राष्ट्रीय प्रौद्योगिकी संस्थान मेघालय

National Institute of Technology Meghalaya

UG Curriculum

With effect from

AY 2024-25

In view of

NEP2020

जानपद अभियांत्रिकी विभाग

Department of Civil Engineering

National Institute of Technology Meghalaya

UG Curriculum with effect from AY 2024-25

In view of NEP2020

Abbreviations

SC	:	Science Core
ESA	:	Engineering Science & Arts
DSC	:	Dept. Specific Core
DSE	:	Dept. Specific Elective
OE	:	Open Elective
AECC	:	Ability Enhancement Compulsory Course
SECC	:	Skill Enhancement Compulsory Course
VAC	:	Value Added Course
L	:	Laboratory Course
A	:	Audit Course

1st Year Common Structure

Semester Wise Model Plan – First Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Science Core							
MA101	Engineering Maths-I (calculus, linear algebra, & statistics)	SC	3	1	0	4	None
CB101/ PH101	Engineering Chemistry/ Engineering Physics	SC	3	0	0	3	None
CB151/ PH151	Engineering Chemistry/Engineering Physics Laboratory	SC (L)	0	0	2	1	None
CB103	Biology for Engineers	SC	2	0	0	2	None
Engineering Science and Arts							
ME101	Engineering Mechanics	ESA	3	1	0	4	None
CS101	Computer & Coding	ESA	2	0	0	2	None
CS151	Computer & Coding Lab	ESA (L)	0	0	2	1	None
CE101	Engineering Graphics	ESA (L)	0	1	3	2	None
Skill Enhancement Compulsory Course							
HS151	Communication Skills	SECC(L)	0	1	2	2	None
Total Contact Hours – Component wise			**13**	**4**	**9**		-
Total Contact Hours			**26**			**21**	-

Semester Wise Model Plan – Second Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Science Core							
MA102	Engineering Maths-II	SC	3	0	0	4	None
PH101/ CB151	Engineering Physics/Engineering Chemistry	SC	3	0	0	3	None
PH151/ CB151	Engineering Physics/Engineering Chemistry Lab	SC (L)	0	0	2	1	None
Engineering Science and Arts							
CB 102	Environmental Science	ESA	2	0	0	2	None
EE102	Basic Electrical & Electronics Engineering	ESA	3	0	0	3	None
EE152	Basic Electrical & Electronics Engineering Lab	ESA (L)	0	0	2	1	None
ME152	Workshop Practice	ESA (L)	0	0	3	1	None
Skill Enhancement Compulsory Course							
HS102	Creativity, Innovation and Entrepreneurship	SECC	2	0	0	2	None
Ability Enhancement Compulsory Course							
CS152	Python Programming	AECC (L)	0	1	2	2	None
Value Added Course							
HS104	Ethics and Morals	VAC	2	0	0	2	None
VA102	Skill Development & Prototyping	VAC (L)	0	0	2	1	None
Total Contact Hours – Component wise			**15**	**1**	**11**		-
Total Contact Hours			**27**			**22**	-

Semester Wise Model Plan – Third Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CE201	Solid Mechanics	DSC	3	0	0	3	
CE203	Fluid Mechanics	DSC	3	0	0	3	
CE205	Surveying	DSC	3	0	0	3	
CE207	Public Health Engineering	DSC	3	0	0	3	
Department Specific Elective (Choose one from the basket)							
CE211	Environmental Impact Assessment	DSE	3	0	0	3	
CE213	Science and Functional Design of Buildings (NPTEL course)						
CE215	Study of historical and ancient civil engineering practices						
CE217	Fundamentals of Sustainability in Engineering projects						
Open Elective							
CE271	Introduction to Construction	OE	2	0	0	2	
Value Added course/ Dissertation							
CE281	Civil Engineering Drawing and Detailing	VAC	1	0	2	2	
Laboratory							
CE251	Solid Mechanics Lab	L	0	0	2	1	
CE253	Fluid Mechanics Lab	L	0	0	2	1	
CE255	Surveying Lab	L	0	0	2	1	
CE257	Public Health Engineering Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**18**	**0**	**10**		-
Total Contact Hours			**28**			**23**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fourth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CE202	Building Materials and Construction	DSC	3	0	0	3	
CE204	Structural Analysis	DSC	3	0	0	3	
CE206	Geotechnical Engineering	DSC	3	0	0	3	
CE208	Hydrology and Water Resources Engineering	DSC	3	0	0	3	
Department Specific Elective (Choose one from the basket)							
CE212	Waste Water Engineering	DSE	3	0	0	3	
CE214	Green Infrastructures and low impact development						
CE216	Introduction to life cycle assessment						
CE218	Accounting and Finance for Civil Engineers (NPTEL course)						
Open Elective							
CE272	Computational Methods in Engineering	OE	2	0	0	2	
Skill Enhancement Compulsory Course							
CE232	Remote sensing and GIS	SE	1	0	2	2	
Laboratory							
CE252	Building Materials Lab	L	0	0	2	1	
CE254	Structural Analysis Lab	L	0	0	2	1	
CE256	Geotechnical Engineering Lab	L	0	0	2	1	
CE258	Hydrology and Water Resources Engineering Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**18**	**0**	**10**		-
Total Contact Hours			**28**			**23**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fifth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CE301	Transportation Engineering	DSC	3	0	0	3	
CE303	Soil Dynamics and Foundation Engineering	DSC	3	0	0	3	
CE305	Hydraulics and Hydraulic Structures	DSC	3	0	0	3	
Department Specific Elective (Choose one from the basket)							
CE311	Theory of Structures	DSE	3	0	0	3	
CE313	Disaster Management (SWAYAM Course)						
CE315	Modern Indian Architecture						
CE317	Smart geotechnology						
Open Elective							
CE371	Waste Management	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
CE375	Internship-1	AE	0	0	0	1	
Skill Enhancement Compulsory Course							
CE331	Seminar and Technical Report Writing	SE	0	0	2	1	
Value Added course/ Dissertation							
CE381	Minor Project-1	VA	0	0	4	2	
Laboratory							
CE351	Transportation Engineering 1 Lab	L	0	0	2	1	
CE353	Soil Dynamics and Foundation Engineering Lab	L	0	0	2	1	
CE355	Hydraulics and Hydraulic Structures Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**14**	**0**	**12**		-
Total Contact Hours			**26**			**21**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Sixth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
CE302	Reinforced Concrete Design	DSC	3	0	0	3	
CE304	Design of Steel Structures	DSC	3	0	0	3	
Department Specific Elective (Choose two from the basket)							
CE312	Fluid Dynamics and Hydraulic Machines	DSE	3	0	0	3	
CE314	Construction methods and equipment management (NPTEL course)						
CE316	Environmental Geotechnics						
CE318	Industrial Pollution Control Engineering						
CE322	Intelligent Transport systems	DSE	3	0	0	3	
CE324	River Engineering (NPTEL course)						
CE326	Urban planning and design						
CE328	Introduction to Pavement design						
Open Elective							
CE372	Introduction to finite element method	OE	2	0	0	2	
Value Added course/ Dissertation							
VA302	Indian Knowledge System	VA	2	0	0	2	
CE382	Minor Project-2	VA	0	0	4	2	
Laboratory							
CE352	Software-based modelling, design, and detailing Lab	L	0	0	2	1	
CE354	Transportation Engineering 2 Lab	L	0	0	2	1	
Total Contact Hours – Component wise			**16**	**0**	**8**		-
Total Contact Hours			**24**			**20**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Seventh Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Elective (Choose four from the basket)							
CE411	Dynamics of Structures (NPTEL Course)	DSE	3	0	0	3	
CE413	Engineering Geology (NPTEL Course)						
CE415	Continuum Mechanics (NPTEL Course)						
CE417	Bridge Engineering (NPTEL Course)						
CE419	Transportation Engineering II (NPTEL Course)	DSE	3	0	0	3	
CE421	Design of Masonry Structures (NPTEL Course)						
CE423	Ground Water Hydrology (NPTEL Course)						
CE425	Air Pollution and Control (NPTEL Course)						
CE427	Composite Materials and Structures (NPTEL Course)	DSE	3	0	0	3	
CE429	Watershed Management (NPTEL course)						
CE431	Rock Engineering (NPTEL Course)						
CE433	Probability Methods in Civil Engineering (NPTEL Course)						
CE435	Construction Planning and Management (NPTEL Course)	DSE	3	0	0	3	
CE437	Machine Learning for Engineering and Science Application (NPTEL Course)						
CE441	Infrastructure Planning and Managements (NPTEL Course)						
CE443	Energy Efficiency, Acoustics and Daylighting in Building (NPTEL course)						
Open Elective							
CE471	Introduction to Optimization Techniques (NPTEL Course)	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
CE475	Internship-2	AE	0	0	0	1	
Value Added course/ Dissertation							
CE481	Major Project-1	VA	0	0	8	4	
Total Contact Hours – Component wise			**14**	**0**	**8**		-
Total Contact Hours			**22**			**19**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

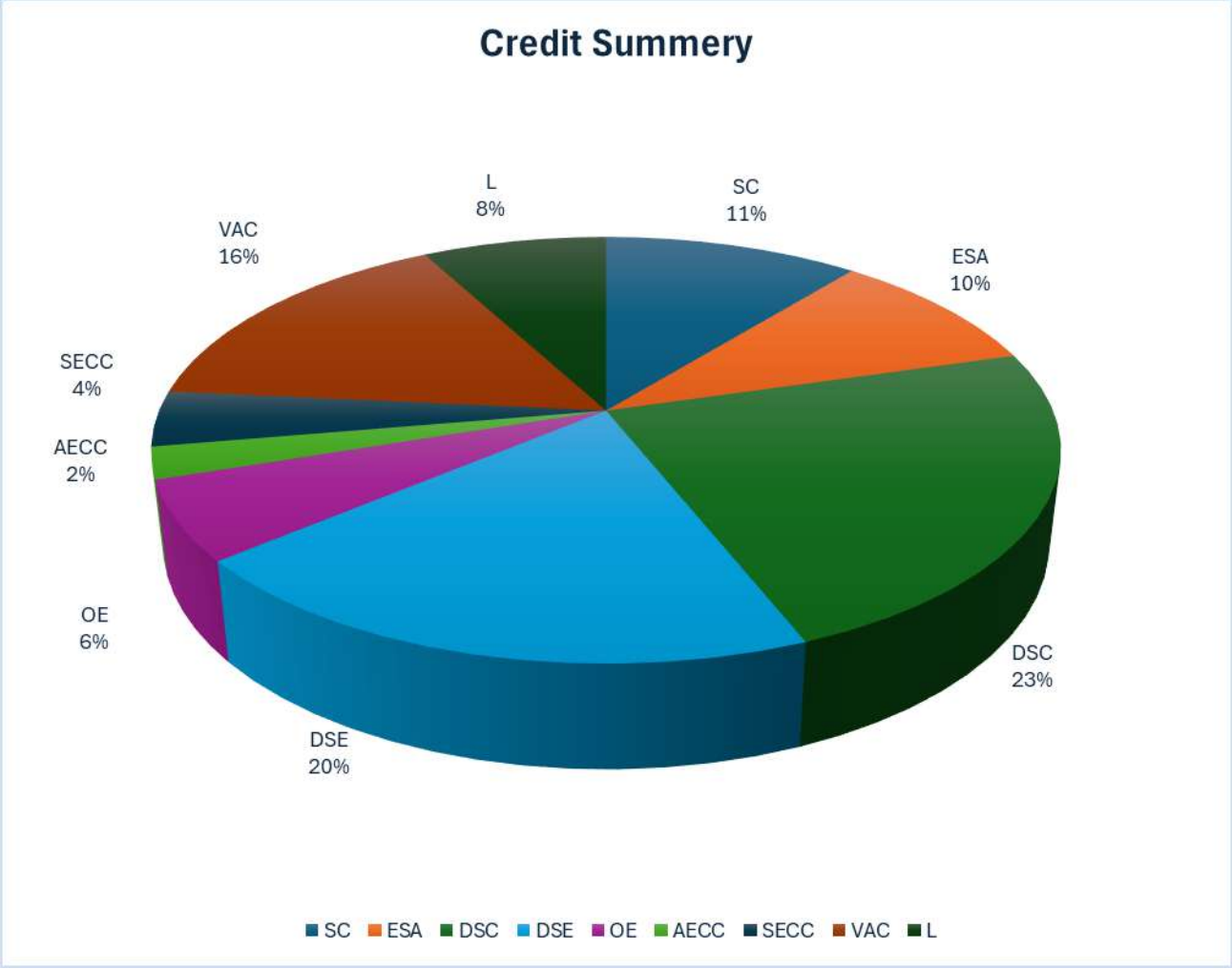
Semester Wise Model Plan – Eighth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Elective (Choose one from each basket)							
CE412	Introduction to Earthquake Engineering (NPTEL Course)	DSE	3	0	0	3	
CE414	Advanced Concrete Technology (NPTEL Course)						
CE416	Retrofitting and Rehabilitation of Civil Infrastructure (NPTEL Course)						
CE418	Irrigation and Drainage (NPTEL Course)						
CE422	Scheduling Techniques in Projects (NPTEL Course)	DSE	3	0	0	3	
CE424	Pre-stressed Concrete Structures (NPTEL Course)						
CE426	Port and Harbour Structures (NPTEL Course)						
CE428	Underground Space Technology (NPTEL Course)						
Value Added course/ Dissertation							
CE482	Major Project-2	VA	0	0	22	11	
Total Contact Hours – Component wise			**6**	**0**	**22**		-
Total Contact Hours			**28**			**17**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan										
Sem	SC	ESA	DSC	DSE	OE	AECC	SECC	VAC	Lab	Total Credit
I	SC1 [4] SC2 [3] SC3 [2] SC-L [1]	ESA1 [4] ESA2 [2] ESA-L [1] ESA-L [2]					SE-L [2]	VA-A [0]		**21**
II	SC4 [4] SC5 [3] SC-L [1]	ESA3 [2] ESA4 [3] ESA-L [1] ESA-L [1]				AE-L [2]	SE1 [2]	VA1 [2] VA-L [1] VA-A [0]		**22**
III			DSC1 [3] DSC2 [3] DSC3 [3] DSC4 [3]	DSE1 [3]	OE1 [2]			VA2 [2]	L1 [1] L2 [1] L3 [1] L4 [1]	**23**
IV			DSC5 [3] DSC6 [3] DSC7 [3] DSC8 [3]	DSE2 [3]	OE2 [2]		SE2 [2]		L5 [1] L6 [1] L7 [1] L8 [1]	**23**
V			DSC9 [3] DSC10 [3] DSC11 [3]	DSE3 [3]	OE3 [2]	AE1 [1]	SE3 [1]	VA3 [2]	L9 [1] L10 [1] L11 [1]	**21**
VI			DSC12 [3] DSC13 [3]	DSE4 [3] DSE5 [3]	OE4 [2]			VA4 [2] VA5 [2]	L12 [1] L13 [1]	**20**
VII				DSE6 [3] DSE7 [3] DSE8 [3] DSE9 [3]	OE5 [2]	AE2 [1]		VA6 [4]		**19**
VIII				DSE10 [3] DSE11 [3]				VA7 [11]		**17**
Total Credit	**18**	**16**	**39**	**33**	**10**	**4**	**7**	**26**	**13**	**166**

Components Credit Summary - BTech Curriculum										
Course Type with Abbreviation		**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
SC	Science Core	10	8							**18**
ESA	Engineering Science & Arts	9	7							**16**
DSC	Dept. Specific Core			12	12	9	6			**39**
DSE	Dept. Specific Elective			3	3	3	6	12	6	**33**
OE	Open Elective			2	2	2	2	2		**10**
AECC	Ability Enhancement Compulsory Course		2			1		1		**4**
SECC	Skill Enhancement Compulsory Course	2	2		2	1				**7**
VAC	Value Added Course		3	2		2	4	4	11	**26**
L	Laboratory Course			4	4	3	2			**13**
Total Credits										**166**



FIRST SEMESTER COURSES

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA101	**Engineering Mathematics-I**	**---**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives	To enable the students to have a good understanding of fundamental concepts of single and multivariable calculus.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To provide the basic and important concepts of linear algebra.		MA101.1	Able to acquire **knowledge** of limit, continuity and differentiation for functions of single and multi-variables and the consequences of different mean value theorems. — **Understand, Analyze**
	To prepare the students to apply the mathematical principles of calculus and linear algebra to solve engineering problems.		MA101.2	Able to **apply** Taylor's series to approximate differentiable functions of single and multi-variables and **estimate** the error. — **Apply, Evaluate**
	To enable the students to have a good understanding of essential methods of statistical inference.		MA101.3	Able to **apply** definite integrals to **evaluate** length of plane curves, volume and surface area of solids of rotation. — **Apply, Evaluate**
			MA101.4	Able to **understand** the basic concepts of vector spaces and to solve systems of linear equations. — **Understand, Evaluate**
			MA101.5	Able to **demonstrate** and **apply** estimation of parameters, confidence interval, and testing hypotheses for normal distribution. — **Understand, Apply**
			MA101.6	Able to **formulate** relationships among random variables using regression and correlation. — **Create**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA101.1	**2**														
MA101.2	**3**														
MA101.3	**3**														
MA101.4	**3**														
MA101.5	**2**														
MA101.6	**3**														
MA101	**2.67**														

SYLLABUS

No.	Content	Hours	COs
I	**Differential Calculus:** Real valued functions of single variable: Limit; continuity; differentiation, Taylor & Maclaurin series, indeterminate forms, L'Hospital's rule. Real valued functions of two/three variables: Limit, continuity, partial differentiation; Taylor and Maclaurin series for function of two variables; Extreme values of functions of two variables.	**14**	**MA101.1 MA101.2**
II	**Integral Calculus:** Definite integral: length of a plane curve, surface area of revolution, volume of solids of revolution; Differentiation under sign of integral: Leibnitz rule; Improper integrals, convergence tests, beta and gamma functions; Multiple Integrals: double and triple integrals, volume and surface integrals.	**16**	**MA101.3**
III	**Linear Algebra:** Vector space over R, subspaces, bases and dimension; Echelon form, rank of a matrix, system of linear equations-direct & iterative methods; eigenvalues and eigenvectors; Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, and unitary matrices.	**14**	**MA101.4**
IV	**Statistics:** Random variables, Probability distributions, Point estimation of parameters, Confidence Intervals, Testing Hypotheses, goodness of fit: Chi-square test, Regression: fitting straight lines, correlation.	**12**	**MA101.5 MA101.6**
	Total Hours (4 Modules)	**56**	

Essential Readings

1. J. Stewart, D. K. Clegg and S. Watson, "Calculus", Cengage Learning India Pvt. Limited, 9th edition, 2023.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.

