydrology and Hydroclimatology</i></b>, Springer, 2018, ISBN: 978-9811087783.</li> <li>2. Y.S. Rao, T. C. Zhang, C. S. P. Ojha, B. R. Gurjar, R. D. Tyagi, and C. M. Kao, <b><i>Climate Change Modeling, Mitigation and Adaptation</i></b>, ASCE, 2013, ISBN : 978-0784412718.</li> </ol> <p>Reference books:</p> <ol style="list-style-type: none"> <li>3. R.S. Teegavarapu, J.D. Salas and J.R. Stedinger (Eds.), <b><i>Statistical analysis of hydrologic variables, Methods and Applications</i></b>, American Society of Civil Engineers, 2019, ISBN : 978-0784415177.</li> </ol>

Course code	CE 318
Title of the course	Computational Hydraulics
Course Category	Departmental Elective
Credit Structure	L - T - P - Credits 2-1-0-3
Name of the Concerned Department	Civil Engineering
Pre-requisite, if any	Basics of Fluid mechanics and numerical methods
Objective of the course	To equip participants with the ability to grasp advanced techniques for solving linear algebraic equations and to establish a solid foundation in finite volume methods, including grid generation. Additionally, to improve participants' proficiency in solving Saint Venant equations for 1D open channel flows
Course Outcomes	<ul style="list-style-type: none"> <li>• Knowledge of advanced techniques for solving linear algebraic equations.</li> <li>• Acquire fundamentals of finite volume methods, including grid generation, as foundational approaches for formulating mathematical solutions to these equations</li> </ul>
Course Content	<p><b>Mathematical Behavior of 1D Saint Venant Equations-</b> Mathematical characteristics of Saint Venant equations and their simplified formulations.</p> <p><b>Numerical Grids-</b> Structured and unstructured grid generation, and computations of necessary information based on a grid.</p> <p><b>Discretization Schemes-</b> Finite difference and finite volume methods for 1D open channel flow, explicit, implicit, and semi-implicit schemes in open channel flow, Truncation error, stability, consistency, and convergence of explicit and implicit schemes.</p> <p><b>1D Numerical Models-</b> Finite volume discretization of Saint Venant equations using shock-capturing schemes, Illustration examples such as subcritical, Supercritical, and trans-critical open channel flows as well as tidal flow.</p> <p><b>2D Numerical Models-</b> Finite volume discretization to shallow water equations using HLL and Roe solvers. Examples of 2D problems like dam breaks flow in the urban area, flood simulations in urban areas due to heavy rainfall, and flows in rivers and estuaries due to storm surges, Demonstration of open-source flood models.</p>
Suggested Books	<p>Textbooks:</p> <ol style="list-style-type: none"> <li>1. E.F. Toro, <i>Shock-capturing methods for free-surface shallow flows</i>, John Wiley and Sons Inc, 2001, ISBN : 9780471987666.</li> </ol>

2. J. H. Ferziger, M. Peric and R.L. Street, ***Computational Methods for Fluid Dynamics***, Springer International, 2019, ISBN : 978-3319996912.

Reference Books

3. C Hirsch, ***Numerical Computation of Internal and External Flows***, Butterworth-Heinemann Publisher, 2007, ISBN : 978-0750665940.