Supplementary Readings

1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.
2. N. Piskunov, "Differential Calculus and Integral Calculus – I", CBS, 1996.
3. N. Piskunov, "Differential Calculus and Integral Calculus – II", CBS, 1996.
4. D. C. Montgomery and G. C. Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th edition, 2018.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
PH101	**Engineering Physics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand the concepts of fundamentals of em wave, vectors, vector calculus and its relevance to science and engineering	Course Outcomes	PH101.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering concepts	Understanding Applying
	To introduce various concepts of special theory of relativity		PH101.2	Able to gain the **knowledge** of special theory of relativity	Understanding
	To introduce various concepts of different optical phenomena observed in nature.		PH101.3	Able to gain the **knowledge** about Geometrical and Physical Optics and its **applications**.	Understanding Applying
	To introduce the developments of Quantum Physics in the beginning of 20th century and the development thereafter.		PH101.4	Able to understand the **concepts** and theories of 20-th century Physics and its **applications**.	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH101.1	**3**	**2**													
PH101.2	**3**	**2**													
PH101.3	**3**	**2**													
PH101.4	**3**	**2**													
PH101	**3**	**2**													

SYLLABUS

No.	Content	Hours	COs
I	**Electromagnetism**: Vector calculus**,** Gauss's law and its applications, divergence and curl of electrostatic fields, electrostatic potential. Lorentz force, Biot-Savart and Ampere's laws and their applications, divergence and curl of magnetostatic fields, force and torque on a magnetic dipole, motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction.	**14**	**PH101.1, PH101.2**
II	**Optics:** Interference - coherence, principle of superposition, Young's double slit experiment, Newton's rings, diffraction - Fresnel and Fraunhofer diffracting, grating and its usages, polarization, Malus' law, polarization by reflection and Brewster's law.	**14**	**PH101.3**
III	**Modern Physics:** Old quantum theory, black body radiation, Planck's law, photoelectric effect, Compton effect, de-Broglie's hypothesis, Heisenberg uncertainty principle, wave packet, group and phase velocities, postulates of Quantum mechanics. Schrödinger's equation, application in 1-dimension: particle in a box.	**14**	**PH101.4**
	Total Hours	**42**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

Supplementary Readings

1. J. C. Morrison, Modern Physics for Scientists and Engineers, Elsevier; 2nd edition, 2015.
2. M. Mansfield and C. O'Sullivan, "Understanding Physics", Wiley-Blackwell; 3rd Edition, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
PH 151	**Engineering Physics Laboratory**	----------	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand the fundamentals of electromagnetism		PH151.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering	Understanding Applying
	To understand various concepts of Optical phenomena in Physics and Engineering		PH151.2	Able to gain the **knowledge** about Geometrical and Physical Optics	Understanding
	To understand the fundamentals of General Physics		PH151.3	Able to **understand** the concepts of General Physics and its **applications**	Understanding Applying
	To understand the fundamentals of Semiconductor Physics		PH 151.4	Able to gain the **knowledge** of Semiconductor Physics and its **applications**	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH 151.1	**3**	**2**													
PH 151.2	**3**	**2**													
PH 151.3	**3**	**2**													
PH 151.4	**3**	**2**													
PH 151	**3**	**2**													

SYLLABUS

S. No.	Title of the Experiment	Hours	COs
I	To verify inverse square law (using a point source of light)	**02**	**PH 151.1**
II	To verify Coulomb's Law of force between two electric poles	**02**	
III	To determine the variation of magnetic field along the axis of the current carrying coil	**02**	
IV	To find resonance frequency in series and parallel LCR circuit	**02**	
V	To find the refractive index of prism by measuring angle of prism and angle of minimum deviation	**03**	**PH 151.2**
VI	Determination of wavelength of monochromatic light (LASER) using Fresnel Biprism	**02**	
VII	To determine the wavelength of sodium light by measuring the diameters of Newton's rings	**03**	
VIII	To determine the wavelength of LASER using Diffraction grating	**02**	
IX	To find the refractive index of a glass plate & water by using a travelling microscope	**02**	
X	To determine frequency of A.C. Mains using sonometer	**03**	**PH 151.3**
XI	To determine the Young's modulus of elasticity of the material of a sample beam by bending	**02**	
XII	I-V characteristic curve of a P-N junction in forward bias and reverse bias	**02**	**PH 151.4**
XIII	Half-wave rectifier circuit without and with filter (HWR)	**02**	
XIV	Evaluation and Viva of all experiments	**03**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
XV	Laboratory written test	**01**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
	Total Hours (for any 10 experiments from Sl. No. I to XIII)	**27**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.
2.D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India, 5th Edition, 2023
3.A. Ghatak, "Optics", Tata McGraw-Hill, 7th Edition, 2020

Supplementary Readings

1. D. Kleppner, and R. J. Kolenkow, "An Introduction to Mechanics", Cambridge University Press, 2nd Edition, 2021.
2. R. Eisberg, and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley, 2nd Edition, 2006

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 103	**Biology for Engineers**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To provide the basic knowledge of various biomolecules, which are essential for life, their structures, and functions.		CY103.1	Able to understand the significance of biomolecules for sustaining life, including the knowledge of the structure of the cell and the biological signal transduction process.	**Understand**
	To discuss the structure and function of cells, different cellular processes, and biological signal transduction.				
	To provide the knowledge of heredity, how genes work, the concept of the central dogma of life, genetic engineering, and genomics.		CY103.2	Able to interpret the heredity, variation, and central dogma of life followed by gene expression and their applications.	**Understand**
	To provide basic knowledge on engineering tools in disease biology, stem cell engineering, 3D printing of artificial organs and various biomaterials.		CY103.3	Able to apply the concepts of engineering tools to solve the issues related to disease aspects, diagnosis, etc.	**Apply**
			CY103.4	Able to apply the concepts of biomaterial processing and their applications.	**Apply**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB103.1	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
2	CB103.2	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
3	CB103.3	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
4	CB103.4	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
	CB103	2	3	3												

SYLLABUS

No.	Content	Hours	COs
I	**Molecules of life**: Chemical basis of life, protein structure and function, nucleic acids and the RNA, carbohydrates, lipids, membranes, and cells, cellular interactions, cell cycle, biological signal transduction.	**06**	CB103.1
II	**Gene structure and expression**: Mitosis, meiosis, Mendelian Genetics. DNA and the gene- Synthesis and repair, how genes work, the central dogma of life, transcription, RNA processing, translation, control of gene expression, analyzing and engineering genes, genomics.	**06**	CB103.2
III	**Trends in bioengineering**: Genetic engineering, disease biology and biopharmaceuticals, stem cell engineering, metabolic engineering, biosafety, and bioethics. Bioprinting techniques and materials, 3D printing of ear, bone, and skin. Bioimaging and Artificial Intelligence for disease diagnosis.	**08**	CB103.3
IV	**Biomaterials Processing**: Classification, concept of biocompatibility, quantification of structure-property correlation - bioglass/ glass-ceramics, biodegradable polymers, biocomposites, bioplastics, macroporous scaffolds. Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and bioremediation via microbial surface adsorption (removal of heavy metals like lead, cadmium, mercury, arsenic).	**08**	CB103.4
	Total Hours	**28**	

Essential Readings

1. E. Engner, R. Ross, D. Bailey, "*Concepts in Biology"*, 14th Edition, McGraw Hill Education, New York, 2011.
2. R. Renneberg, V. Berkling and V. Loroch, "Biotechnology for Beginners", 2nd Edition, Academic Press, 2016.

Supplementary Readings

1. G.K. Suraishkumar, "Biology for Engineers", 1st Edition, Oxford University Press, New Delhi, 2019.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", 7th edition, Wiley, New York, 2013.
3. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", 1st Edition, MIT Press, 2008.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
ME101	**Engineering Mechanics**	-----	**3**	1	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	This course describes the different laws of forces associated with different engineering elements.		ME101.1	Able to understand vector mechanics and classify the different laws of forces associated with engineering systems	Knowledge Identification
	This course introduces the use of force, moments and MOIs in various conditions.		ME101.2	Able to i) Illustrate the use of force and moments in various working conditions (Understanding). ii) understand the centre of gravity, centroid, centre of mass and details of MOIs.	Knowledge Identification and Application
	This course illustrates the use of subject knowledge in the fields of engineering.		ME101.3	Able to identify the equilibrium conditions of engineering structures (truss, beams, frames) under various loads.	Knowledge Identification and Analyse
	This course introduces the states of engineering elements and structures under various loading conditions.		ME101.4	Able to solve the basics of friction and its associated laws along with the related problems.	Knowledge Identification and Analyse
	This course explains how to solve the practical problems of mechanics to determine the static forces with their magnitudes and directions.		ME101.5	Able to understand the kinematics of particles and Rigid Bodies and principle of work along with the related problems.	Knowledge Identification and Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ME 101.1	3	2	2	2								2	3	2
ME 101.2	3	2	2	2								2	3	2
ME 101.3	3	2	2	2								2	2	2
ME 101.4	3	2	1	1								2	2	2
ME 101.5	3	2	1	2								2	2	2
ME 101	**3**	**2**	**1.6**	**1.8**								**2**	**2.4**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Vector Mechanics with applications: Definition and representation of vectors, projection and decomposition, force vector and types, dot product, resolving force vector along and perpendicular to a given direction, cross product and scalar triple product	**06**	**ME101.1**
II	Compositions of two force system, Resolution of forces, General method of composition of forces, Equilibrium of bodies, Free body diagram. Lami's theorem, Equilibrium of connected bodies	**06**	**ME101.1**
III	Moment of force, Varignon's theorem, Couple, Resolution of a force into a force and couple, Resultant of non-concurrent force system, Equilibrium of non-concurrent system of forces.	**06**	**ME101.2**
IV	Center of gravity, Centroid, Use of axis of symmetry, Centroid of a composite section, Center of gravity of a flat plate, Difference between center of gravity and centroid, Determination of centroid from first principle.	**06**	**ME101.1 ME101.2 ME101.3**
V	Moment of inertia, Radius of gyration, Polar moment of inertia, Moment of inertia from first principles, Theorems of moment of inertia, Moment of inertia of composite sections, Moment of inertia of standard sections	**06**	**ME101.3**
VI	Frames, Truss, Assumptions in analysis of frame and Truss, Nature of forces, Methods of analysis, Method of joints, Method of sections	**06**	**ME101.3**
VII	Laws of friction, Angle of friction, angle of repose, cone of friction, Wedges, Problems involving non-concurrent force system, Rope/belt friction, pulleys, screw-jack, rolling resistance	**05**	**ME101.1 ME101.2 ME101.4**
VIII	Types of supports, Types of beam, Types of loading, finding reactions at support, shear force and bending moment, axial force and twisting moment, Concept of Stress and Strain – Stress strain, diagram, factor of safety, uniaxial loading, single and double shear, applications. Generalized Hooke's law - Poisson's ratio, Generalized Hooke's law, Relations between E, G and K	**06**	**ME101.2 ME101.4**
IX	Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.	**05**	**ME101.1**
X	Work, Work done by varying force, Energy, Power, Work energy equation for translation, Motion of connected bodies, work done by spring	**04**	**ME101.1**
	Total Hours	**56**	

Essential Readings

1. F.P. Bear, E. R. Johnston, Vector Mechanics for Engineers, Tata McGraw Hill, 12th Edition 2019,
2. S. Timoshenko, D.H., Young, JV Rao, S. Pati, Engineering Mechanics, McGraw Hill Education, 5th Edition, 2017

Supplementary Readings

1. H. J. Shah, S. B. Junarkar, Applied Mechanics, Charotar Publication, 19th Edition 2015
2. S. S. Bhavikatti, K. G. Rajashekarappa, Engineering Mechanics, Wiley Eastern Ltd., 2018
3. R. C. Hibbeler, Engineering Mechanics –Statics & Dynamics, Macmillan Publication Co., 11th Edition, 2006

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS101	**Computer and Coding**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the basic architecture of a computer, the concept of algorithm, the basic concepts and terminology of programming in general and concept of functional hierarchical code organization.		CS101.1	**Able to explain the basic architecture of a computer, the concept of algorithm, and the basic concepts and terminology of programming in general.**	Understand
	To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.		CS101.2	**Able to develop the ability to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
	To introduce programming using C language and writing programs in C on a computer, and edit, compile, debug, correct, recompile and run those.		CS101.3	**Able to apply the C programming language to implement various algorithms.**	Apply
	To train the students in choosing right data representation formats based on a problem specification.		CS101.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
			CS101.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
			CS101.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS101.1	3		1		1					1	1	1			
CS101.2	2	3	3	2	1	1			1				1	1	1
CS101.3	3	3	3	2	1				1					1	1
CS101.4	3	1	1	2										2	3
CS101.5	3		3	1	3				1					1	1
CS101.6	3	2	2	2					2						1
CS101	2.83	2.25	2.17	1.80	1.50	1.00			1.25	1.00	1.00	1.00	1.00	1.25	1.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Organization of a Computer: Von Neumann architecture; CPU; Memory; RAM; ROM; Hardware; Software; Application Programs; System Programs; Operating Systems; Number Systems.** **Concept of Programming and Programming Languages: Machine Language; Assembly Language; High-Level Programming language; Compiler; Assembler; Interpreter; Linker; Loader; Compiling a C program in command line and in an IDE** **Concept of Algorithm, Flowchart, Pseudo code, Illustrative Problem Solving Examples.**	**5**	**CS101.1** **CS101.2**
II	**Introduction to C programming language** **Features of a Programming Language: Character Set; Constants; Escape Sequences; Identifiers; Keywords; Data Types; Data Type Qualifiers; Variables; Declarations; enum; typedef; Operators & Expressions - Binary operators :- Arithmetic Operators, Logical Operators, Relational Operators, Bitwise Operators; Assignment Operator; Shorthand Assignment Operators; Unary Operators; Ternary Operators; Special Operators; sizeof(); Operator Precedence and Associativity in expressions; Data type conversion: coercion (implicit type conversion), type casting (explicit type conversion); Statements: Assignment statements, Input/ Output statements for standard input/ output devices.** **Flow Control - Conditionals and Branching:- Simple if Statement, if-else Statement, Nested if-else Statement, Ladder structure of if-else, switch-case statement, goto statement;** **Iteration - while Statement, do-while Statement, for Statement, break and continue.** **Functions; Function Types - standard library functions, user defined functions; syntax of functions; Arguments and Parameters; Call by Value; Call by Reference; parameterized main function; Storage Classes - auto, register, static, extern; Scope Rule: Variable scope - local, global; Recursion.** **Arrays - Single Dimensional Arrays, Multi-Dimensional Arrays, Introduction to strings :- Definition of a string, character arrays and strings, pointers and strings, standard library string functions, arrays of strings; Pointers - different types of pointers, pointer arithmetic, pointers and arrays.** **Structures - creating structures using struct, Arrays in Structures, Array of Structures, Difference between arrays and structures; Unions - creating structures using union, difference between structures and unions.** **Preprocessor directives and Files - Preprocessor directives :- File inclusion by macro, macros, macros and functions; Basic Input/ Output operations on Files :- Text files and binary files, file opening modes, opening, closing, reading, writing and appending to a file.** **(A programming language like C/ C++ shall be used as a basis language. The same language is to be used for the laboratory).**	**23**	**CS101.3** **CS101.4** **CS101.5** **CS101.6**
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.
2. V. Rajaraman, "Fundamentals of Computers", PHI Learning, 6th revised edition, 2014.

3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.

2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.

3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS151	**Computer & Coding Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using C language and to write programs in C on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS151.1	**Able to explain the basic concepts and terminology of programming in general.**	Understand)
CS151.2	**Able to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
CS151.3	**Able to use the C programming language to implement various algorithms.**	Apply
CS151.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
CS151.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
CS151.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS151.1	3		1		1					1	1	1			
CS151.2	2	3	3	2	1	1			1					1	
CS151.3	3	3	3	2	1				1					3	
CS151.4	3	2	1	2										1	
CS151.5	3		3	2	3	1			1					2	
CS151.6	3	2	2	2					2					1	
CS151	**2.83**	**2.50**	**2.17**	**2.00**	**1.50**	**1.00**			**1.25**	**1**	**1**	**1**		**1.60**	

SYLLABUS

No.	Content	Hours	COs
I	1. C program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. C program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a + ab^2}{\sqrt{a^2+9}}$	**02**	**CS101.1** **CS101.2** **CS101.3** **CS101.4** **CS101.5** **CS101.6**
II	3. C program to check a given number is odd or even and positive or negative. 4. C program to read three numbers and find the greatest one.	**02**	
III	5. C program to read five numbers and find the second smallest number. 6. C program to find GCD and LCM of two numbers.	**02**	
IV	7. C program to store ten numbers in an array and find the largest and smallest. 8. C program to store N numbers in an array and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. C program to check whether a given number is prime or not. 10. C program to print first N numbers of Fibonacci series.	**02**	
VI	11. C program to find a key from n numbers using sequential search (Linear search), and if found, show the position. 12. Implementation of an algorithm to insert an element at any arbitrary position in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after insertion.	**04**	
VII	13. Implementation of an algorithm to delete an element in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after deletion. 14. Implementation of an algorithm to reverse the elements of an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after reversal.	**04**	
VIII	15. C program to solve Tower of Hanoi problem for n disks. 16. C program to generate n Fibonacci numbers using both recursive and non-recursive methods.	**04**	
IX	17. C program to implement a swap function to swap the values of two variables. 18. C program to store the name, roll number, marks and grades of 5 students using array of structure.	**04**	
X	19. C program to create a file named "StudentDatabase" and storing the name, roll number, phone number and average marks of N students, where N is a natural number between 2 to 10.	**02**	
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.

2. V. Rajaraman, “Fundamentals of Computers”, PHI Learning, 6th revised edition, 2014.
3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.
2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.
3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 101	**Engineering Graphics**	**-----**	**0**	**1**	**3**	**2**	**50**	**50**	**100**	**200**

Course Objectives

- To develop the student's ability to understand the role and importance of technical drawings in engineering drawing process, and application of BIS and ISO conventions.
- To develop the student's ability to understand the proper representation and practice of Lines, Lettering, and dimensioning.
- To develop student's ability to understand the importance of types of scales.
- To develop the student's ability to construct plane geometry.
- To develop the student's ability to understand the concepts of projection and their application in technical drawing.
- To develop the student's ability to apply projection technique to draw Multi-view, pictorial view (Isometric View) drawings.
- To develop the student's ability to understand development process of surfaces of various objects.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE101.1	Able to acquire knowledge about BIS conventions and it's application to draw letters, lines and dimensions.	Knowledge Application
CE101.2	Able to acquire knowledge about developing various types of scales associated with engineering drawing and it's application.	Knowledge Application
CE101.3	Able to acquire knowledge about constructing points, lines, curves, polygons, planes, solids etc. and it's application.	Knowledge Application
CE101.4	Able to acquire knowledge about the system of projection with respect to the observer, object, the reference planes and it's application.	Knowledge Application
CE101.5	Able to acquire knowledge about creating orthographic, isometric, multi-view drawing, and sectional views of objects and it's application.	Knowledge Application
CE101.6	Able to acquire knowledge about the development process of surfaces of various objects and it's application.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE101.1	2	2	2		2				1	3		1	3		
CE101.2	2	2	2		2				1	3		1	3		
CE101.3	2	2	2		2				1	3		1	3		
CE101.4	2	2	2		2				1	3		1	3		
CE101.5	2	2	2		2				1	3		1	3		
CE101.6	2	2	2		2				1	3		1	3		
CE101	**2**	**2**	**2**		**2**				**1**	**3**		**1**	**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Importance of Engineering Drawing, drawing Instruments and materials, B.I.S. and ISO conventions, Lines, Lettering, and Dimensioning	**02**	**CE101.1**
II	**Scales:** Construction of scales – plane scale, diagonal scale, Vernier scale, functional scale; concept of conversion scale and nomogram	**02**	**CE101.2**
III	**Plane Geometry:** Geometrical Construction: line, arc, and angle, divisions of straight line and circumference, construction of polygon	**02**	**CE101.3**
IV	**Conic Sections and other Curves:** Construction of Ellipse, Parabola, Hyperbola, Rectangular Hyperbola, Cycloidal Curves: Cycloid, Involute	**02**	**CE101.3**
V	**Projection:** Principle of Projection and Orthographic Projection, Projection of points and lines, Projection of Planes.	**03**	**CE101.4**
VI	**Solid Geometry:** Types of Solids: polyhedral, prisms, pyramids, cylinder, cone, sphere, auxiliary projection method, Orthographic projection of solids: one view, two view and three view drawings, Missing view, rules for selection of views.	**03**	**CE101.4**
VII	Sectional view, section plane perpendicular to the HP & VP and other Various positions, true shape of sections.	**03**	**CE101.4**

VIII	Classification, line of intersection, line/generator method and section plane method: intersection of two prisms, two cylinders, intersection of cone and cylinder	**03**	**CE101.4**
IX	Terminology, isometric scale, isometric view and isometric projection, isometric axes, and lines, missing view	**02**	**CE101.5**
X	Method of development, parallel line development, radial line development, developments of cylinder, cone, prism, pyramid, true length of edges – oblique surface.	**02**	**CE101.6**
XI	Introduction to CAD software	**04**	**All COs**
Total Hours		**28**	

Essential Readings

1. N.D. Bhatt, Engineering Drawing, Chrotar Publishing House, 2011.
2. Dhananjay A Jolhe, Engineering drawing, TMH, 2008
3. M.B. Shah and B.C. Rana, Engineering Drawing, Pearson, 2009.

Supplementary Readings

1. T E French, C J Vierck and R J Foster, Graphic Science and Design, 4th edition, McGraw Hill, 1984
2. W J Luzadder and J M Duff, Fundamentals of Engineering Drawing, 11th edition, Prentice-Hall of India, 1995.
3. K Venugpoal, Engineering Drawing and Graphics, 3nd edition, New Age International, 1998.
4. Gary R. Bertoline, Eric N. Wiebe, Nathan W. Hartman, William A. Ross, Technical graphics Communication, 4th Edition, McGraw Hill Higher Education, 2009
5. Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, Cindy M. Johnson Technical Drawing With Engineering Graphics, 15th Edition, Prentice Hall, 2016
6. SP 46: 2003, Engineering Drawing Practice for schools and colleges.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
HS151	**Communication Skills**	**Nil**	**0**	**1**	**2**	**2**	**01 Experiment X 10**	**100**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To introduce the basic concepts of communication		HS151.1	Describe and apply the skill of listening in Communicative English	Apply
	To improve English communication skills of students which are essential to succeed in today's business environment.		HS151.2	Demonstrate good reading skills in English	Apply
	To improve oratory skills and body language		HS151.3	Demonstrate good writing skills in English	Apply
	To develop the ability to critically analyze topics and contexts independently or in groups		HS151.4	Demonstrate good oratory skills in English	Apply

	Mapping with Program Outcomes (POs)													Mapping with PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS151.1	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.2	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.3	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.4	-	-	-	-	-	-	-	-	1	3	-	3			
HS151	-	-	-	-	-	-	-	-	1.0	3.0	-	3.0			

SYLLABUS

No.	Activities/Experiments	Hours	COs
I	Short speeches or other audio files: Listening; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
II	Short movies or other video files: Watching; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
III	Unseen comprehension: Reading passages or essays; Conversing with the teacher or other students; Writing a summary or answering questions	6	HS151.2
IV	Written composition: Writing paragraphs and argumentative and narrative essays; Letter writing–official, personal, job application; Notice writing; Reports	12	HS151.3
V	Oratory: Greetings & introductions; Extempore; Debate; Group discussion; Individual/group seminar presentations; Vocabulary building; Taking and giving interviews; pronunciation skills exercises	12	HS151.4
	Total Hours	**42**	

Essential Readings

1. C. Muralikrishna and Sunita Mishra, *Communication Skills for Engineers*, Pearson, 2nd Edition, 2011.
2. Nitin Bhatnagar and Mamta Bhatnagar, *Communicative English for Engineers and Professionals*, Pearson, 2010.

Supplementary Readings

1. J. K. Gangal, *A Practical Course for Developing Writing Skills in English*, PHI, 2011.
2. John Seely, *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 3rd Edition, 2013.
3. Sanjay Kumar and Pushp Lata, *Communication Skills*, Oxford University Press, 2nd Edition, 2015.

SECOND SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**II**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA 102	**Engineering Mathematics-II**	**NIL**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	1. To introduce the fundamental concepts of various engineering mathematics tools involving integral transforms, differential equations and complex variables.		MA102.1	Able to **describe** the basic concepts of Fourier series, Fourier transform, Laplace transform and their applications.	**Understand**
			MA102.2	Able to **solve** ordinary differential equations analytically and **implement** the ODEs to model real world problems.	**Apply**
	2. To develop problem-solving and critical thinking skills in engineering mathematics.		MA102.3	Able to **compare** second order PDEs and **solve** Laplace, heat and wave equations using Fourier series.	**Analyze** **Apply**
			MA102.4	Able to **recognize** analytic functions, **solve** contour integrals and **determine** the Taylor and Laurent series expansions.	**Understand** **Apply**
			MA102.5	Able to **use** the basic knowledge of engineering Mathematics in solving real-world problems .	**Apply**
			MA102.6	Able to **apply** Gauss' divergence theorem, Stokes' theorem and Green's theorem to evaluate double and triple integrals	**Apply**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA102.1	**3**														
MA102.2	**3**														
MA102.3	**3**														
MA102.4	**3**														
MA102.5	**3**														
MA102.6	**3**														
MA102	**3**														

SYLLABUS

No.	Content	Hours	COs
I	**Integral Transforms:** Fourier series of a function with arbitrary period, Fourier series of even and odd functions, half-range Fourier series, Fourier Transform: Fourier integral theorem, Fourier sine and cosine integrals, complex form of Fourier integral, Fourier transform of derivative of a function, applications of Fourier transform in boundary value problems; Laplace Transform: Laplace transform of a function, existence theorem, Laplace transform of derivatives and integrals, inverse Laplace transform, convolution theorem.	**13**	**MA102.1** **MA102.5**
II	**Ordinary Differential Equations:** First order ordinary differential equations: exact, integrating factors, linear and Bernoulli's equations, Higher order differential equations with constant coefficients, Cauchy-Euler equations, method of variation of parameters, system of differential equations. Use of Laplace and Fourier transform in solving ordinary differential equations**.**	**12**	**MA102.2** **MA102.5**
III	**Partial Differential Equations:** First order partial differential equation: linear, semi-linear, quasi-linear, and non-linear types. Classification of integrals. Lagrange's method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations. Method of separation of variables to solve Wave equation, Laplace equation, Heat equation. Use of Laplace and Fourier transform in solving partial differential equations**.**	**13**	**MA102.2** **MA102.5**
IV	**Complex Analysis:** Basic concept of complex numbers, limits, continuity and differentiability of a complex valued function of a complex variable, analytic functions, Cauchy-Riemann Equations, harmonic functions, complex exponential, trigonometric, hyperbolic and logarithmic functions, line integral in complex plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor and Laurent series, singularities.	**12**	**MA102.4** **MA102.5**
V	**Vector Calculus:** Gradient, divergence, curl; Green's theorem; Gauss' divergence theorem; Stokes' theorem.	**06**	**MA102.6**
	Total Hours (5 Modules)	**56**	

Essential Readings

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.
2. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.

Supplementary Readings
1. P. Dyke, “An Introduction to Laplace Transforms and Fourier Series”, Springer Nature; 2nd edition, 2014.
2. Shepley L. Ross, “Differential Equations”, John Wiley & Sons, Inc, 3rd edition 2007.
3. S. J. Farlow, “Partial Differential Equations for Scientist and Engineers”, Dover Publications, 2003.
4. J. W. Brown and R. V. Churchill, “Complex Variables and Applications”, McGraw Hill; 9th edition, 2021.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology (All Branches)**	Year of Regulation	**2024-25**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CB 101	**Engineering Chemistry**	NIL	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the students to the concept, classifications, and industrial applications of polymers		CB101.1	The students will be apply the knowledge about polymers, polymerization processes, and their industrial applications.	**Apply**
	To gain knowledge of different types of fuels and their analysis		CB101.2	Able to describe different types of fuels and their analysis, petroleum technology	**Understand**
	To learn about metallurgy, metal extraction process, composition, and properties of alloys		CB101.3	Able to explain the process of metal extraction from ores and discuss the properties of alloys and composition	**Analyze**
	To introduce students to different types of materials, properties, and their applications.		CB101.4	Able to analyze the properties of different materials and apply the knowledge of nanotechnology for various practical applications.	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB101.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.4	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101	2	2	3												

SYLLABUS

No.	Content	Hours	COs
I	**Polymer Chemistry:** Concepts, classification, structures, and molecular weights of polymers, mechanism and kinetics of various polymerization processes, natural rubber and its properties, vulcanization of rubber, synthesis and applications of various industrial polymers, adhesives, paints, conducting polymers and their applications in electronic devices, biodegradable polymers.	**10**	CB101.1
II	**Petroleum Chemistry:** Composition, characteristics of crude oil, cracking. Solid, liquid and gaseous fuels, coal analysis; classification of coal; anti-knocking agents, octane number and cetane number, aviation fuel and biofuels, lubricants.	**08**	CB101.2
III	**Metallurgy:** Minerals, ores, and general methods of extraction and purification of metals (Fe, Al, Cu, Zn). Alloys: Definition of alloy, types of alloys (ferro, non-ferro & amalgam), composition, properties, and uses of brass, bronze, and steel.	**08**	CB101.3
IV	**Material Chemistry:** Introduction and properties of glass, ceramics and their composites, magnetic materials, and smart materials. Piezoceramic materials, electro-active materials, shape-memory materials, energy harvesting materials, self-healing materials, semiconducting materials, and liquid crystals. **Nanomaterials** Introduction, classification, properties of nanomaterials, carbon-based nanomaterials, synthesis of nanomaterials, top-down and bottom-up approaches, characterization of nanomaterials, applications of nanomaterials - materials for light emitting diodes, batteries, and fuel cells, memory devices and sensors, nanotechnology for pharmaceutical applications, nanomaterials for tissue engineering, carbon nanotubes and nanocomposites in textiles.	**16**	CB101.4
	Total Hours	**42**	

Essential Readings

1. P. C. Jain and M. Jain, "Engineering Chemistry", 17th Edition", Dhanpat Rai Publication Co., 2019.
2. S. Chawla, "A Text Book of Engineering Chemistry", 1st Edition, Dhanpat Rai & Co. (P) Limited, 2017

Supplementary Readings

1. M. G. Fontana, "Corrosion Engineering", Third Edition, McGraw-Hill Book Company, 2017
2. R. Gopalan, D. Venkappayya, S. Nagarajan, " A textbook of Engineering Chemistry" 4th Edition, Vikas Publishing House Pvt. Ltd.
3. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications", 2nd edition, Cambridge University Press, 2019

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution		
		L	T	P	C	Continuous Evaluation		Total
CB 151	**Chemistry Laboratory**	**0**	**0**	**2**	**1**	**01 Expt.**	**10**	**100**

Course Objectives		Course Outcomes	COs	Statement	Bloom's Taxonomy
	To provide the students with knowledge of various titration-based techniques for chemical analysis.		**COs**	**Statement**	**Bloom's Taxonomy**
	To teach the fundamentals of basic chemistry-related aspects for practical applications and sample analysis.		CB151.1	Able to explain the concepts of acid-base, redox, potentiometric and pH metric titration for quantitative analysis	Understand
	To develop the student's ability to use different instrumental methods for chemical analysis and testing of various samples.		CB151.2	Able to prepare standard solutions for various quantitative analysis	Apply
			CB151.3	Able to analyze water sample, alloy samples by complexometric iodometric and spectrophotometric analysis	Analyse
			CB151.4	Able to apply the concepts of partition coefficient, viscosity in analysis	Apply

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB151.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
2	CB151.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
3	CB151.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
4	CB151.4	**2**	**2**													
	CB151	**2**	**2**													

SYLLABUS

No.	Content	Hours	COs
1	To determine the alkalinity of a given water sample	**2**	CB151.1 CH151.2
2	Estimation of Fe(II) in Mohr's salt solution using standard $KMnO_4$ solution via Redox titration	**2**	CB151.1 CB151.2
3	Conductometric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
4	pH-metric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
5	Complexometric determination of hardness of water	**2**	CB151.3
6	Iodometric determination of copper in brass alloy	**2**	CB151.3
7	Spectrophotometry on copper sulphate solution	**2**	CB151.3
8	Determination of partition coefficient of acetic acid between *n*-butanol and water	**2**	CB151.4
9	Determination of percentage composition of sugar solution from viscosity	**2**	CB151.4
10	Estimation of Fe(II) in a solution using standard $K_2Cr_2O_7$ solution via potentiometric titration	**2**	CB151.1
	Total Hours	**20**	

Essential Readings

1. J. Mendham, R. Denny, J. Barnes, M. Thomas, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson.

Supplementary Readings

1. V. D. Athawale, P. Mathur, "Experimental Physical Chemistry", 1st Edition, New Age International (P) Limited Publishers, 2001.
2. Departmental laboratory manual

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 102	**Environmental Science**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs		**Bloom's taxonomy**
Course Objectives	To introduce students to natural resources and the impact of various human activities on natural resources and the environment.	Course Outcomes	CB102.1	The students will be able to discuss various types of natural resources, their proper utilization, and conservation for maintaining ecological balance.	**Understand**
	To provide basic knowledge about the environment and its related socio-economic problems, environment protection, and environment improvement programs.		CB102.2	Able to analyze the impacts of various types of pollutants on the environment and provide a proper scientific and technical solutions to control them.	**Analyze**
	To study the causes and effects of air, and water pollution and the techniques for monitoring air and water quality in the environment.		CB102.3	Able to apply different techniques to manage solid wastes and recovery of useful materials from wastes.	**Apply**
	To provide basic knowledge and overview of solid waste management and its impact on human health and surrounding environments.		CB102.4	Able to understand the features of renewable energy resources and their importance for sustainable development.	**Understand**

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CB102.1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
2	CB102.2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
3	CB102.3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
4	CB102.4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	CB102							2								

SYLLABUS

No.	Content	Hours	COs
I	**Natural resources:** Scope and importance, concept of sustainability and sustainable development. Land resources- Land degradation, soil erosion and desertification. Deforestation; impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water- Surface and ground water, floods, droughts, population growth, and associated problems.	**05**	CB102.1 CB102.2
II	**Human communities and the Environment:** Demography, population, population explosion and population control, family welfare programs, resettlement and rehabilitation of affected persons, case studies. Disaster management- flood, earthquake, cyclones and landslides. Environmental movements – Chipko, Silent valley and Bishnois of Rajasthan. Environmental ethics, environmental conservations, public awareness. Environmental Protection Acts.	**04**	CB102.1
III	**Air pollution:** Source and effect of pollutants, primary and secondary pollutants, control measures. Acid rain and its impacts. Green-house effects and their impact on global climate change. Depletion of the ozone layer and its effects. Air pollution monitoring techniques. **Water pollution:** Natural water, pollutants- their origin and effects, oxygen demanding wastes, pathogens, nutrients, salts, heavy metals, pesticides, volatile organic compounds. River/ lake/ ground water pollution. Water pollution monitoring techniques	**08**	CB102.2
IV	**Solid Waste Management:** Municipal, industrial, commercial, agricultural, hazardous solid wastes, recovery and conversion method of waste and waste management, land filling/disposal, incineration, composting. Environment management and sustainability tools (material management and recovery planning) for sustainable management including ISO, RIOS & R2 certifications, environment audit. E-waste- composition and generation, global context in e- waste, effects of pollutant (E- waste) on human health and surrounding environment, e-waste control measures, steps in recycling and recovery of materials from e-waste.	**07**	CB102.3
V	**Energy Resources:** Renewable and non-renewable energy sources, use of alternate energy sources [solar energy, hydro (tidal) energy, wind energy, geothermal, biomass, nuclear energy).	**04**	CB102.4
	Total Hours	**28**	

Essential Readings

1. A. Basak, "Environmental Studies", 2nd Edition, Pearson, 2015.
2. D. Dave and S.S. Katewa, "Text Book of Environmental Studies", Cenage Learning, 2nd Edition, 2012.

Supplementary Readings

1. R. Daniels and J. Khrishnaswamy, "Environmental Studies", 1st Edition, Wiley, 2009.
2. A. Khan, Inamuddin, A. M. Asiri "E-waste Recycling and Management", Springer Nature Switzerland AG, 2020

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE102	**Basic Electrical & Electronics Engineering**	**No**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To understand basic circuit theorems and laws
- To develop the skills to analyze the basic DC/AC system
- To introduce the principle of semiconductor physics
- To understand the concept of diode and its applications
- To understand the fundamentals of Bipolar Junction Transistors

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EE102.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
EE102.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
EE102.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
EE102.4	Able to acquire knowledge about the fundamentals of semiconductor physics.	Knowledge Synthesis
EE102.5	Able to gather knowledge about diode and its applications.	Knowledge Application
EE102.6	Able to understand the Bipolar Junction Transistors	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**					**2**		**2**	**3**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**					**2**		**2**	**3**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**					**2**		**2**	**3**
EE102.4	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.5	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102.6	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**2**	**2**	**2**	**3**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**2.00**	**2.00**	**2.40**

SYLLABUS

No.	Content	Hours	COs
I	**Analysis of DC circuits** Mesh, node, branch, Ohm's law, series and parallel circuit, basic devices: resistors, capacitors, inductors, dependent and independent sources, Kirchhoff's Laws, Mesh and Node Analysis, Star-Delta conversion, Superposition theorem, Source conversion, Thevenin theorem, Norton theorem, Maximum power transfer theorem.	**07**	**CO1**
II	**Electromagnetic Induction & Magnetic Circuit** Magnetic field, Right hand rule, Left hand rule, Electromechanical laws, relation between electricity and magnetism, production of emfs (ac & dc), Faraday's law of electromagnetic induction, direction of induced emf, Lenz law, dynamically and statically induced emfs, self-inductances, and mutual inductances, coefficient of coupling, Inductance in series and parallel, energy stored in a magnetic field.	**07**	**CO2**
III	**A.C Fundamentals and R.L.C circuits** Phasors, Complex quantities, Application of complex algebra to A.C circuit, series and parallel RL, RC, RLC circuit, concept of impedance triangle, complex power: active, reactive and apparent power, power triangle, admittance triangle, series parallel circuit. Balanced two phase and three phase systems, Balanced Star-Delta connections, phase and line currents and voltages and their relations, Measurement of three phase power.	**07**	**CO3**
IV	**Introduction to Semiconductors:** Fundamentals of semiconductor, Energy Bandgap, intrinsic and extrinsic semiconductors, Mobility, Conductivity & Resistivity.	**05**	**CO4**
V	**Diodes & applications**: Physical structure and working mechanism of the p-n junction, p-n junction under forward & reverse bias, I/V characteristics, Half wave & full-wave, bridge rectifiers.	**08**	**CO5**
VI	**Bipolar Junction Transistors:** Physical structure and working mechanism of BJT transistors, Input Output characteristics, Regions of operation, Transistor configurations: CB, CE, CC.	**08**	**CO6**
	Total Hours	**42**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013

3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

1. A. Chakroborty, S. Nath and C.K. Chanda, YBasic Electrical EngineeringZ, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
2. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
3. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
4. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.
5. https://onlinecourses.nptel.ac.in/noc21_ee55/preview

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	”ear of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE152	**Basic Electrical and Electronics Engineering Lab**	**EE**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To understand basic circuit theorems and laws		EE152.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
	To develop the skills to analyze the basic DC/AC system		EE152.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
	To develop the student's ability to apply the basic principles of electronics in circuit designing		EE152.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
	To develop the student's ability to design circuits based on diode		EE152.“	Verify the V-I characteristics of the basic diodes	Knowledge Application
	To develop the student's ability to study characteristics of BJT		EE152.5	Study the operational mechanism of diode circuits as a rectifier	Knowledge Application
			EE152.6	Study the characterises of BJT	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO“	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO“
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**0**
EE102.4	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.5	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102.6	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**	**2**	**0**
EE102	**3.00**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**					**2.00**	**1.00**	**2.00**	**2.40**	

SYLLABUS

No.	Content	Hours	COs
1	Study and verification of Kirchhoff's Current Law & Kirchhoff's voltage law applied to D.C. circuit.	**02**	**CO1**
2	To Study & Verify the Maximum Power Transfer theorem.	**02**	**CO1**
3	To find the inductance of the choke coil.	**02**	**CO2**
“	To study the R-L-C series circuit.	**02**	**CO3**
5	To study three-phase power measurement using The two-wattmeter method.	**02**	**CO3**
6	I-V characteristics of forward biased P-N junction Diode.	**02**	**CO4**
7	Reverse characteristics of 4ener Diode.	**02**	**CO4**
8	Half-wave rectifier using diode.	**02**	**CO5**
9	Full-wave rectifier using diode.	**02**	**CO5**
10	Input & output characteristics of BJT in CE mode.	**02**	**CO6**
	Total Hours	**20**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.
2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013
3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2006

Supplementary Readings

“. A. Chakroborty, S. Nath and C.K. Chanda, YBasic Electrical EngineeringZ, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
5. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
6. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
7. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2017.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisites	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
ME 152	**Workshop practice**	**--**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives			CO's	Statement	Bloom's Taxonomy
	Explain the tools, equipment and safety procedures of carpentry, fitting, welding and foundry shops. (Understanding).	Course Outcomes	ME152.1	Utilize the tools and equipment to perform specified jobs in fitting shop and compare with prescribed dimensions.	Applying
			ME152.2	Utilize the tools and equipment to perform specified jobs in carpentry shop and compare with prescribed dimensions.	Applying
			ME152.3	Utilize the tools and equipment to perform specified jobs in welding shop and compare with prescribed dimensions.	Applying
			ME152.4	Utilize the casting process to develop the prescribed job	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO 3
ME152.1	2	1				2			2				2	1	
ME152.2	2	1				2			2				2	1	
ME152.3	2	1				2			2				2	1	
ME152.4	2	1				2			2				2	1	
ME152	**2**	**1**				**2**			**2**				**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	To perform T-join with drilling in the centre in the fitting with the use of specific tools	**07**	**ME152.1**
II	To develop cross join/dovetail join/ briddle join in carpentry shop with the use of specific tools	**07**	**ME152.2**
III	To develop T-join Oxy-acetylene gas welding	**07**	**ME152.3**
IV	To make specific job using casting process	**07**	**ME152.4**
	Total Hours	**28**	

Essential Readings

1. S.K. Hajra Chaudhary, Elements of Workshop Technology Vol-I and II, Asia Publishing House, 2008

Supplementary Readings

1. K.N. Gupta, J. P. Kaushish, Workshop Technology, New Delhi Heights Publications, 1992
2. H.S. Bava, Workshop Technology, Tata McGraw Hill Publishing Co. Ltd., 2nd Edition, 2009
3. W.A.J. Chapman, Workshop Technology, ELBS Low Price Text, Edward Donald Pub. Ltd., 5th Edition, 1972

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS102	**Creativity, Innovation and Entrepreneurship**	**Nil**		**COs**	**Statement**				**Bloom's Taxonomy**	
Course Objectives	To introduce the basic aspects of creativity, innovation and entrepreneurship		Course Outcomes	HS102.1	Describe the basic concepts of creativity, innovation and entrepreneurship				Understand	
	To familiarize the importance of creativity, innovation, and entrepreneurship			HS102.2	Describe and illustrate the importance of creativity				Apply	
	To discuss the role and importance of creativity, innovation, and entrepreneurship for social development			HS102.3	Describe and illustrate the importance of innovation				Apply	
	To discuss the stages of the entrepreneurial process for the successful development of entrepreneurial projects			HS102.4	Describe and illustrate the importance of entrepreneurship				Apply	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
HS102.1	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.2	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.3	-	-	3	-	1	2	2	-	3	2	3	2			
HS102.4	-	-	3	-	1	2	2	-	3	2	3	2			
HS102	-	-	2.0	-	1.0	2.0	2.0	-	3.0	2.0	3.0	2.0			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of creativity, innovation, and entrepreneurship; Relation between creativity, innovation, and entrepreneurship; Differences between creativity and innovation; Differences between creativity and entrepreneurship; Differences between innovation and entrepreneurship; Event funding	06	HS102.1
II	Individual creativity, behaviour and psychological aspects of creativity; Idea generation; Creativity tools and techniques; Creativity in groups	06	HS102.2
III	Innovation and competitive advantage; Framework of innovative strategies; Organizational issues of innovation; Innovation in a competitive environment; Sources of innovation; Innovation selection; Effective implementation of innovative ideas	08	HS102.3
IV	Historical development of entrepreneurship; Types of entrepreneurship; Entrepreneurial opportunities; Entrepreneurial processes; Entrepreneurial strategies; Entrepreneurial practice; Sources of entrepreneurial ideas; Entrepreneurial project; Start-up; Contributions of entrepreneurs in society	08	HS102.4
	Total Hours	**28**	

Essential Readings

1. Pradip N. Khandwalla, *Lifelong Creativity: An Unending Quest*, Tata McGraw Hill, 2004.
2. Vinnie Jauhari and Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
3. Robert D. Hisrich et. al. *Entrepreneurship*, McGraw Hill Higher Education, 6th Edition, 2004.

Supplementary Readings

1. D. H. Holt, *Entrepreneurship: New Venture Creation*, Prentice Hall, 1992.
2. Lewrick, M., Link, P., and Leifer, L., *The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods,* John Wiley & Sons, 2020.
3. Hisrich, R. D., Peters, M. P., and Shepherd, D. A., *Entrepreneurship,* New York: McGraw-Hill, 2020.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS152	**Python Programming**		**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using Python and to write programs in python on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyze real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS152.1	**Able to understand the basic concepts of scripting and the contributions of scripting language.**	Understand
CS152.2	**Able to develop Python programs with conditionals and loops, functions and calling them.**	Create
CS152.3	**Able to analyse and explore python data structures like Lists, Tuples, Sets and dictionaries.**	Analyze
CS152.4	**Able to develop Python program to read and write data from/to files**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS152.1	3		1		1					1	1	1			
CS152.2	2	3	3	2	1				1					1	
CS152.3	3	3	3	2	1				1					3	
CS152.4	3	2	1	2										1	
CS152	2.75	2.67	2.00	2.00	1.00				1.00	1.00	1.00	1.00		1.67	

SYLLABUS

No.	Content	Hours	COs
I	1. Python program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. Python program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a+ab^2}{\sqrt{a^2+9}}$	**02**	**CS152.1 CS152.2 CS152.3 CS152.4**
II	3. Python program to check a given number is odd or even and positive or negative. 4. Python program to read three numbers and find the greatest one.	**02**	
III	5. Python program to read five numbers and find the second smallest number. 6. Python program to find GCD and LCM of two numbers.	**02**	
IV	7. Python program to store ten numbers in a list and find the largest and smallest. 8. Python program to store N numbers in a list and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. Python program to check whether a given number is prime or not. 10. Python program to print first N numbers of Fibonacci series.	**02**	
VI	11. Python program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments. 12. Python program to check whether the given string is palindrome or not.	**02**	
VII	13. Python program to find factorial of a given number using functions. 14. Python function that takes two lists and returns True if they are equal otherwise false	**04**	
VIII	15. Python program to open and write "hello world" into a file. 16. Python program to read a csv file using pandas module and print the first and last five lines of a file.	**04**	
IX	17. Python program to open a file and check what are the access permissions acquired by that file using os module. 18. Python program to copy the contents of a file to another file.	**04**	
X	19. Python program to count frequency of characters in a given file. 20. Python program to print each line of a file in reverse order.	**04**	
	Total Hours	**28**	

Essential Readings

1. Mark Lutz, " Programming Python", Prentice Hall India, 7th Edition, 2017
2. Mark Lutz, "Learning Python", McGraw-Hill publication, 6th Edition, 2021
3. Luciano Ramalho, "Fluent Python", O'Reilly Media, 2nd Edition, 2021

Supplementary Readings

1. Allen Downey, "Think Python", O'Reilly Media, 2nd Edition, 2015
2. Marl Pilgrim, "Dive into Python", APress Media LLC, 1st Edition, 2005
3. Brett Slatkin , "Effective Python: 59 Specific Ways to Write Better Python", Pearson Education, Inc, 2nd Edition 2019

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS104	**Ethics and Morals**	**Nil**								

Course Objectives		Course Outcomes			Bloom's Taxonomy
	To introduce the basic aspects of human values and ethics		HS104.1	Explain the basic aspects of ethics, values, and morals	Understand
	To familiarize a few ethical theories that guide human values and principles		HS104.2	Explain a few theories that guide ethics, values, and morals	Understand
	To discuss a multi-dimensional perspective of human values and ethics		HS104.3	Demonstrate a multi-dimensional perspective of human values and ethics	Apply
	To help in applying the concepts of ethics to personal ethical lifestyle choices and for community well-being		HS104.4	Apply the concepts of ethics to personal ethical lifestyle choices and decision making	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS104.1	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.2	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.3	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.4	-	-	2	-	-	3	2	3	1	1	1	-			
HS104	-	-	2.0	-	-	3.0	2.0	3.0	1.0	1.0	1.0	-			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of ethics, morals, and values; Differences between ethics, morals, and values; Types of ethics; Dimensions of ethics; Ethics in human actions; Role of family, society, and educational institutions in inculcating values	06	HS104.1
II	Theories on ethics; Egoism; Ethical ideologies; Moral development; Moral thinking; Values; Transparent standards; Fair competition; Equal opportunity; Conflict of interest; Code of conduct	08	HS104.2
III	Emotional intelligence and ethics; Corporate social responsibility and consumer protection; Environment ethics; Industry and environment management; Discrimination; Privacy; Surveillance; Coping with failures; Performance appraisals	07	HS104.3
IV	Relationship between attitude, thought and behaviour; Ethics and attitude; Social influence and persuasion; Ethical decision making; Personal values and ethical decision making; Trustworthiness; Respect; Responsibility; Fairness; Integrity	07	HS104.4
	Total Hours	**28**	

Essential Readings

1. R. R. Gaur, R. Sangal and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, 2010.
2. R. Subramanian, *Professional Ethics*, Oxford University Press, 2nd Edition, 2017.

Supplementary Readings

1. A. Carr, *Positive Psychology: The Science of Happiness and Human Strength*, Brunner-Routledge, 2004.
2. Charles E. Harris et.al. *Engineering Ethics: Concepts and Cases*, Wadsworth Publishing Co. Inc., 5th Edition, 2013.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
VA 102	**Skill Development and Prototyping**	**-----**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives

- To develop basic skills in the field of Electrical and Mechanical Engineering.
- To make students familiar with different electrical, automobile, and plumbing instruments, setups, assembly, and tools.
- To develop basic skills and understanding in 3-D printing technology

Course Outcomes

	CO's	Statement	Bloom's Taxonomy
	VA102.1	Students will be able to design domestic electric circuits and other basic circuits and function of different measuring instruments.	design
	VA102.2	Students will be able to understand the concept of battery charging/discharging systems and construction of machines, its starting, and fabrication of armature coil.	understand
	VA102.3	Students will be able to understand the functioning of different automobile parts and assemblies.	understand
	VA102.4	Students will be able to understand the functioning of different plumbing parts, tools, and assemblies.	understand
	VA102.5	Students will be able to understand the concepts of 3-D printing and its superiority over conventional manufacturing.	understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102.2	3	3	3	2	1	1			1		1	1	3	3	3
VA102.3	3	3	2	3	3	3	3		1		1	1	3	3	3
VA102.4	3	3	3	3	3	2	1		1		1	1	3	3	3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102	**3**	**3**	**2.75**	**2.5**	**2**	**2.25**	**2.33**		**1**		**1**	**1**	**3**	**3**	**2.75**

SYLLABUS

No.	Content	Hours	COs
I	**Electrical Shop:** Study and design different types of electrical wiring with loads, Study the cut- section of different types of AC/DC machines, Design and fabricate an armature coil using a handy coil winding machine, Assembling different parts of the electrical machine and testing its operation, Charging and discharging circuit of Batteries, Familiarization with analog /digital universal IC tester and advanced digital measuring instruments, To study the measurement of earth resistance using an earth tester, Energy measurement using a smart energy meter, Measurement of insulation resistance of cable/machine using insulation tester/megger, Starting of machine using various starters.	**6**	**VA102.1 VA102.2**
II	**Automobile Shop:** Demonstration on the cut section of the single and multicylinder engine (diesel and petrol), anti-lock braking system, constructional view and internal details of common automobile parts, fuel supply system of petrol and diesel engine, and coil ignition and electrical ignition system of an automobile.	**5**	**VA102.3**
III	**Plumbing Shop:** Demonstration on full-scale sewerage system, assembly station pipes, valves and fittings, tools for plumbing (plumbing wrenches, drain tools, and tools and supports for PVC pipes), cut away models of straightway valve, corner valve, angle seat valve, nonreturn valve, pressure reducing valve, strainer, gate valve, straightway plug valve, three ways plug valve, safety valve, screwed pipe connections, changeover valve, nonreturn butterfly valve, and strainer.	**4**	**VA102.4**
IV	**Additive Manufacturing Lab:** Introduction to 3-d printing, additive v/s conventional manufacturing, Engineering graphics, coordinate systems and their transformation, CAD, product design and prototyping, solid modeling and slicing software, STL files, additive manufacturing techniques, FDM printing, printing materials, support materials.	**5**	**VA102.5**
V	**Prototyping:** Circuit designing based on Electrical Shop, prototyping of automobile parts, plumbing tools, and parts, 3-D printing, etc.	**8**	**All COs**
	Total Hours	**28**	

Essential Readings

1. R.P. Singh, 'Electrical Workshop, Dreamtech Press, 3rd Edition, 2019
2. S.L. Uppal, "Electrical Wiring Estimating and Costing", Khanna Publishers, 6th Edition, 2015
3. K. Singh, "Automobile Engineering", Standard Publishers, 2020.
4. U. Rathore, N. K. Sharma, "A Textbook of Electrical Workshop Practices", S.K. Kataria & Sons, 1st Edition 2019
5. C.K. Chua, K. F. Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

Supplementary Readings

1. R.C. Mullin, P. Simmons, "Electrical Wiring Residential", Cengage Learning, 17th Edition, 2011.

THIRD SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation: **2024-25**
Department	**Civil Engineering**	Semester: **III**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE201	**Solid Mechanics**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO`s	Statement	Bloom`s Taxonomy
Course Objectives	To understand the basic concepts of solid mechanics	Course Outcomes	CE201.1	Able to **understand** the theory of elasticity and **identify** strain/displacement and Hooke's law relationships	Knowledge Identification
	To introduce the concept of stress strain and deformation due to internal actions.		CE201.2	Able to **analyse** stresses and deflections of beams **determine** under general loading	Analyze Determine
	To analyze solid mechanics problems using classic methods and energy methods		CE201.3	Able to **analyse and determine** torsion problems in bars and thin walled members	Analyze Determine
	To apply various failure criteria for general stress state at a point		CE201.4	Able to **categorize** problems and **apply**classical methods and energy methods	Categorize Application
			CE201.5	Able to **perceive and evaluate** stresses and deflections of beams on elastic foundations	Evaluate Percieve

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CE201.1	3	2	1									2		3	2
2	CE201.2	3	2	1	1								2		3	2
3	CE201.3	3	3	2	3								2		3	2
4	CE201.4	3	3	1	3								2		3	2
5	CE201.5	3	2	1	1								2		3	2
CE201		**3.0**	**2.4**	**1.4**	**1.6**								**2**		**3.0**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Stress** Definition of stress, Stress at a point –matrix of stress / stress tensor, Symmetry of stress tensor, Equilibrium of a body –differential equations of equilibrium, Different states of stress –uniaxial, biaxial, plane stress, etc., Transformation of plane stress; extension to 3-D, Principal stresses and maximum shear stress, Mohr's circle	**08**	CE201.1, CE201.2
II	**Strain** Definition of strain –shear and normal strains, Strain at a point –matrix of strain / strain tensor, Symmetry of strain tensor, Different states of strain –uniaxial, plane strain, etc., Transformation of plane strain; extension to 3-D,Principal strains, Mohr's circle for plane strain	**07**	CE201.1, CE201.2
III	**Mechanical properties** Stress-strain diagrams, generalized Hooke's law, Lame's constant, elastic modulus, bulk modulus, Relationship between different elastic constants	**05**	CE201.1, CE201.2
IV	**Bending** Relation between transverse loads, shear and bending moments, Shear and bending moment diagrams, Pure bending –beams with symmetric cross-sections, Beams with composite cross-section, Shear stresses in beams, Deflections in beams	**08**	CE201.2
V	**Torsion** Torsional moment diagrams, Torsion formula for circular cross-sections, Maximum normal and shear stresses, Angle of twist	**08**	CE201.3
VI	**Energy methods** Stored energy in elastic members –axial, torsional, bending, etc. Castigliano's theorem, Application of Castigliano's theorem to different classes of problems, Virtual work principles –the basis, Application of virtual work principles to classes of problems	**06**	CE201.4
VII	**Elastic stability** Motion of stability of equilibrium, Euler buckling, Members with eccentric loading, etc.	**03**	CE201.5
Total Hours		**42**	

Essential Readings

1. Kazimi S.M.A., "Solid mechanics-First revised edition", Tata McGraw Hill.; Twenty sixth edition, 2006
2. Popov E. P., "Engineering Mechanics of Solids", Dorling Kindersley (India) Pvt Ltd; Second edition, 1999
3. Timoshenko, S.P. and Gere, J.M., Mechanics of Materials, Tata McGraw Hill, First edition, 1992.

Supplementary Readings

1. Srinath L. S., "Advanced Solid Mechanics", Tata McGraw Hill; Third edition, 2010
2. Pitarresi J.M., "Introduction to Solid Mechanics", Prentice Hall of India; Third edition, 2000

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE203	**Fluid Mechanics**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To Understand the fundamental principles and concepts of fluid mechanics, including fluid properties, fluid statics, and fluid dynamics.	Course Outcomes	CE203.1	Students will be able to demonstrate comprehensive **knowledge** and understanding of fluid mechanics principles, including fluid properties, the continuity equation, Bernoulli's equation, the Navier-Stokes equations, and their **applications** in various engineering problems.	**Knowledge** **Application**
	To develop proficiency in applying mathematical and computational techniques to solve problems related to fluid flow, pressure, and velocity distributions.		CE203.2	Student will be able to apply mathematical and computational methods to **analyze** and solve problems related to fluid flow, pressure distribution, and fluid forces acting on immersed objects.	**Analysis**
	To gain knowledge of different types of flow regimes, such as laminar and turbulent flow, and their characteristics.		CE203.3	Students will be able to **identify** and differentiate between different flow regimes and **evaluate** flow behavior under various conditions, including laminar, turbulent, and transitional flow.	**Analysis** **Evaluation**
	To learn about practical applications of fluid mechanics principles in various engineering fields, including civil and mechanical engineering.		CE203.4	Students will be able to **analyze** and design fluid systems and components, such as pumps, pipes, and valves, considering factors such as flow rate, pressure drop, and energy efficiency.	**Analysis**
	To explore experimental methods and laboratory techniques used to study fluid behaviour and validate theoretical models.		CE203.5	Students will be able to **design** and conduct experiments, analyze experimental data, and interpret results to validate theoretical models and understand practical aspects of fluid mechanics in engineering **applications.**	**Application** **Design**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE203.1	3	3	3	1						1			0	3	0
CE203.2	3	3	3	1	1			1		1			3	3	3
CE203.3	3	3	3	1	1			1		2			3	3	2
CE203.4	3	3	3	1	1			1		1			3	3	3
CE203.5	3	3	3	1	1			1		1			3	3	3
CE203	3	3	3	1	1			1		1.2			3	3	2.75

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Fluid Mechanics** Definition and scope of fluid mechanics, Continuum Approach, Important physical properties: density, specific weight, viscosity, surface tension, capillarity, compressibility, vapor pressure, Classification of fluids-ideal and real fluid, non-Newtonian fluids.	**05**	**CE203.1**
II	**Fluid Statics** Pressure at a point-Pascal's Law, pressure variation in a static fluid. Scales of Pressure-absolute and gauge pressure, Measurement of pressure-manometers, Forces on submerged plane and curved surfaces, Buoyant Force centre of buoyancy, metacentre, determination of metacentric height, Equilibrium of floating and submerged bodies, relative equilibrium-translation and rotation of fluid masses.	**08**	CE203.2
III	**Dynamics of Fluid Flow** Momentum equation and its application to simple problems, Continuity equation: mass conservation in fluid flow, Navier-Stokes equations: derivation, significance, and applications, Euler's equation of motion, Bernoulli's equation: energy conservation in fluid flow, applications and limitations and its application-venturi-meter, orifice meter, pitot tube,	**08**	CE203.3
IV	**Orifice; Mouthpiece; Notches and Weirs** Classification, discharge through a free orifice, orifice coefficients-experimental determination, External and internal mouthpiece, mouthpiece running full and free; Classification, Velocity of Approach, Broad crested weir	**07**	CE203.4
V	**Flow through Pipes** Flow regimes in pipes: laminar flow, transitional flow, turbulent flow, Head losses in pipe flow-major loss (Loss due to friction)-Darcy Weisbach equation, minor losses, Hydraulic gradient lines, Total Energy lines. Pipe networks: series and parallel pipe systems, analysis techniques, Siphon.	**06**	CE203.4 CE203.5
VI	**Dimensional Analysis** Dimensions-fundamental and derived qualities, dimensional homogeneity, methods of dimensional analysis Rayleigh's method and Buckingham's π theorem.	**08**	CE203.4 CE203.5
	Total Hours	**42**	

Essential Readings

1. SK Som, GautamBiswas, SumanChakraborty, :Introduction to Fluid Mechanics and FluidMachines" McGraw Hill Publications, Third Edition, 2010
2. Dr. R K Bansal, "A text book of Fluid mechanics & Hydraulics machines", Laxmi Publications,Revised Ninth Edition, 2010
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, 21st Edition,2017

4. Er. R K Rajput, “A text book of Fluid Mechanics”, S Chand publications, 9th Edition, 2017

Supplementary Readings

1. Kumar K.L., “Fluid Mechanics”, S. Chand & Co., 22nd Edition, 2016
2. Jain A.K., “Fluid Mechanics”, Khanna Publisher, 23rd Edition, 2010
3. White B.F., “Fluid Mechanics”, McGraw Hill.,7th Edition, 2010
4. Frabzini J., “Fluid Mechanics with Engineering Applications”, McGraw Hill.,10th Edition, 2001

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE205	**Surveying**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's knowledge to understand the basic skills of surveying work including distance and angle measurement	Course Outcomes	CE205.1 Able to acquire **knowledge** the basic skills of surveying and levelling work	Knowledge
	To provide knowledge on types of survey methodology and equipment suitable for a particular engineering projects.		CE205.2 Able to **estimate** and select a particular type of survey and equipment suitable for a particular engineering and its **application**.	Estimate Application
	To introduce different type of surveying equipment		CE205.3 Able to **compute** different type of surveying equipment like Compass, Theodolite, levels etc., for direction measurement, angle measurement, differential levelling and contouring	Compute Application
	To provide knowledge on how to prepare a surveying map using collected surveying data.		CE205.4 Able to **estimate** a surveying map using collected surveying data from total station	Estimate
	To get introduced to modern advanced surveying techniques involved such as remote sensing, Total station, GPS etc.		CE205.5 Able to acquire **knowledge** the basic concept of remote sensing & GIS and its **application**	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE205.1	**3**	**3**			**0**		**0**						**3**	**3**	
CE205.2	**3**	**3**			**0**		**0**						**3**	**3**	
CE205.3	**3**	**3**			**3**		**0**						**3**	**3**	
CE205.4	**3**	**3**			**0**		**0**						**3**	**3**	
CE205.5	**3**	**3**			**3**		**3**						**3**	**3**	
CE205	**3**	**3**			**1.2**		**0.5**						**3**	**3**	

SYLLABUS

No.	Content	Hours	COs
I	**Basics of surveying** Introduction to surveying-concept of plane and geodetic surveys, principles of surveying, errors in measurements, surveying instruments, types of maps, scale and uses, plotting accuracy coordinate systems.	04	CE205.1
II	**Linear measurements** Direct and indirect methods, chain and tape measurements-corrections.	04	CE205.1, CE205.2
III	**Measurement of directions** Bearings and angles, compass surveying-magnetic bearings, declination, local attraction errors and adjustments; Theodolite- different types, uses, methods of observation and booking of data.	04	CE205.2, CE205.3
IV	**Plane table surveying** Equipment's, principles, operation, methods, errors, advantages and disadvantages.	06	CE205.1, CE205.2
V	**Levelling and contours** Methods of height determination, profile levelling and cross sectioning, contours - their characteristics, uses and methods of contouring.	06	CE205.1, CE205.2, CE205.3
VI	**Curve survey** Setting out of simple circular, compound, reverse, transition and vertical curves	04	CE205.3, CE205.4
VII	**Traversing and Triangulation Surveying** Compass and theodolite traverses; Triangulation systems, intervisibility, Signals, satellite stations, computations and adjustments.	04	CE205.3, CE205.4
VIII	**Photogrammetry** Aerial Photographs, basic terms & definitions, scales, relief displacements, flight planning, stereoscopy, characteristics of photographic images, fundamentals of aerial photo-interpretation.	04	CE205.1, CE205.3
IX	**Modern surveying equipment** Introduction to total station.	04	CE205.4
X	**Global positioning system (GPS)** Introduction, GPS principles, satellite navigation system, GPS, space segment, control segment, user segment, and GPS satellite signals, receivers, static, kinematic and differential GPS.	02	CE205.5
XI	**Remote sensing:** Principles, EME, sensors and platforms of remote sensing, its application and scope.	02	CE205.5
Total Hours		**44**	

Essential Readings

1. B.C. Punmia, "Surveying Vol.I and II, Standard Publishers", Second edition, 1994.
2. S.K. Duggal, "Surveying Vol. I and II, Tata McGraw Hill", Fourth edition, 2004.
3. W. Schofield and M. Breach, "Engineering Surveying", 6th edition, CRC Press, 2007.

Supplementary Readings

1. N.N. Basak , "Surveying & Levelling, McGraw Hill, second edition, 2014
2. K.R. Arora, "Surveying Vol. I and II" Standard Book House, 1996
3. G. Satheesh, "The Global Positioning System and Surveying using GPS", Tata McGraw, 2005.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE207	**Public Health Engineering**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To emphasize on the importance of Public water supply scheme and elucidate about Population forecasting and estimation of water demand..	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To compute water quality parameters		CE207.1	Student will be able to identify environmental problems arising due to engineering and technological activities and the science behind those problems. — Identify
	To familiarize students about Water Purification systems.		CE207.2	Student will be able to estimate the population - economic growth, energy requirement and demand. — Estimate
	To analysis and design water distribution systems.		CE207.3	Student will be able to analyse material balance for different environmental systems. — Analyse
			CE207.4	Student will be able to assess the importance of ecosystem and biodiversity for maintaining ecological balance. — Assess
			CE207.5	Student will be able to detect the major pollutants and abatement devices for environmental management and sustainable development — Detect

. COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE207.1	3	3												3	
CE207.2	3	3												3	
CE207.3	3	3												3	
CE207.4	3	3												3	
CE207.5	3	3	3	3										3	
CE207	3	3	3	3										3	

SYLLABUS

No.	Content	Hours	COs
I	**Water Supply System and Sources** Public water supply system, Planning and Components; Surface and Groundwater; Reservoir; Surface and Sub-surface sources - types, selection, storage reservoir – yield and capacity estimation.	**07**	CE207.1, CE207.2, CE207.3
II	**Distribution System** Requirements, Classification, Analysis and Design of distribution systems, Detection and Prevention of leakage	**06**	CE207.3
III	**Water Demand** Population forecasting, Design period, estimation of water demand for various uses, factors affecting consumption	**06**	CE207.3, CE207.4
IV	**Water Quality** The hydrologic cycle and water quality parameters: physical, chemical and biological; water quality standards for chemical, physical and microbiological parameters; Drinking Water quality standards.	**07**	CE207.4, CE207.5
V	**Basic microbiology and chemistry** Microorganisms in natural water systems, development of dissolved oxygen (DO) sag model, introduction to environmental chemistry	**05**	CE207.2, CE207.3
VI	**Water Treatment** Screening, Design and operation of sedimentation and settling tanks, Theory of settling, types of settling (Type – I and Type – II Settling) and Coagulation and flocculation, Design of flocculation process, Aeration, Disinfection process-theory, Chlorination, Hardness Removal, Fluoride and Arsenic Removal, Household Water Treatment Systems; Flow-sheets for treatment of surface and sub-surface waters; Types of filtration, Mechanism of filtration, Design of Considerations, Filter design criteria, operation and maintenance	**11**	CE207.5
	Total Hours	**42**	

Essential Readings

1. Environmental Engineering, Peavy H. S., Rowe D. R. and George Tchobanoglous, McGraw-Hill International, First Edition, 2017
2. Water Supply and Sewerage, McGhee T. J ., McGraw-Hill Inc., Sixth Edition, 2007
3. Sawyer, C.N., McCarty, P.L., Parkin, G.F., Chemistry for Environmental Engineering, Tata McGraw-Hill, 2000.

Supplementary Readings

1. Wastewater Engineering- Treatment and Reuse, Metcalf & Eddy (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill, Fourth Edition, 2010
2. Introduction to Environmental Engineering, Davis M. L and Cornwell D. A McGraw-Hill, Inc.,5th Edition, 2012
3. Manual for Sewer and Sewerage, Central Public Health & Environmental Engineering Organization, Ministry of Housing and Urban Development, Govt. of India, 2013.
4. APHA, Standard Methods Examination of Water and Wastewater, American Public Health Association, Washington DC, 1995, 22nd Edition, 2012
5. Manual for water supply and treatment, Central Public Health & Environmental Engineering Organization, Ministry of Housing and Urban Development, Govt. of India, 1999.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE211	**Environmental Impact Assessment**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
		CO's		**Statement**	**Bloom's Taxonomy**
	To understand the purpose and significance of Environmental Impact Assessment (EIA) in sustainable development and decision-making processes.		CE211.1	Students will have the **knowledge** and ability to critically evaluate environmental issues and apply interdisciplinary knowledge to address complex environmental challenges.	**knowledge**
	To analyze the historical development and legal frameworks governing EIAs at both national and international levels.		CE211.2	Students will gain proficiency in conducting comprehensive environmental impact assessments using appropriate methodologies, techniques, and tools	**Application** **Analysis**
	To apply key concepts in EIA such as environmental sustainability, ecological footprint, and carrying capacity to assess environmental impacts effectively.		CE211.3	Students will develop competence in analyzing and interpreting environmental data, assessing potential impacts on ecosystems and human communities, and devising effective mitigation and management strategies.	**Analysis** **Synthesis**
	To demonstrate proficiency in conducting an EIA step-by-step process, including scoping, baseline data collection, impact prediction, mitigation measures, and monitoring.		CE211.4	Students will acquire an understanding of legal and regulatory frameworks governing environmental assessment at local, national, and international levels, and they will comply with ethical standards and professional codes of conduct.	**Knowledge** **Application**
	To evaluate regulatory requirements and best practices in different jurisdictions to ensure compliance and successful implementation of EIAs.		CE211.5	Students will demonstrate effective communication skills to **design** and implement strategies that engage stakeholders, facilitate public participation, and resolve conflicts in environmental decision-making processes.	**Design** **Application**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE211.1	**3**	**1**	**1**	**1**	**1**		**1**			**1**			**1**	**3**	**1**
CE211.2	**3**	**1**	**1**	**2**	**1**					**1**			**1**	**3**	**1**
CE211.3	**3**	**1**	**1**	**2**	**1**		**1**			**1**			**1**	**3**	**1**
CE211.4	**3**	**1**	**1**	**1**	**2**					**1**			**1**	**3**	**1**
CE211.5	**3**	**1**	**1**	**1**	**1**		**3**			**1**			**1**	**3**	**1**
CE211	**3**	**1**	**1**	**1.4**	**1.2**		**1.33**			**1**			**1**	**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Environmental Impact Assessment** Purpose and Importance of EIAs: Understanding the role of EIAs in decision-making processes, Significance of EIAs for sustainable development,	06	CE211.1
II	**Historical Development and Legal Frameworks** Evolution of Environmental Impact Assessment: Tracing the development of EIAs globally, Overview of key historical milestones. Legal Frameworks Governing EIAs:Examination of international conventions and national legislation Understanding regulatory requirements for conducting EIAs	07	CE211.1 CE211.2
III	**Key Concepts in Environmental Impact Assessment** Environmental Sustainability: Defining environmental sustainability and its relevance to EIAs, Exploring principles of sustainability in EIA practice Ecological Footprint and Carrying Capacity: Understanding concepts of ecological footprint and carrying capacity, Assessing their implications for EIA processes	07	CE211.3
IV	**EIA Process** Step-by-Step Process of Conducting an EIA: Detailed overview of scoping, baseline data collection, impact prediction, mitigation measures, and monitoring, Practical guidance on each stage of the EIA process. Regulatory Requirements and Best Practices:Examination of regulatory frameworks and best practices in various jurisdictions, Understanding compliance requirements for successful EIA implementation.	07	CE211.4
V	**Methods and Techniques** Assessing Environmental Impacts: Introduction to various assessment methods including checklist approaches, matrix methods, and modeling techniques, Understanding their applications in evaluating environmental impacts Data Gathering and Analysis Techniques: Exploration of GIS and remote sensing technologies, Practical guidance on data collection and analysis methods in EIA practice	07	CE211.5
VI	**Impact Assessment and Management** Identification and Evaluation of Potential Impacts: Assessing impacts on air quality, water resources, biodiversity, soil, and socio-economic aspects, Methods for predicting and quantifying impacts. Mitigation and Management Strategies: Strategies for avoiding, minimizing, or compensating for adverse impacts, Designing effective mitigation measures and monitoring plans	07	CE211.5
	Total Hours	**42**	

Essential Readings

1. Canter, L. (1996). Environmental Impact Assessment. McGraw-Hill Education.
2. Glasson, J., Therivel, R., & Chadwick, A. (2012). Introduction to Environmental Impact Assessment (4th ed.). Routledge.

3. Petts, J. (2009). Handbook of Environmental Impact Assessment. Wiley-Blackwell.
4. Sadler, B., &Verheem, R. (1996). Strategic Environmental Assessment for Policies: An Instrument for Good Governance. Directorate-General Environment, European Commission.

Supplementary Readings

1. Wood, C. (2003). Environmental Impact Assessment: A Comparative Review. Prentice Hall.
2. Morrison-Saunders, A., & Fischer, T. (2013). Environmental Impact Assessment: A Guide to Best Professional Practices. Wiley.
3. Sadler, B. (1996). International Study of the Effectiveness of Environmental Assessment: Final Report (Vol. 1). Canadian Environmental Assessment Agency.
4. Glasson, J., Therivel, R., & Chadwick, A. (2017). Introduction to Environmental Impact Assessment (5th ed.). Routledge.
5. Petts, J. (Ed.). (2005). Handbook of Environmental Impact Assessment (2nd ed.). Wiley-Blackwell.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Department of Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE213	**Science and Functional Design of Buildings (NPTEL course)**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

To provide an insight to the students to various terms and acoustics and lighting and other relationships.

To provide an insight to the students to various aspects of functional design of buildings and innovative construction methods.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE213.1	Develop an **understanding** of acoustical design and noise control techniques.	Understanding
CE213.2	Understand elemental concepts of natural and artificial lighting designs	Understanding
CE213.3	**Remember** the principles involved in the design of buildings for thermal comfort and influence of climate on design of buildings	Remember
CE213.4	Have basic **understanding** for electrical load calculation, plumbing design, HVAC load Calculation, functioning of elevators and escalators and rough cost estimation.	Understanding
CE213.5	Acquire **knowledge** of innovative construction concepts	Knowledge

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE213.1	**3**	**1**	**0**	**0**	**0**	**0**	**3**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**
CE213.2	**3**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CE213.3	**3**	**2**	**1**	**0**	**2**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CE213.4	**3**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**
CE213.5	**3**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**
CE213	**3.0**	**1.4**	**0.5**	**0**	**0**	**0**	**1.4**	**0**	**1.0**	**0**	**0**	**1.0**	**1.2**	**0.4**	**0.2**

SYLLABUS

No.	Content	Hours	Cos
I	**Acoustical / Sonic Environment and acoustical comfort** Sound, Nature of sound,Behavior of sound in enclosed spaces, Concept of Geometric Acoustics, Reflection of sound and their applications, Human Audibility range&Reverberation, Time Calculation, Sabine's formula, Eyrings modification, Design requirement of sound insulation.	5	CE213.1
II	**Acoustics and applications** Measures of noise control, Source-path and receiving end, TL value and computation of TL value, Acoustical defects, acoustical design of auditoriums, small lecture halls, Acoustical considerations of offices, hospitals and Industrial buildings.	5	CE213.1
III	**Natural lighting** Standards of Lighting and Visual comfort, Calculation of daylight factor, Design of sidelight windows, BIS and CBRI methodsskylights	3	CE213.1,CE213.2
IV	**Artificial lighting** Illumination requirements, lux meter, lamps and luminaries, polar distribution curves, Color temperature and color rendering index, glare, Design of artificial lighting, lumen method, point by point method.	3	CE213.1,CE213.2
V	**Thermal comfort** Factors affecting thermal comfort, temperature effective, thermal comfort indices, ET, CET, Bioclimatic, Psychrometry and Psycrometric chart.	4	CE213.2,CE213.3
VI	**Earth-Sun relationship** Sun's apparent movement with respect to the earth. Solar angles and Computation of solar radiation on different surfaces, solar path diagramand design of shading devices.	4	CE213.2,CE213.3
VII	**Thermal design of buildings** Thermo physical properties of building materials and thermal control, passive and active building design, Steady and periodic heat flow through building envelope.	4	CE213.3
VIII	**Design approaches** Climate conscious designs, Climatic zones in India, orientation, buildings shape in different climatic zones, Passive solar, Active solar and Active approaches.	4	CE213.3
IX	**Functional elements** Concept for electrical load calculation of structures, basic criteria for plumbing design, basic concept of HVAC load calculation, Basic concept of functioning of elevators and escalators, basic cost estimation.	4	CE213.4

X	**Functional protection** Causes and classification of fire, Mechanism of fire spread in buildings, High temperature effects and combustibility of building materials and structure, Fire alarm system, and means of escape, Firefighting installations.	4	CE213.4
XI	**Innovative concepts of functionality** Concept of green building, Concepts of Intelligent building	2	CE213.5
Total Hours		**42**	

Essential Readings

1. Knudsen V.O. and Harris C.M., Acoustical Design in Architecture, John Wiley,1980
2. M David Egan, Architectural Acoustics, J.Ross Publishing,2007
3. Jain. V.K., "Design and Installation of Services in Building complexes &High-Rise Buildings", Khanna Tech. Publishers, New Delhi,1986.
4. National Building Code of India (NBC2016)

Supplementary Readings

1. Marshall Long, “Architectural Acoustics”, Second Edition, Academic Press, Waltham, USA, 2014
2. Koenigseberger, Manual of tropical Housing and Building Part I – Climatic design, Orient Longman,2011
3. AjithaSimha.D, Building Environment, Tata McGraw Hill Publishing Co., New Delhi,1985
4. Bureau of Energy Efficiency, India. Design Guidelines for Energy Efficient Multi-Storey Buildings,2014.
5. Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T)-1987

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE215	**Study of historical and ancient civil engineering practices**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To explore the architectural and engineering achievements of ancient civilizations.	Course Outcomes	CE215.1	Able to **comprehend** the importance of studying ancient civil engineering practices and their impact on modern engineering.	**Comprehend**
	To understand the materials and construction techniques used in ancient structures.		CE215.2	Able to **identify** the materials and construction techniques used in Egyptian architecture.	**Identify**
	To analyze the cultural, social, and environmental factors influencing ancient civil engineering practices.		CE215.3	Able to **evaluate** the engineering feats of Mesopotamia and the Indus Valley Civilization, including ziggurats, canals, and urban planning.	**Evaluate**
	To examine the sustainability and durability of ancient infrastructure.		CE215.4	Able to **comprehend** the architectural innovations and engineering principles of ancient Greece and Rome, such as temples, aqueducts, and city planning.	**Comprehend**
	To draw parallels between ancient and modern civil engineering practices.		CE215.5	Able to **identify** and compare engineering practices in various ancient civilizations beyond Egypt, Mesopotamia, and the Indus Valley.	**Identify**
			CE215.6	Able to **employ** lessons learned from ancient civil engineering practices to address contemporary engineering challenges, emphasizing sustainability and durability.	**Employ**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE215.1	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215.2	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215.3	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215.4	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215.5	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215.6	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE215	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Ancient Civil Engineering:** Definition and scope of ancient civil engineering, Overview of major ancient civilizations (Egyptian, Mesopotamian, Indus Valley, Chinese, Greek, Roman, etc.), Importance of studying ancient civil engineering practices	**08**	CE215.1
II	**Egyptian Civilization:** Engineering achievements (pyramids, temples, irrigation systems), Materials and construction techniques, Role of engineering in Egyptian society	**08**	CE215.2
III	**Mesopotamian & Indus Valley Civilizations:** Engineering feats of Mesopotamia (ziggurats, canals, city planning), Utilization of clay and mud brick in Mesopotamian construction, Influence of geography and environment on Mesopotamian engineering Urban planning and drainage systems in the Indus Valley cities, Construction materials and techniques of Harappan architecture, Decline and disappearance of the Indus Valley Civilization	**08**	CE215.3
IV	**Greek & Roman Civilizations:** Architectural innovations in ancient Greece (temples, theatres, aqueducts), Use of marble and limestone in Greek architecture, Engineering principles in Greek city planning and public works Engineering legacy of ancient Rome (roads, bridges, aqueducts, colosseum), Concrete technology and its significance in Roman construction, Roman engineering achievements and their impact on modern civilization	**08**	CE215.4
V	**Other Ancient Civilizations:** Overview of engineering practices in Chinese, Mayan, Inca, etc., Comparative analysis of different ancient engineering styles	**05**	CE215.5
VI	**Modern Perspectives on Ancient Civil Engineering:** Influence of ancient engineering on modern practices, Lessons learned from ancient civilizations for sustainable engineering, Preservation and conservation of ancient structures	**05**	CE215.6
	Total Hours	**42**	

Essential Readings

1. Civil Engineering: A Very Short Introduction, David Muir Wood, Oxford, 2012
2. Engineering in the Ancient World, J.G. Landels, University of California Press, 2000

Supplementary Readings

1. A New Topographical Dictionary of Ancient Rome, L. Richardson Jr., Johns Hopkins University Press,1992
2. Scholarly articles and papers on specific ancient civilizations and their engineering achievements.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Department of Civil Engineering**	Semester	**III**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE217	**Fundamentals of Sustainability in Engineering Projects**	**Nil**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To inculcate the essentials of Project designing from the ground up for both eco-safety and cost efficiency To provide the students an illustration of the significance of a more natural and sustainably built environment	Course Outcomes	CE217.1	Student will be able to define the role of engineer in the development of the society	Define
			CE217.2	Student will be able to associate the fundamental aspects of sustainability to the corporate environment	Associate
			CE217.3	Student will be able to understand and examine the risk of ignoring sustainability aspects in projects	Understand Examine
			CE217.4	Student will be able to correlate types of structural aspects of sustainable network	Correlate
			CE217.5	Student will be able to assess sustainability practices into project management knowledge areas	Assess

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE217.1		**1**					**3**		**1**			**1**			**1**
CE217.2	**1**	**2**					**1**		**1**			**1**	**3**		
CE217.3	**2**	**2**	**1**		**2**		**1**		**1**			**1**	**3**		
CE217.4		**1**					**1**		**1**			**1**		**1**	
CE217.5		**1**					**1**		**1**			**1**		**1**	
CE217	**1.5**	**1.4**	**1**		**2**		**1.4**		**1**			**1**	**3**	**1**	**1**

SYLLABUS

No	Content	Hours	COs
I	Introduction: Need and scope for sustainable engineering: Principles of green engineering as a foundation for sustainability	**6**	CE217.1, CE217.2
II	Critical demands on sustainable systems and sustainable management: Metrics and standards, Project identification through feasibility studies, formulation, design, implementation, monitoring, evaluation	**8**	CE217.3
III	Characteristics of Project Sustainability Adaptability, Audit Ability, Extensibility, Manageability	**6**	CE217.4
IV	Sustainability Society Indexes: Good governance, Social issues, Financial aspects, Healthy environment, Use of renewable resources	**8**	CE217.5
	Total Hours	**28**	

Essential Readings

1. Morgese, P., Handbook for Sustainable Projects Global Sustainability and Project Management, CreateSpace Independent Publishing Platform, 1st edition 2014.
2. Capek, B., Sustainable Development Projects: Development of a Categorization, 1st edition, 2010.

Supplementary Readings

1. Tharp, J., Sustainability in Project Management: Practical Applications, Mastodon Consulting, USA, IGI Global, 2013.
2. McDonough, W., Braungart,M., Cradle to Cradle: Remaking the Way We Make Things, North Point Press, 1st edition, 2002.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Department of Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE271	**Introduction to Construction**	**Nil**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives

To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.

To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE271.1	To describe the role of engineer in the development of the society and **understand** relationship of civil engineering with other branches of engineering and technology.	Understand
CE271.2	The students will be able to plan and **create**/perform building drawings	Create
CE271.3	Able to **understand** and perform basic surveying and related calculations.	Understand
CE271.4	To **analyse** types of buildings and select materials of constructions	Analyse
CE271.5	Get **knowledge** on various building components/finishes and other structural aspects of civil engineering.	Knowledge

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE271.1	**0**	**1**	**0**	**0**	**0**	**0**	**3**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**1**
CE271.2	**1**	**2**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CE271.3	**2**	**2**	**1**	**0**	**2**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**3**	**0**	**0**
CE271.4	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**
CE271.5	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**1**	**0**	**1**	**0**
CE271	**0.6**	**1.4**	**0.2**	**0**	**0.4**	**0**	**1.4**	**0**	**1.0**	**0**	**0**	**1.0**	**1.2**	**0.4**	**0.2**

SYLLABUS

No.	Content	Hours	Cos
I	**General introduction to Civil Engineering** Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings; Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building;	8	CE271.1, CE271.2
II	**Surveying** Principles, Objectives, Horizontal measurements with tapes, Ranging; Levelling – Instruments, Reduction of levels; Modern surveying instruments.	6	CE271.3
III	**Building Materials** Bricks, cement blocks, Cement, Cement mortar, Steel; Building construction.	6	CE271.4
IV	**Brief Study on** Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting; Basic infrastructure and services – Elevators, Escalators, Ramps, HVAC, Heating, Ventilation, Air conditioning, Acoustics, Chimneys, Water Tanks, Green buildingpractices, Modern construction technologies	8	CE271.5
	Total Hours	**28**	

Essential Readings

1. Shetty, M.S., Concrete Technology (Theory & Practice), S.Chand and Co, Revised edition, 2015
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, fifth edition, 2013.
3. Basak NN. "Surveying & Levelling, McGraw Hill, second edition, 2014

Supplementary Readings

1. R. Chudley and r. Greeno, building construction handbook, addisonwesley, longman group, England, 6th edition, 2006
2. M. S. Mamlouk, and J. P. Zaniewski, Materials for Civil and Construction Engineers, Pearson, Prentice Hall, 2nd Edn., 2006.
3. N N Basak, Surveying and Levelling, Mccrawhill publications. 2017

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE281	**Civil Engineering Drawing and Detailing**	**1**	**0**	**2**	**2**	**50**	**50**	**100**	**200**
								Bloom's Taxonomy	

Course Objectives	To teach the student usage of Auto cad, basic drawingfundamentals in various civil engineering applications, especially in building drawing.	Course Outcomes	CE281.1	Able to acquire **knowledge** on CAD software and basic functions	Knowledge
	To teach students the basic commands and tools necessary forprofessional 2D drawing, 3D drawing and drafting using AutoCAD		CE281.2	Able to evaluate plans of Single storied building & multistorey buildings.	Knowledge
	To learn to sketch and take field dimensions.		CE281.3	Able to develop different sections at different elevations	Design
	To learn to take data and transform it into graphic drawings.		CE281.4	Able to detail building components like doors, windows roof trusses	Design
			CE281.5	Able to detail section and elevation for single and multistorey buildings using CADsoftware.	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE281.1	**3**	**3**	**2**	**3**	**3**	**2**	**1**						**3**	**3**	**3**
CE281.2	**3**	**3**	**2**	**3**	**3**	**3**							**3**	**3**	**3**
CE281.3	**3**	**3**	**2**	**2**	**3**	**3**							**3**	**3**	**3**
CE281.4	**3**	**3**	**2**	**3**	**3**	**3**	**1**						**2**	**3**	**3**
CE281.5	**3**	**3**	**2**	**2**	**3**	**3**	**3**						**3**	**3**	**3**
CE281	**3**	**3**	**2**	**2.6**	**3**	**2.8**	**1**						**2.8**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to computer aided drafting &coordinate system.	06	CE281.1
II	Exercise on Draw, Modify tool bars, Layer, Dimension, Texting and Block etc.	04	CE281.1
III	Drawing a plan of Building and dimensioning using layers. Single storied buildings b) Multi storied buildings.	06	CE281.2
IV	Developing sections and elevations for given a) Single storied buildings b) Multistoried buildings.	06	CE281.3
V	Drawing of building components like walls, lintels, Doors, and Windows.	04	CE281.4
VI	Introduction to 3 – D view.	02	CE281.5
	Total Hours	**28**	

Essential Readings

1. G. Omura Mastering AUTOCAD: John Wiley & Sons; 2012.
2. Shaw, Kale and Patki Building Drawing with an Integrated Approach to Built Environment: McGrawHill; 2002.

Supplementary Readings

1. A. Jefferis & K. D Smith Commercial Drafting and Detailing: Cengage Learning; 2010

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Credit Structure				Marks Distribution	
		L	T	P	C	Continuous Assessment	Total
CE251	**Solid Mechanics Lab**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

Course Objectives		Course Outcomes	CO`s	Statement	Bloom`s Taxonomy
	To understand the basic concepts of solid mechanics		CE251.1	Able to **understand** basics about the subject and practically **identify** problems	Knowledge Identification
	To introduce the concept of stress strain and deformation due to internal actions.		CE251.2	Able to **analyse** hardness of materials	Analyze
	To analyze solid mechanics problems using classic methods and energy methods		CE251.3	Able to **analyse and determine**the material strengths through Uniaxial test under tension and compression	Analyze Determine
	To apply various failure criteria for general stress state at a point		CE251.4	Able to**analyse and determine**torsional capacity of materials	Analyze Determine
			CE251.5	Able to **analyse and determine**impact capacity of materials	Analyze Determine

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CE251.1	3	2	1	1		1			1			2		3	2
2	CE251.2	3	3	2	2	3	1			2			2		3	2
3	CE251.3	3	3	2	2	3	1			2			2		3	2
4	CE251.4	3	3	2	2	3	1			2			2		3	2
5	CE251.5	3	3	2	2	3	1			2			2		3	2
CE251		**3.0**	**2.8**	**1.8**	**1.8**	**2.4**	**1.0**			**1.8**			**2**		**3.0**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to the laboratory**	**04**	**CE251.1**
II	**Hardness test:** To determine the hardness of a given set of specimens by Brinell hardness testing machines	**02**	**CE251.2**
III	**Hardness test:** To determine the hardness of a given set of specimens by Vickers hardness testing machines	**02**	**CE251.2**
IV	**Hardness test:** To determine the hardness of a given set of specimens by Rockwell hardness testing machines	**02**	**CE251.2**
V	**Uni-axial tension test:** To obtain the stress-strain relation of mild steel using a circular cylindrical Specimen and determine (i) Young's modulus (E), (ii) proportional limit (p), (iii) yield stress (y), (iv) Ultimate tensile stress (u) and percentage elongation.	**02**	**CE251.3**
VI	**Uni-axial compression test:** To obtain the stress-strain relation of mild steel using a circular cylindrical Specimen and determine (i) Young's modulus (E), (ii) proportional limit (p), (iii) yield stress (y), **(iv)** Ulttimate tensile stress (u) and percentage elongation.	**02**	**CE251.3**
VII	**Torsion test**: To obtain twisting moment- twist relationship of a mild steel specimen. To determine: (i) shear modulus G, (ii) Yield stress y in pure shear, theoretical and experimental ultimate torque based on elastic-perfectly plastic model of material.	**02**	**CE251.4**
VIII	**Impact Test** To determine the toughness or impact strength of a given specimen by Izod Impact testing machine	**02**	**CE251.5**

IX	**Impact Test** To determine the toughness or impact strength of a given specimen by Charpy Impact testing machine	**02**	**CE251.5**
X	Revision and doubt clearing sessions	**04**	**CE251.1**
Total Hours		**24**	

Essential Readings

1. Kazimi S.M.A., “Solid mechanics-First revised edition”, Tata McGraw Hill.; Twenty sixth edition, 2006
2. Popov E. P., “Engineering Mechanics of Solids”, Dorling Kindersley (India) Pvt Ltd; Second edition, 1999
3. Timoshenko, S.P. and Gere, J.M., Mechanics of Materials, Tata McGraw Hill, First edition, 1992.

Supplementary Readings

1. Srinath L. S., “Advanced Solid Mechanics”, Tata McGraw Hill; Third edition, 2010
2. Pitarresi J.M., “Introduction to Solid Mechanics”, Prentice Hall of India; Third edition, 2000

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE253	**Fluid Mechanics Lab**	**---**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

		CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop practical skills in conducting experiments to verify fundamental principles and laws of fluid mechanics learned in theory classes.	CE253.1	Students will acquire **knowledge** and demonstrate proficiency in setting up and operating experimental apparatus to investigate fluid flow phenomena.	**Knowledge** **Application**
	To gain hands-on experience in using laboratory equipment and instrumentation commonly used in fluid mechanics experiments, such as flow meters, pressure gauges, and manometers.	CE253.2	Students will be able to apply measurement techniques accurately to determine fluid flow parameters using appropriate instruments.	**Application** **Analysis**
	To Learn techniques for measuring and analyzing fluid flow characteristics, including velocity, pressure, and flow rate, using experimental setups and instruments.	CE253.3	Students will be able to analyze experimental data, including uncertainty analysis, to validate fundamental principles of fluid mechanics.	**Analysis** **Evaluation**
	To understand the significance of experimental uncertainty and error analysis in fluid mechanics experiments and learn methods for minimizing and quantifying measurement errors.	CE253.4	Students will be able to develop practical troubleshooting and problem-solving skills during experimental setups and data collection	**Application** **Synthesis**
	To Apply theoretical knowledge to design and execute experiments, analyze experimental data, and draw conclusions regarding fluid behavior and phenomena observed in the laboratory.	CE253.5	Student will be able to design and communicate experimental procedures, results, and conclusions effectively through written reports and oral presentations, demonstrating understanding of fluid mechanics experimental methods and outcomes	**Application** **Design**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE253.1	3	1	1	1	1		1					1		3	1
CE253.2	3	1	1	2	2				1					3	1
CE253.3	3	2		1	1		1							3	2
CE253.4	3	2		1	2				1			2		3	1
CE253.5	3	1	1	1	2				1					3	2
CE253	3	1.4	3	1.2	1.6		1		1			1.5		3	1.4

SYLLABUS

No.	Syllabus (List of Experiments)	Hours	COs
I	Introduction	02	
II	To determine the metacentric height of a ship model.	02	CE253.1, CE253.2, CE253.3, CE253.4, CE253.5
III	Verification of Bernoulli's theorem.	02	
IV	To calibrate a venturimeter and to determine its coefficient of discharge.	02	
V	To calibrate an orifice meter and study the variation of coefficient of discharge.	02	
VI	To study the flow over V-notch (weir) and Rectangular notch and to find their coefficient of discharge.	02	
VII	To determine the velocity using pitot tube.	02	
VIII	To study the variation of coefficient of discharge with the Reynolds number.	02	
IX	To determine the coefficient of friction of pipes of different diameters.	02	
X	To obtain the surface profile on the total heads distribution of a vortex.	02	
	Total Hours	**20**	

Essential Readings

1. SK Som, Gautam Biswas, Suman Chakraborty, :Introduction to Fluid Mechanics and Fluid Machines" McGraw Hill Publications, Third Edition, 2010
2. Dr. R K Bansal, "A text book of Fluid mechanics & Hydraulics machines", Laxmi Publications, Revised Ninth Edition, 2010
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, 21st Edition, 2017
4. Er. R K Rajput, "A text book of Fluid Mechanics", S Chand publications, 9th Edition, 2017

Supplementary Readings

1. Streeter, V.L. and Wylie E.B., "Fluid Mechanics", McGraw Hill.9 th Edition 2017
2. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House.21st Edition.2017.
3. Kumar K.L., "Fluid Mechanics", S. Chand & Co.22nd Edition 2016.
4. Jain A.K., "Fluid Mechanics", Khanna Publisher.23rd Edition 2010.
5. White B.F., "Fluid Mechanics", McGraw Hill.7 th Edition 2010.
6. Frabzini J., "Fluid Mechanics with Engineering Applications", McGraw Hill.10th Edition 2001.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE255	**Surveying lab**	**NIL**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

Course Objectives	To develop the student's knowledge to understand the basic skills of surveying work including distance and angle measurement	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To provide knowledge on types of survey methodology and equipment suitable for a particular engineering projects.		CE255.1	Able to acquire **knowledge** on conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling — Knowledge Application
	To introduce different type of surveying equipment		CE255.2	Able to **estimate** and select a particular type of survey and equipment suitable for a particular engineering application. — Application Estimate
	To provide knowledge on how to prepare a surveying map using collected surveying data.		CE255.3	Able to apply the procedures involved in field work and to work as a surveying team — Application
	To make student's understand the basic concept of remote sensing & GIS		CE255.4	Able to **estimate** accurate measurements, field booking, plotting and adjustment of errors can be understood. — Estimate
			CE255.5	Able to acquire **knowledge** to understand the basic concept of remote sensing & GIS and its **application**. — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE255.1	**3**	**3**	**0**										**3**	**3**	
CE255.2	**3**	**3**	**3**										**3**	**3**	
CE255.3	**3**	**3**	**3**										**3**	**3**	**3**
CE255.4	**3**	**3**	**3**										**3**	**3**	**3**
CE255.5	**3**	**3**	**3**										**3**	**3**	
CE255	**3**	**3**	**2.4**										**3**	**3**	**0.60**

SYLLABUS

No.	Content	Hours	COs
1	To perform chain surveying of a given area	02	CE255.1, CE255.2 , CE255.3, CE255.4, CE255.5
2	Compass traversing and error adjustment of a given area	02	
3	Theodolite traversing and error adjustment of a given area	02	
4	To conduct surveying using profile levelling and cross sectioning of a given route	02	
5	To determine the difference in elevation of two given points.	02	
6	To prepare the contour map of an area	02	
7	To conduct surveying using plane tabling by radiation and intersection method of a given area	02	
8	To set out a simple circular curve by different methods.	02	
9	To use total station for finding slope, horizontal distance & vertical distances and traversing of a given area	02	
10	Collecting topographic data using hand held GPS	02	
11	Viva-voce and exam	04	
	Total hours	**24**	

Essential Readings

1. B.C. Punmia, "Surveying Vol.I and II, Standard Publishers", Second edition, 1994.
2. S.K. Duggal, "Surveying Vol. I and II, Tata McGraw Hill", Fourth edition, 2004.
3. W. Schofield and M. Breach, "Engineering Surveying", 6th edition, CRC Press, 2007.

Supplementary Readings

1. N.N. Basak , "Surveying & Levelling, McGraw Hill, second edition, 2014
2. K.R. Arora, "Surveying Vol. I and II" Standard Book House, 1996
3. G. Satheesh, "The Global Positioning System and Surveying using GPS", Tata McGraw, 2005.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**				Year of Regulation			**2024-25**
Department	**Department of Civil Engineering**				Semester			**III**
Course Code	Course Name	**Prerequisite**	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE257	**Public Health Engineering Lab**	**NIL**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To familiarize the students with the physical and chemical parameters of water and wastewater	Course Outcomes	CE257.1	Student will be able to identify the importance of water and its quality requirement.	Identify
	To develop ability and skill for analysing for the analysis of various water quality parameters and prepare water quality assessment report		CE257.2	Student will be able to understand the procedure for analysis of various quality parameter	Understand
			CE257.3	Student will be able to execute the best suited water treatment process for a raw water	Execute
			CE257.4	Student will be able to estimate the water quality requirements for industrial and domestic purposes	Estimate
			CE257.5	Student will be able to assess the importance of problem solving and laboratory skills using modern instrumentation	Assess

COs	**Mapping with Program Outcomes (POs)**											**Mapping with PSOs**			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE257.1	**1**	**3**	**3**	**2**		**2**			**3**		**1**	**3**		**3**	**2**
CE257.2	**1**	**3**	**3**	**2**					**3**		**1**	**3**		**3**	**2**
CE257.3	**1**	**3**	**3**	**2**					**3**		**1**	**3**		**3**	**2**
CE257.4	**1**	**3**	**3**	**2**	**3**				**3**		**1**	**3**		**3**	**2**
CE257.5	**1**	**3**	**3**	**2**	**3**	**2**			**3**		**1**	**3**		**3**	**2**
CE257	**1**	**3**	**3**	**2**	**3**	**2**			**3**		**1**	**3**		**3**	**2**

SYLLABUS

No.	Content	Hours	COs
I	To find the pH, turbidity and colour of a given sample of water.	**2**	CE257.1, CE257.2
II	To determine the conductivity, total dissolved solid and suspended solids of a given sample of water	**2**	CE257.1, CE257.2
III	To determine the alkalinity in a given sample of water.	**3**	CE257.1, CE257.2
IV	To estimate the hardness of the given sample of water by standard EDTA method.	**3**	CE257.1, CE257.2
V	To determine residual chlorine in a given sample of water	**3**	CE257.1, CE257.2
VI	To find the optimum amount of coagulant required to treat the turbid water by Jar Test.	**3**	CE257.3
VII	To determine biochemical oxygen demand (BOD) exerted by the given wastewater sample.	**4**	CE257.4, CE257.5
VIII	To determine Chemical oxygen demand (COD) exerted by the given wastewater sample.	**4**	CE257.4, CE257.5
IX	To determine the bacteriological quality of a given sample of water	**4**	CE257.4, CE257.5
Total Hours		**28**	

Essential Readings

1. APHA, Standard Methods Examination of Water and Wastewater, American Public Health Association, Washington DC, 22nd Edition, 2012.
2. Metcalf & Eddy (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill.4th Edition,2003.

Supplementary Readings

1. Rowe D. R. and George Tchobanoglous, "Environmental Engineering", McGraw-Hill International. 1st Edition,1985
2. McGhee. and Terence. J ., "Water Supply and Sewerage", McGraw-Hill Inc., 6th edition,1991
3. Davis M. L and Cornwell D. A "Introduction to Environmental Engineering", McGraw-Hill, Inc.5 th Edition, 2012.
4. Sawyer C. N., McCarty P. L and Parkin G. F., "Chemistry for Environmental Engineers", McGraw- Hill. Fifth edition, 2002.
5. Manual for Sewer and Sewerage, Central Public Health & Environmental Engineering Organization, Ministry of Housing and Urban Development, Govt. of India. 1993.
6. Manual for water supply and treatment, Central Public Health & Environmental Engineering Organization, Ministry of Housing and Urban Development, Govt. of India,2023.

FOURTH SEMESTER COURSES

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE202	**Building Materials and Construction**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To provide basic knowledge of building materials for construction of various building components		CE202.1	Classify and characterize various building materials	Classify characterize
	To illustrate the functional requirements of building components and its construction		CE202.2	Recognize the proper application of building materials for different components of a building	Recognize
			CE202.3	Understand the construction practices for various components of a building	Understand
			CE202.4	Utilize the basic knowledge of functional requirements to be considered in design and construction of building	Utilize

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE202.1	**2**	**1**	**1**				**3**							**3**	**1**
CE202.2	**2**	**1**	**1**				**3**							**3**	**1**
CE202.3	**2**	**1**	**1**				**1**							**3**	**1**
CE202.4	**2**	**1**	**1**				**3**							**3**	**1**
CE202	**2**	**1**	**1**				**2.5**							**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Building Materials:** Classification of bricks, tiles, types of terra-cotta, Classification of stones, requirements of good structural stone, Classification of Limes, Cement and Mortars, manufacturing, artificial hydraulic lime, testing lime and storage of lime, cements composition, types of cement, special types of cement, cement mortars, mortars for masonry and plastering, fly ash, pozzolana, Basic constituents ofPaints and Varnishes, types, painting of wood, constituents, characteristics, and types of varnishes.	7	CE202.1, CE202.2
II	**Masonry Construction:** Introduction, various terms used, stone masonry, classifications of stone masonry, safe permissible loads, brick masonry, bonds in bricks, laying of brick work, defects in brick masonry, reinforced brick work, composite stone and brick masonry, glass block masonry.	5	CE202.2, CE202.3
III	**Foundation:** Function, types of shallow foundation, types of deep foundations and its constructions**.**	4	CE202.2, CE202.3, CE202.4
IV	**Cavity and Partition Walls:** Position of cavity, constructional details and precautions, construction of cavity wall. Types of non-load bearing partitions.	3	CE202.3
V	**Damp and Water Proofing:** Defects and causes of dampness, prevention of dampness, materials used, damp-proofing treatment in buildings, water proofing of roofs including pitched roofs.	5	CE202.3
VI	**Staircases:** Functional requirements and terminology, Types of staircases & construction.	3	CE202.2, CE202.3
VII	**Doors & Windows:** Locations, types of doors & windows, fixtures and fasteners for doors and windows.	4	CE202.3
VIII	**Acoustics, Sound Insulation and Fire Protection:** Classification, measurement and transmission of sound, sound absorber, classification of absorbers, sound insulation of buildings, fire-resisting properties of materials, fire resistant construction and fire protection requirements for buildings.	5	CE202.3, CE202.4
	Total Hours	**42**	

Essential Readings

1. Duggal, S.K, (2008), Building Materials, Third Revised Edition, New Age International (P) Limited Publishers.
2. Varghese P. C. Building construction, PHI Learning Pvt. Ltd., 2008.
3. Arora S. P., and Bindra S. P. The text book of building construction, Dhanpat Rai Publications, 2010.

Supplementary Readings

1. Peter A. Claisse, (2016), Civil Engineering Materials, Butterworth-Heinemann (Imprint of Elsevier). Copyright © 2016 Elsevier Ltd.
2. Haimei Zhang, (2011), Building Materials in Civil Engineering, Woodhead Publishing Limited and Science Press.
3. Punmia B. C., Jain A. J. and Jain A. J. Building construction, Laxmi Publications, 2005.
4. National Building Code of India, 2016.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE204	**Structural Analysis**	**CE204**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To analyze and study the response of structures subjected to various types of loading.	Course Outcomes	CE204.1 Able to **use** the concept of structural analysis and thus able to **solve** different critical analytical problems in the civil engineering field.	**Use, Solve**
	To apply the equation of equilibrium to structures and compute the reactions.		CE204.2 Able to **distinguish** statically determinate trusses, beams, and frames and obtain internal loading.	**Distinguish**
	To acquire the knowledge to solve statically determinate structures by different methods		CE204.3 Able to **evaluate** the influence lines for statically determinate and indeterminate structures.	**Evaluate**
			CE204.4 Able to **predict** the deflections of beams and frames using classical methods and energy methods.	**Predict**
			CE204.5 Able to **interpret** the analysis of the indeterminate structures by force and flexibility coefficient method.	**Interpret**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE204.1	3	3	3	3	3	0	0	0	2	1	0	0	1	3	1
CE204.2	3	3	3	3	3	0	0	0	2	1	0	0	1	3	1
CE204.3	3	3	3	3	3	0	0	0	2	1	0	0	1	3	1
CE204.4	3	3	3	3	3	0	0	0	2	1	0	0	1	3	1
CE204.5	3	3	3	3	3	0	0	0	2	1	0	0	1	3	1
CE204	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**2**	**1**	**0**	**0**	**1**	**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Structural analysis** Forms of structures, Loads and Forces on the structural system, Free body diagram, conditions of equilibrium of forces, support and connections – reactions, Difference between determinate and indeterminate structures, static and kinematic indeterminacy.	**04**	CE204.1
II	**Methods of Analysis** Equilibrium equations, compatibility requirements, Introduction to force and displacement methods.	**04**	CE204.1
III	**Analysis of trusses** Plane truss, compound truss, complex truss and space truss, Arches and suspension cables, three-hinged arches, and suspension cables.	**06**	CE204.2
IV	**Deflection in Beams** Computation of slope and deflection by double integration, moment area method, conjugate beam method, applications to simply supported, overhang, and cantilever beams.	**08**	CE204.4
V	**Energy methods** Principle of minimum potential energy, principle of virtual work, Castigliano's theorems, Reciprocal theorem, and their applications to find deflection and redundant forces in simple cases.	**08**	CE204.4
VI	**Moving loads and influence lines** Unit load method, Influence line and Rolling loads, beam, frames and arches, Muller- Breslau Principles and its applications to determinate and indeterminate structures.	**08**	CE204.3
VII	**Introduction of the analysis of indeterminate structures** Force methods, flexibility coefficients methods	**04**	CE204.5
	Total Hours	**42**	

Essential Readings

1. Kassimali, Aslam, G. V. Ramana, and Germán Rojas Orozco. Structural analysis. Stamford, CT: Cengage Learning, 2015.
2. Hibbeler R.C., "Structural Analysis", Pearson, 9th Edition, 2017
3. Reddy C.S., "Basic Structural Analysis," Tata McGraw Hill, 3rd Edition, 2011

Supplementary Readings

1. Prakash Rao, D.S., "Structural Analysis: Unified approach", Universities Press., 1st Edition,1996
2. Norris C.H., Wilbur J.B. and Utku S., "Elementary Structural Analysis", Tata McGraw Hill, 6th Edition, 2003
3. Negi L.S and Jangjid R.S., "Structural Analysis", Tata McGraw Hill, 6th Edition, 2003
4. Punmia B. C., "Theory of Structures" Laxmi Publication house, 16th Edition, 2017
5. Ramamrutham S., "Theory of Structures", Dhanpat Rai Publications, 9th Edition, 2014

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE206	**Geotechnical Engineering**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce basic assumptions in soil mechanics and application of the principles of hydraulics and mechanics in soil mechanics	CE206.1	Able to acquire knowledge about origin of soil, basic soil terminology and simple tests	**Knowledge**
	To introduce Soil classification, their origin and properties	CE206.2	Able to acquire knowledge about classification of various soil types, clay mineralogy and soil structure and their application.	**Knowledge Application**
	To introduce different geotechnical engineering structures and their design	CE206.3	Able to compute the index properties (such as grain size distribution, Atterberg's limits etc.) and engineering properties (such as permeability, compressibility, shear strength) of soil and their application in geotechnical site investigation.	**Compute Application**
		CE206.4	Able to acquire knowledge about compaction and consolidation of soil	**Knowledge**
		CE206.5	Able to learn application of soil mechanics to design safe geotechnical structures such as slope, retaining structure etc.	**Application Design**
		CE206.6	Able to understand the application of reinforced soil structures.	**Application**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE206.1	3		0											3	
CE206.2	3		0											3	
CE206.3	3		0											3	
CE206.4	3		0											3	
CE206.5	3		1											3	
CE206.6	3		1											3	
CE206	3		0.33											3	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Origin and types, Identification and classification of soils, Index properties, phase relationship, consistency, sensitivity, clay mineralogy.	06	CE206.1, CE206.2, CE206.3
II	**Permeability and Seepage** Darcy's law of permeability, Determination of Coefficient of permeability, Equivalent permeability for stratified soil, Flow nets – principles, construction and application, Effective stress analysis, quick sand condition, piping, filtration criteria.	06	CE206.3
III	**Shear Strength of Soil** Strength envelope, total and effective stress paths, pore pressure, evaluation of shear strength parameters, direct shear, triaxial shear, vane shear, unconfined compression test.	06	CE206.3
IV	**Compaction and Consolidation** Principle of compaction, Light and heavy compaction, field compaction control, factors affecting compaction. Compressibility and Consolidation: Terzagli's theory of one-dimensional consolidation, Secondary Consolidation, estimation of consolidation settlement.	06	CE206.4
V	**Lateral Earth Pressure** Earth pressure at rest, active and passive earth pressure, Rankine and Coulomb's earth pressure theories, Graphical Solutions.	06	CE206.5
VI	**Stability of Slope** Stability of infinite slope, stability of finite slope, slope protection.	06	CE206.5
VII	**Reinforced Soil Structures** Principles of reinforced soil structures, Types of reinforcements (geotextiles, geogrids, etc.), basics design and applications of reinforced soil walls and slopes	06	CE206.6
	Total Hours	**42**	

Essential Readings

1. Ranjan Gopal and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International, 2005.
2. Terzaghi K., Peck R. B. and Mesri G., "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1996.
3. Arora K. R., "Soil Mechanics and Foundation Engineering", Standard Publishers Distributors, 2004.
4. Murthy V. N. S., "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishers & Distributors/Alkem Company (S), 2018.

Supplementary Readings

1. Kaniraj S.R., "Design Aids in Soil Mechanics & Foundation Engineering", Tata McGraw Hill, 2017.
2. Lambe T.W. and Whitman R.V., "Soil Mechanics", John Wiley & Sons, 2012.
3. Punmia B.C., "Soil Mechanic and Foundation Engineering", Laxmi Publication Pvt. Ltd, 2005.
4. Braja M. Das., "Fundamental of Foundation Engineering", Thomson Asia Pvt. Ltd, Singapore, 2011.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE208	**Hydrology and Water Resources Engineering**	**----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on various processes of hydrologic cycle with detail understanding of its components.	Course Objectives	CE208.1	Able to **classify** the various components of hydrologic cycle that affect the movement of water in the earth.	Understand
	To provide some knowledge about various forms of precipitations and representation of hydrological data.		CE208.2	Able to **demonstrate** the ability to perform **analysis** and representation of hydrological data.	Understand Analyse
	To develop understanding of surface yield and rainfall-runoff model.		CE208.3	Able to **develop** various techniques for measurement of precipitation and estimate abstractions from precipitation.	Apply
	To make the student understand hydrologic flood routing.		CE208.4	Able to **evaluate** yield from a catchment and **develop** rainfall-runoff model.	Evaluate Create
	To provide knowledge about ground water flow and ground water storage.		CE208.5	Able to **formulate** hydrologic flood routing model.	Create
			CE208.6	Able to **summarise** the concept of occurrence of ground water, and its movement and storage beneath the earth.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE208.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE208.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE208.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE208.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE208.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE208.6	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE208	**2**	**2.33**	**2.67**	**2.2**	**2**	**1.83**	**1.67**	**0.67**	**1.33**			**2**	**2.5**	**2.8**	**2.67**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Hydrology - definition & scope, Hydrologic cycle and its components, Hydrologic data variability, Hydrologic data analysis.	2	CE208.1
II	**Precipitation** Formation and types, Forms, Measurement, Estimating missing precipitation data, Average precipitation over area, Depth-area-duration analysis, Abstractions from precipitation, Evapotranspiration and its measurement, Infiltration and its measurement, Interception process.	8	CE208.2, CE208.3
III	**Runoff and Hydrograph** Runoff components, Drainage basin characteristics, Factor effecting runoff, Hydrograph and its components, Base flow separation, Unit hydrograph– concept, derivation, limitations and use, S-hydrograph, Synthetic unit hydrograph, Instantaneous unit hydrograph.	10	CE208.3, CE208.4
III	**Floods** Definition, Flood estimation, Rational method and unit hydrograph method, Flood routing: reservoir routing and channel routing, Flood frequency analysis.	11	CE208.4, CE208.5
V	**Ground water hydrology** Occurrence of ground water, Aquifers, Movement of ground water, Darcy's law, Porosity, specific yield and specific retention, Yield from wells for confined and unconfined aquifers, Yield of an open well.	11	CE208.6
	Total Hours	**42**	

Essential Readings

1. V. T. Chow, D. R. Maidment and L. W. Mays, "Applied Hydrology", McGraw Hill, 1st Edition, 1988.
2. K. Subramanya, "Engineering hydrology", McGraw Hill, 2nd Edition, 1994.

Supplementary Readings

1. V. P. Singh, "Elementary Hydrology", Englewood Cliffs, NJ : Prentice Hall, 1st Edition, 1992.
2. D. K. Tood and L. W. Mays, "Ground Water Hydrology", Wiley India Pvt. Ltd, 3rd Edition, 2004.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE212	**Waste Water Engineering**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To analyse the Wastewater sources and wastewater characteristics and to develop various wastewater treatment process.	Course Outcomes	**CE212.1**	Student will be able to highlight the implementation of environmental Engineering on engineering concepts which are applied in field.	Highlight
	To train the students on developing practical, efficient and cost-effective solutions on problems and challenges on environmental sciences and engineering.		**CE212.2**	Student will be able to associate diverse knowledge of environmental engineering practices applied to real life problems.	Associate
	To give an experience in the implementation of engineering concepts which are applied in field of wastewater treatment process.		**CE212.3**	Student will be able to learn to understand and examine the theoretical and practical aspects of environmental engineering along with the design and management applications.	Understand Examine
			CE212.4	Student will be able to evaluate environmental problems and test for solutions.	Evaluate Test
			CE212.5	Student will be able to design and create various physico-chemical unit processes and operations to achieve the desired water quality in water and wastewater systems.	Design Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE212.1	3													3	
CE212.2	3													3	
CE212.3	3													3	
CE212.4	3													3	
CE212.5	3		1											3	
CE212	3		0.2											3	

SYLLABUS

No.	Content	Hours	COs
I	**Sanitary Engineering** Definition of sullage, sewage, sewerage, sewer, refuge, garbage, sewage treatment/Disposal system and wastewater management.	**05**	CE212.1, CE212.2, CE212.3
II	**Sewage Systems, Collection and Conveyance** Strength of Sewage, Sampling of Sewage to analyze for Physical, Chemical and Biological Parameters; Decomposition of sewage, comparison, Design of Sewer; Domestic and industrial sewage, volume of domestic sewage, variability of flow, limiting velocities-Self cleansing and Maximum velocities of sewer; Types of Sewers.	**07**	CE212.3
III	**Waste Water Flow** Estimation of Dry Weather Flow and Storm Water, Variation of flow, Estimation of design discharge.	**05**	CE212.3
IV	**Waste Water Characteristics** Physical, chemical, and biological characteristics of sewage and wastewater, effluent standards	**05**	CE212.4
V	**Waste Water Disposal and Treatment** Treatment Methods – Principles; Dilution, self-purification, Flow diagram of conventional sewage treatment plant, Primary treatment – screens, Grit Chambers, detritus tank, skimming tank, Type – III and Type – IV settling, Design of secondary sedimentation tank. Secondary treatment – Trickling fitters, biological contractor, Activated sludge process, Sequencing Batch Reactor (SBR); Membrane Bioreactor (UASB); Waste Stabilization Ponds; oxidation pond and ditches, aerated lagoon; Tertiary Treatment of Sewage; Decentralised Sewage Treatment & Reuse.	**09**	CE212.5
VI	**Treatment and Disposal of Sludge** Sludge characterization; Thickening; Design of gravity thickener; Aerobic and anaerobic digestion; Standard rate and High rate digester design; Biogas recovery; Sludge Conditioning and Dewatering;Sludge drying beds; Standards for Disposal Methods; Mass balance principle; Self-purification of river; Oxygen sag curve.	**06**	CE212.5
VII	**Environmental Safety** Significance of Environmental Safety, Legislation and Environmental Protection, Sustainable Practice, Occupational Health Risk Assessment, Environmental Impact Assessment, Environmental Audit, reuse of wastewater for environmental safety**.**	**05**	CE212.4, CE212.5
	Total Hours	**42**	

Essential Readings

1. Environmental Engineering, Peavy H. S., Rowe D. R. and George Tchobanoglous, McGraw-Hill International.
2. McGhee. and Terence. J ., "Water Supply and Sewerage", McGraw-Hill Inc., 6th edition,1991
3. Garg, S.K., "Environmental Engineering", Vol. 1 & II Khanna Publishers, New Delhi, 2005.

Supplementary Readings

1. Davis M. L and Cornwell D. A "Introduction to Environmental Engineering", McGraw-Hill, Inc.5 th Edition, 2012.
2. Wastewater Engineering- Treatment and Reuse, Metcalf & Eddy (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill.
3. Rowe D. R. and George Tchobanoglous, "Environmental Engineering", McGraw-Hill International. 1st Edition,1985
4. APHA, Standard Methods Examination of Water and Wastewater, American Public Health Association, Washington DC, 1995.
5. Manual for water supply and treatment, Central Public Health & Environmental Engineering Organization, Ministry of Housing and Urban Development, Govt. of India, 1999.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-2025**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE214	**Green Infrastructures and low impact development**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO`s	**Statement**	**Bloom`s Taxonomy**
Course Objectives	Describe the guiding principles of green infrastructure and low-impact development	Course Outcomes	CE214.1	Understand green infrastructure and low-impact development	Understand
	To teach students the green infrastructure system for flood protection		CE214.2	Evaluate to low impact analysis strategy.	Evaluate
	To learn green infrastructure stormwater practices.		CE214.3	Develop a model for flood protection using green infrastructural system.	Develop
	To learn to make policy document for green infrastructural system.		CE214.4	Student will be able to know green infrastructure stormwater practices.	know
			CE214.5	Student will be able to formulate and solve various problem on green infrastructure and flood protection.	Formulate Solve
			CE214.6	Student will be able to understand the policy requirement for green infrastructure system.	understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE214.1	**3**	**3**													
CE214.2	**3**	**3**	**3**												**3**
CE214.3	**3**	**3**	**3**												
CE214.4	**3**	**3**	**3**												**3**
CE214.5	**3**	**3**	**3**				**3**							**3**	**3**
CE214.6	**3**	**3**	**3**				**3**							**3**	**3**
CE214	**3**	**3**	**2.5**				**1**							**1**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Green Infrastructure and LID Defined: Green roofs and vegetative walls, Bioretention, or rain gardens, Bioswales, Planter boxes, Permeable pavement, urban tree canopy, Rainwater harvesting	10	CE214.1
II	Green infrastructure for flood protection: An introduction to the green infrastructure concept, Green infrastructure — Floodplain restoration and management Green infrastructure — Wetland restoration and management	12	CE214.2, CE214.3
III	Green infrastructure stormwater practices: Bio-infiltration, Infiltration practices, Permeable pavement, Stormwater/rainwater harvest and use/reuse, Stormwater disconnection, Swales and filters strips.	12	CE214.4, CE214.5
IV	Best management practices and Case studies on Green Infrastructure	8	CE214.4, CE214.5, CE214.6
	Total Hours	42	

Essential Readings

1. The Sustainable Site: The Design Manual for Green Infrastructure and Low Impact Development by Rodney Tyler, Forester Press Edition 2011
2. Economic Benefits of Low-Impact Development & Green Infrastructure: Case Studies (Economic Issues, Problems and Perspectives) Hardcover – Import, 1 January 2015 by Kirsty Myles

Supplementary Readings

1. Global Green Infrastructure: Lessons for successful policy-making, investment and management by Ian Mell, Routledge; 1st edition (16 March 2016)

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE216	**Introduction to Life Cycle Assessment**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**100**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To provide basic conceptual understanding of fundamental principles of Life Cycle Assessment (LCA) methodology	Course Outcomes	CE216.1	Students will be able to understand and define the importance of LCA and Sustainability in the Environment	Understand Define
	To provide a general concept to understand and explore the feasibility of application of life cycle assessment on sustainability projects		CE216.2	Students will be able to identify the factors affecting the methodology of LCA	Identify
			CE216.3	Students will be able to comprehend and apply the framework of LCA	Comprehend Apply
			CE216.4	Students will be able to analyse the environmental aspects of a life cycle	Analyse
			CE216.5	Students will be able to apply the principles of performing a life cycle assessment and create sustainable solutions	Apply Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE216.1	**1**						**1**	**1**					**1**	**2**	**3**
CE216.2		**1**					**1**	**1**					**1**	**3**	**3**
CE216.3							**1**	**1**					**1**	**1**	**3**
CE216.4		**1**					**1**	**1**					**1**	**2**	**3**
CE216.5	**1**	**1**					**1**	**1**					**1**	**2**	**3**
CE216	**0.4**	**0.6**					**1**	**1**					**1**	**2**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** LCA and Sustainability, LCA and Environmental Systems, LCA and Water, Food and Energy	**08**	CE216.1
II	**LCA Methodology:** Environmental Data Collection and LCA Methodology, The ISO Framework, Unit Process, Data and LCI Databases, Inventory Data and LCIA, Unit Process and System Boundary, LCIA	**12**	CE216.1, CE216.2
III	**Risk Assessment and LCA Frameworks:** Risk Assessment Methods. RISK Assessment Toxicology, Key Points of a Good LCA, ISO Terminologies, LCA Benefits and Drawbacks	**12**	CE216.2, CE216.3
IV	**Design for Sustainability:** Sustainable Engineering Design Principles, Green Sustainable Materials, Summary and Case Studies	**10**	CE216.3, CE216.4
	Total Hours	**42**	

Essential Readings

1. Curran, M. A., Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, John Wiley & Sons, Inc., 2012.
2. M. Z., Hauschild, M. A. J., Huijbregts, Life Cycle Impact Assessment, Springer, 2015.

Supplementary Readings

1. J.B. Guinee (ed.), Handbook on Life Cycle Assessment Operational Guide to the ISO Standards, Springer, 2002.
2. H. S. Matthews, C. T. Hendrickson, and D. H. Matthews, "Life Cycle Assessment: Quantitative Approaches for Decisions that Matter" Wiley, 2018

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE218	**Accounting and Finance for Civil Engineers (NPTEL Course)**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the student's knowledge on accounting and finance, and analysis of financial statements.		CE218.1	Able to acquire knowledge about accounting and concepts in finance.	**Knowledge**
	To provide understanding on financial planning and capital budgeting.		CE218.2	Able to acquire knowledge about analysis of financial statements and it's application.	**Knowledge Application**
			CE218.3	Able to acquire knowledge about financial planning including capital budgeting and it's application.	**Knowledge Application**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE218.1	**1**			**1**				**2**	**1**	**2**	**3**	**2**		**2**	
CE218.2	**1**			**1**				**2**	**1**	**2**	**3**	**2**		**2**	
CE218.3	**1**			**1**				**2**	**1**	**2**	**3**	**2**		**2**	
CE218	**1**			**1**				**2**	**1**	**2**	**3**	**2**		**2**	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Basic Accounting and concepts in finance; Book keeping: definitions, objectives, elements, journal and ledger.	10	CE218.1
II	**Accounting & Concepts in Finance:** Definitions, objectives, characteristics, limitations, basic terms; GAAP (Generally Accepted Accounting Principles), Systems of accounting, cash book, bank book, depreciation; provisions, reserves, accounting equation, journal & ledger entries, trial balance, profit & loss; account, balance sheet, cash flow statement	10	CE218.2
III	**Analysis of financial statements:** Financial leverage, financial ratios, Significance and applications.	10	CE218.3
IV	**Financial planning including capital budgeting:** Definition, financial planning options and objectives, time value of money, simple and compound interest, rule of 72, methods of capital budgeting - payback period, Accounting rate of return (ARR), net present value (NPV), internal rate of return (IRR).	12	CE218.4
	Total Hours	**42**	

Essential Readings

1. Theusen G.J., Fabrycky W.J., Engineering Economy, 9th Edition, Prentice-Hall, Inc., New Delhi, India, 2001.
2. Crundwell F.K., Finance for Engineers-Evaluation and Funding of Capital Projects, Springer, London, UK, 2008. (ISBN 978-1-84800-032-2).

Supplementary Readings

1. Jha K.N., Construction Project Management- Theory and practice, 2nd Edition, Pearson India Education Services Pvt. Ltd., UP, India 2015.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE272	**Computational Methods in Engineering**	**----**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the numerical solution of algebraic, transcendental and system of linear equations.	Course Objectives	CE272.1	Able to **analyse** errors, accuracy and precision concepts.	Analyse
	To apply the concept of interpolation and extrapolation for the given data sets.		CE272.2	Able to **demonstrate** the ability to find the missing data points from the given data using interpolation and extrapolation.	Understand
			CE272.3	Able to **solve** numerical solution of algebraic, transcendental and system of linear equations.	Apply
	To understand the concept of solving integration and differential equations numerically for various real world problems		CE272.4	Able to **develop** numerical differentiation and numerical integration.	Create
			CE272.5	Able to numerically **solve** ordinary differential equations.	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE272.1	**3**	**3**		**2**	**2**								**1**	**2**	**3**
CE272.2	**3**	**3**			**3**	**1**							**1**	**2**	**3**
CE272.3	**3**	**3**	**1**	**2**		**1**		**3**					**1**	**2**	**3**
CE272.4	**3**	**3**	**1**					**3**					**1**	**2**	**3**
CE272.5	**3**	**3**					**3**						**1**	**2**	**3**
CE272	**3**	**3**	**0.4**	**0.8**	**1**	**0.4**	**0.6**	**1.2**					**1**	**2**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Errors and Accuracy** Approximate numbers and significant figures, absolute error, relative error and percentage error, error in determinants, accuracy and precision	2	CE272.1
II	**Polynomial Approximation and Interpolation** Relation between difference and derivatives, Newton's forward and backward interpolation, divided difference, Newton's general interpolation formula, Lagrange's interpolation formula, accuracy of Newton's and Lagrange's interpolation, Gauss's central-difference formula, multivariate approximation, least squares approximation	6	CE272.2, CE272.3
III	**Numerical Solution of Transcendental Equation** Approximate value of the root, regula Falsi method, Newton-Raphson method, error and geometric significant of Newton-Raphson method, method of iteration, convergence of Newton-Raphson and iteration methods, Newton-Raphson method for simultaneous equations	8	CE272.3, CE272.4
III	**Numerical Differentiation and Difference Formulas** Taylor series approach, difference formulas, general quadrature formula, Simpson's rule, trapezoidal rule, Gauss's quadrature formula, Euler's quadrature	7	CE272.4, CE272.5
V	**Numerical Solution to Ordinary Differential Equation** Euler's method, stability analysis of Euler's method, Picard's method of successive approximation, Milne's method, Runge-Kutta method	5	CE272.5
	Total Hours	**28**	

Essential Readings

1. J. B. Scarborough, "Numerical Mathematical Analysis", Oxford & IBH Publishing Co Pvt. 6th Edition, 2020.
2. J. D. Anderson Jr, "Computational Fluid Dynamics", McGraw-Hill Higher Education. 3rd Edition, 1995

Supplementary Readings

1. J. D. Hoffmanm and S. Frankel, "Numerical Methods for Engineers and Scientists", CRC Press. 2nd Edition, 2001.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press. 2nd Edition, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation: **2024-25**
Department	**Civil Engineering**	Semester: **IV**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE232	**Remote Sensing and GIS**	**1**	**0**	**2**	**2**	**50**	**50**	**100**	**200**

			CO`s	Statement	Bloom`s Taxonomy
Course Objectives	1. To understand use of aerial camera, aerial photographs and procedure of aerial survey	Course Outcomes	CE232.1	Able to **understand** the basics of photogrammetry surveying.	Understand
	2. To provide background knowledge and understanding of principle of remote sensing and remote sensing system		CE232.2	Able to **apply** the working principle of remote sensing system.	Apply
	3. To gain knowledge about the data interpretation techniques.		CE232.3	Able to **dissect and analyze** various image processing techniques	Dissect Analyze
	4. To provide knowledge about the basic of GPS		CE232.4	Able to **extend** on understanding of GPS	Understand
	5. To gain knowledge about working principle of GIS		CE232.5	Able to **extend** on understanding of GIS	Understand

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CE232.1	2	1										2	**3**		
2	CE232.2	2	3	2		3	2						2	**3**		
3	CE232.3	2	3	2		3	2						2	**3**		
4	CE232.4	2	3	2		3	2						2	**3**		
5	CE232.5	2	3	2		3	2						2	**3**		
CE232		**2.0**	**2.6**	**1.6**		**2.4**	**1.6**						**2**	**3.0**		

SYLLABUS

No.	Content	Hours	COs
I	**Photogrammetry:** Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy	04	CE232.1
II	**Remote Sensing**: Introduction, Definition and Overview of Remote Sensing and Remote Sensing Systems, Electromagnetic Radiation, Terms and Definitions, electromagnetic Spectrum, Sources of electromagnetic radiation, Principles of energy interaction in atmosphere and earth surface features, Remote sensing advantages & Limitations	07	CE232.2
III	**Image Processing and Interpretation:** Image interpretation techniques, visual interpretation, Digital image processing, Principles of Thermal Remote Sensing & its applications, Principles of Microwave Remote Sensing & its applications	07	CE232.3
IV	**GPS Basics:** System overview, working principle of GPS, Satellite ranging, calculating position, Ranging errors and its correction, Static and Rapid GPS surveyingc, DGPS and Kinematic methods, Real time and post processing DGPS, visibility diagram, GAGAN.	05	CE232.4
V	**Geographical Information System:** Definition of GIS, Key Components of GIS, Functions of GIS, Spatialdata,spatial information system Geospatial analysis, Integration of Remote sensing and GIS,and Applications in Civil Engineering	05	CE232.5
Total Hours		**28**	

Essential Readings

1. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications, 2005.
2. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications, 2016.
3. Principals of Geo physical Information Systems – Peter ABurragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
4. Surveying Vol. II and III by Dr. B.C. Punamia, Laxmi Publishers. New Delhi, 2023.

Supplementary Readings

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE252	**Building Materials Lab**	**NIL**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

Course Objectives	To develop the student's knowledge on basics of civil engineering materials and its relevant testing methodology	Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	To provide some knowledge about various methods for design of concrete mix.		CE252.1	Student will be able to understand the basics civil engineering materials which are relevant in engineering applications.	Understand
	To provide some knowledge on quality control for obtaining good fresh and hardened concrete		CE252.2	Student will be able to evaluate the impact of engineering solutions on the society and also will be aware of contemporary issues regarding failure of structures due to unsuitable materials.	Evaluate
	To provide knowledge about causes of deterioration of buildings.		CE252.3	Student will be able to understand the various factors affecting in producing a suitable fresh and hardened concrete.	Understand
	To provide knowledge on quality assessment of existing concrete structures through nondestructive testing		CE252.4	Student will be able to analyze and perform a suitable concrete design mix for various grades.	Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CE252.1	**3**	**3**	**3**										**3**	**3**	**3**
CE252.2	**3**	**3**	**3**										**3**	**3**	**3**
CE252.3	**3**	**3**	**3**										**3**	**3**	**3**
CE252.4	**3**	**3**	**3**										**3**	**3**	**3**
CE252	**3.0**	**3.0**	**3.0**										**3.0**	**3.0**	**3.0**

SYLLABUS

No.	Content	Hours	COs
1	Determination of standard consistency, initial and final setting time of cement sample using Vicat's apparatus.	4	CE252.1, CE252.2, CE252.3, CE252.4, CE252.5,
2	Determination of soundness of cement, compressive & tensile strength	2	
3	To determine the fineness modulus and particle size distribution of coarse, fine, and all in aggregates	2	
4	To determine the specific gravity, water absorption, bulking of fine aggregates and impact & crushing strength of coarse aggregates	2	
5	To conduct design concrete mix using IS Method and determine the strength of concrete (cube, cylinder & beam)	4	
6	To conduct workability comparison of concrete by slump test, compaction factor test, flow table test	2	
7	To determine cement and concrete permeability of a given mix.	2	
8	To determine the water absorption, compressive strength & efflorescence of burnt clay bricks.	2	
9	To determine the tensile and elongation of reinforcing steel bar	2	
10	To conduct non destructive test of concrete using rebound hammer & UPV	2	
11	Viva-voce and exam	4	
	Total Hours	**28**	

Essential Readings

1. M. Neville M and J.J Brooks, "Concrete Technology", Pearson Education, Twelfth impression, 2014
2. A.R Santhakumar, "Concrete Technology", Oxford Higher Education, Ninth impression, 2012
3. M.S. Shetty, "Concrete Technology (Theory & Practice)", S.Chand and Co, Revised edition, 2015
4. Relevant Indian Standards codes

Supplementary Readings

1. M. S. Mamlouk, and J. P. Zaniewski, Materials for Civil and Construction Engineers, Pearson, Prentice Hall, 2nd Edn., 2006.
2. J. F. Shackelford and M. K. Muralidhara, Introduction to Material science for Engineers, Pearson Education, 6th Edn., 2007
3. M.L. Gambhir, "Concrete Technology", Tata McGraw Hill, fifth edition, 2013.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE254	**Structural Analysis Lab**	----------	**0**	**0**	**2**	**1**	**Experiments, Quiz, etc.**	**100**

Course Objectives	To develop a comprehensive understanding of the fundamental theories and principles governing structural behavior, such as bending, deflection, torsion, buckling, and plastic deformation.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
			CE254.1	Able to **demonstrate** a comprehensive understanding of the behavior of various structural elements under different loading conditions, including bending, deflection, torsion, buckling, and plastic deformation. — **Demonstrate**
	To apply experimental methodologies to investigate and analyze the behavior of various structural elements and systems under different loading conditions and configurations.		CE254.2	Able to **apply** experimental methodologies effectively to **investigate** and analyze the performance and characteristics of structural systems and components. — **Apply, Investigate**
	Explore the factors influencing structural stability, failure modes, and the effects of load distribution on different types of structures and components		CE254.3	Able to **develop** analytical skills to **assess** and **predict** structural stability, failure modes, and the effects of load distribution on different types of structures. — **Develop, Assess, Predict**
	Bridge the gap between theoretical knowledge and practical applications by conducting experiments to validate theoretical concepts related to structural mechanics and behavior.		CE254.4	Able to **establish** a connection between theoretical concepts and practical applications by conducting experiments that validate and reinforce fundamental principles of structural mechanics. — **Establish**
			CE254.5	Able to **develop** the ability to critically **analyze** experimental data, **interpret** results, and **draw** conclusions regarding the behavior and performance of structural elements and systems. — **Develop, Analyze, Interpret, Draw**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE254.1	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CE254.2	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CE254.3	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CE254.4	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**
CE254.5	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**3**	**1**	**1**	**1**
CE254	**2.6**	**2.6**	**2.6**	**2.6**	**2.8**	**1.2**	**1.2**	**1.4**	**2**	**1**	**1**	**1.4**	**1**	**1**	**1**

SYLLABUS

No.	Content	Hours	COs
1	**Course Introduction** Overview of the course objectives and its significance in understanding structural engineering principles, Importance of hands-on experiments in comprehending theoretical concepts, Brief overview of key concepts like equilibrium, loads, reactions, and internal forces in structures.	**01**	CE252.1, CE252.2, CE252.3, CE252.4, CE252.5
2	**Experiment 1: Bending Moments and Shear Forces in a Beam** Introduction to basic theory, experiment setup, and verification of bending moments and shear forces in a beam.	**02**	
3	**Experiment 2: Beam Deflection** Exploration of beam deflection under varied loads and fixing conditions to understand its behavior.	**02**	
4	**Experiment 3: Torque and Deflection in Circular Sections** Study of torque and deflection in materials with circular sections, examining their characteristics.	**02**	
5	**Experiment 4: Unsymmetrical Bending and Shear Center** Understanding unsymmetrical bending and determining the shear center of different asymmetric sections.	**02**	
6	**Experiment 5: Analysis of Pin-Jointed Frameworks** Study of strains, stresses, forces, and deflections in various pin-jointed frameworks.	**02**	
7	**Experiment 6: Behavior of Arches** Analysis of three-pinned, two-pinned, and fixed arches under diverse load conditions.	**02**	
8	**Experiment 7: Buckling of Slender Columns** Investigating the buckling behavior of slender columns and establishing relationships between length, end-fixing conditions, and buckling load.	**02**	

9	**Experiment 8: Behavior of Indeterminate Beams** Study of the behavior and characteristics of various indeterminate beams.	**02**	
10	**Experiment 9: Plastic Bending of Beams and Portal Frames** Examination of plastic bending in beams and portal frames.	**02**	
11	**Experiment 10: Rectangular Portals** Analysis of deflections, reactions, bending moments, and sway in rectangular portals.	**02**	
12	**Experiment 11: Characteristics of Suspension Bridges** Understanding the characteristics and behavior of a simple suspension bridge.	**02**	
	Total Hours	**23**	

Essential Readings

1. Kassimali A., “Structural Analysis,” Cengage.
2. Hibbeler R.C., “Structural Analysis”, Pearson, 9th Edition, 2017
3. Reddy C.S., “Basic Structural Analysis,” Tata McGraw Hill, 3rd Edition, 2011

Supplementary Readings

1. Prakash Rao, D.S., “Structural Analysis: Unified approach”, Universities Press., 1st Edition,1996
2. Norris C.H., Wilbur J.B. and Utku S., “Elementary Structural Analysis”, Tata McGraw Hill, 6th Edition, 2003
3. Negi L.S and Jangjid R.S., “Structural Analysis”, Tata McGraw Hill, 6th Edition, 2003
4. Punmia B. C., “Theory of Structures” Laxmi Publication house, 16th Edition, 2017
5. Ramamrutham S., “Theory of Structures”, Dhanpat Rai Publications, 9th Edition, 2014

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE256	**Geotechnical Engineering Lab**	-----	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva - voce**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To introduce basic properties of soil	Course Outcomes	CE256.1	Able to acquire knowledge about conducting simple tests to identify basic soil properties and its application.	**Knowledge Application**
	To introduce Soil classification		CE256.2	Able to acquire knowledge about classifying various soil types	**Knowledge**
	To introduce index and engineering properties of soil		CE256.3	Able to acquire knowledge about conducting tests to compute the index properties (such as Atterberg limits etc.) properties and its application.	**Knowledge Application**
	To introduce basic properties of geo-synthetics		CE256.4	Able to acquire knowledge about conducting compaction test of soil and its application.	**Knowledge Application**
			CE256.5	Able to acquire knowledge about conducting tests to compute engineering properties (such as permeability, shear strength) of soil and its application in geotechnical site investigation.	**Knowledge Application**
			CE256.6	Able to acquire knowledge about conducting tests to compute basic properties of geo-synthetics and its application.	**Knowledge Application**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE256.1	3								1					3	
CE256.2	3								1					3	
CE256.3	3								1					3	
CE256.4	3								1					3	
CE256.5	3								1					3	
CE256.6	3								1					3	
CE256	**3**								**1**					**3**	

SYLLABUS

No.	Content	Hours	COs
I	To determine the specific gravity of soil	02	CE256.1
II	To determine the water content of soil sample	02	CE256.1
III	Grain size analysis of soils	02	CE256.2
IV	To estimate the consistency limit of fine-grained soils	02	CE256.3
V	To determine the optimum moisture content of soil.	02	CE256.4
VI	To estimate shear strength of soils by vane shear test.	02	CE256.5
VII	To estimate the engineering properties of the soils by density test, CBR test, permeability test	04	CE256.1
VIII	Basic property testing of geo-synthetics material as soil reinforcing element	04	CE256.6
	Total Hours	**20**	

Essential Readings

1. Terzaghi K., Peck R. B. and Mesri G., "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1996.
2. Head K.H. (1982). Manual of Soil Laboratory Testing, Vol. 1, 2, 3, Whittles Publishing, Scotland, UK.
3. IS 2720 (Various parts). Methods of Test for Soils, Bureau of Indian Standards.

Supplementary Readings

1. Bowles J.E. (1979). Physical and Geotechnical Properties of Soils, McGraw Hill Publishers.
2. Lambe (1951). Soil Testing in Engineering, Wiley & Sons.
3. Punmia B.C., "Soil Mechanic and Foundation Engineering", Laxmi Publication Pvt. Ltd, 2005.
4. Mandal J.N. and Divshikar D.G. (1994). Soil Testing in Civil Engineering, Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
CE258	**Hydrology and Water Resources Engineering Lab**	**----**	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's knowledge on various processes of hydrologic cycle with detail understanding of its components.	Course Objectives	CE258.1	Able to **classify** the various components of hydrologic cycle that affect the movement of water in the earth.	Understand
	To provide some knowledge about various forms of precipitations and representation of hydrological data.		CE258.2	Able to **demonstrate** the ability to perform **analysis** and representation of hydrological data.	Understand Analyse
	To develop understanding of surface yield and rainfall-runoff model.		CE258.3	Able to **develop** various techniques for measurement of precipitation and estimate abstractions from precipitation.	Apply
	To make the student understand hydrologic flood routing.		CE258.4	Able to **evaluate** yield from a catchment and **develop** rainfall-runoff model.	Evaluate Create
	To provide knowledge about ground water flow and ground water storage.		CE258.5	Able to **formulate** hydrologic flood routing model.	Create
			CE258.6	Able to **summarise** the concept of occurrence of ground water, and its movement and storage beneath the earth	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE258.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE258.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE258.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE258.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE258.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE258.6	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE258	**2**	**2.33**	**2.67**	**2.2**	**2**	**1.83**	**1.67**	**1**	**2**			**2**	**2.5**	**2.8**	**2.67**

SYLLABUS

No.	Content	Hours	COs
1	Introduction to Darcy's law	04	CE258.1, CE258.2, CE258.3, CE258.4, CE258.5, CE258.6,
2	Determination of hydraulic conductivity	02	
3	Steady flow into a well in unconfined aquifer	02	
4	Steady flow into a well in confined aquifer	02	
5	Measurement of infiltration using double ring infiltrometer	02	
6	Rainfall measurement using rain gauge	02	
7	Evaporation measurement using evaporimeter	02	
8	Analysis of rainfall data	04	
9	Analysis of evaporation data	04	
10	Viva-voce and exam	04	
	Total Hours	**28**	

Essential Readings

1. V. T. Chow, D. R. Maidment and L. W. Mays, "Applied Hydrology", McGraw Hill, 1st Edition, 1988.
2. K. Subramanya, "Engineering hydrology", McGraw Hill, 2nd Edition, 1994.

Supplementary Readings

1. V. P. Singh, "Elementary Hydrology", Englewood Cliffs, NJ : Prentice Hall, 1st Edition, 1992.
2. D. K. Tood and L. W. Mays, "Ground Water Hydrology", Wiley India Pvt. Ltd, 3rd Edition, 2004.

FIFTH SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE301	**Transportation Engineering**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO	Statement	Bloom's Taxonomy
Course Objectives	To understand the importance of transportation engineering and various characteristics of road transport.	Course Outcomes	**CE301.1**	To **demonstrate** surveys involved in planning and highway alignment	**Demonstrate**
	To study about the geometric design of highways and apply basic principles to estimate sight distances, and design horizontal and vertical alignment.		**CE301.2**	To develop an understanding for highway layout, design cross section elements, sight distance, horizontal and vertical alignment.	**Understand**
	To know about the various pavement materials and equipment available.		**CE301.3**	To evaluate the pavement material properties and suggest the suitable material and test for pavement as per requirement	**Evaluate**
	To study the design aspects and methods of flexible and rigid pavement.		**CE301.4**	To design flexible and rigid pavements as per IRC	**Design**
	To learn about various highway maintenance techniques		**CE301.5**	Able to analyze pavement failure pattern and suggest relevant maintenance techniques.	**Analyze**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE301.1	1	1	1									1	3	1	
CE301.2	1	1	2			2						1	3	2	2
CE301.3		2		2		3						2		2	
CE301.4	1			1	3							2		3	1
CE301.5	1		3	2	1		1					2	2	2	2
CE301			1.2	0.8	0.8	1	0.2					1.6	1.6	2	1

Nos	Content	Hours	COs
I	**Introduction:** Historical development of roads, Road Patterns, Surveys for highway alignment design.	**04**	**CE301.1**
II	**Highway Geometric Design**: Sight Distances analysis; Design of Horizontal Alignment:, Design of Vertical Alignment,	**10**	**CE301.2**
III	**Highway Materials and Construction**: Pavement materials and characterization, Flexible pavements, Rigid Pavements; Soil stabilization, Sustainable Pavement materials: alternate materials like RAP, Steel slag, Fly ash etc.	**11**	**CE301.3**
IV	**Pavement Design and Analysis**: Stresses and Strains in Flexible Pavement, Stresses and deflections in Rigid Pavement, design philosophies of flexible and rigid pavements, Design method as per IRC and MoRT&H. Climate-Resilient Pavement Design	**11**	**CE301.4**
V	**Highway Maintenance:** Pavement failure and critical stress condition**,** Evaluation and remedial measures; Design of overlays based on Benkelman Beam and Falling Weight Deflectometer (FWD). Pavement Management Systems (PMS),	**06**	**CE301.5**
	Total Hours	**42**	

Essential Readings

1. S.K.Khanna, C.E.G.Justo, A.Veeraragavan,"Highway Engineering", Nemchand Bros.,2022
2. Kadiyali, L.R. "Highway Engineering" Khanna Publishers,2018
3. Partha Charaborty and Animesh Das "Principles of Transportation Engineering", PHI Learning,2017

Supplementary Readings

1. Yoder E.J., and Witczak M.W, "Principles of Pavement Design", John Willey & Sons., 1975
2. Kandhal, Prithvi Singh Veeraragavan, Amirthalingam Choudhary, Rajan. "Bituminous Road Construction in India" PHI learning 2023
3. Yang H. Huang, "Pavement Analysis and Design" 2003
4. MORT& H, "Specifications of Road and Bridge Works" 2013
5. Relevant IRC codes.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE303	**Soil Dynamics and Foundation Engineering**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

To emphasize the importance of site investigations and need for engineered ground improvement

To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration

To study about the dynamic soil properties & their determination by field and laboratory tests & create an understanding about the general principles of analysis and design of machine foundation

Course Outcomes

	CO's	**Statement**	**Bloom's Taxonomy**
	CE303.1	Able to understand the concepts of subsurface exploration and generate sub-soil investigation report of real sites	Understand Generate
	CE303.2	Able to evaluate stresses underneath a soil foundation	Evaluate
	CE303.3	Able to understand different types of shallow foundations and analyse it as per their relevance in various field situations, and interpret their behaviours	Understand, Analyse Interpret
	CE303.4	Able to understand the need of pile foundations and analyse it as per their relevance in various field situations, and evaluate loads for caisson foundations	Understand Analyse Evaluate
	CE303.5	Able to understand different methods for evaluation of dynamic soil properties required for design purpose, interpret liquefaction potential of any site	Understand Evaluation Interpret
	CE303.6	Able to understand the basic concepts of ground improvement techniques and their implementation	Understand Implementation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE303.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE303.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE303.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE303.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE303.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE303.6	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**0**	**0**			**1**		**3**	**3**
CE303	1.83	2.33	2.5	2	1.83	1.67	1.83	0.75	1.5			1.83	2.6	2.8	2.67

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to subsurface exploration** Planning of subsurface exploration, methods, sampling and samplers, In situ tests – plate load test, standard penetration test, static and dynamic cone test, Vane shear test, hands on training on sub-soil investigation report making at a real site.	04	CE303.1
II	**Stresses in Soil** Boussinesq's Equation, Newmark's Chart, computation of stresses in horizontal direction as well as in vertical direction, Solving practical examples	05	CE303.2
III	**Shallow Foundations** Bearing Capacity, Terzaghi, Meyerhoff, IS code methods for determination of bearing capacity, Effect of depth of water table, eccentricity and inclination of load Bearing capacity in slopes and layered soil, Bearing capacity from in situ tests, Immediate and consolidation settlement, Correction for pore pressure, depth and rigidity, Settlement calculation from field tests, Solving practical examples	10	CE303.3
IV	**Deep Foundations** Pile load capacity, group action, settlement, negative skin friction, lateral load capacity, pile load tests, Caisson Foundations, types and selection, forces and moments, fitting of caisson, depth determination, Solving practical examples	09	CE303.4
V	**Soil Dynamics and Machine Foundation** Determination of dynamic soil properties through field tests, laboratory tests and model tests, stress-strain behaviour of cyclically loaded soils, elastic half space theory, Design Criteria for machine foundation, liquefaction concepts, Solving practical examples	07	CE303.5
VI	**Introduction to Ground Improvement Techniques** Need for engineered ground improvement, objectives of improving soil, classification of ground modification techniques; suitability, feasibility and desirability of ground improvement technique, Ground Improvement Case Histories and Advances in Practice	07	CE303.6

Total Hours	**42**	
Essential Readings		
1. Ranjan, G. and Rao, A.S.R., “Basic and Applied Soil Mechanics”, New Age International, 2022.		
2. Terzaghi K., Peck R. B. and MesriG., ”Soil Mechanics in Engineering Practice”, John Wiley & Sons, 1996.		
3. Das, B.M., "Fundamentals of Soil Dynamics", Elsevier, 1983.		
4. Kramer S., "Geotechnical Earthquake Engineering", Pearson, 1996.		
Supplementary Readings		
1. Lambe, T.W and Whitman R.V., “Soil Mechanics”, John Wiley & Sons, 1969.		
2. SARAN S., "Soil Dynamics & Machine Foundations", Galgotia Publications Pvt Ltd., 1999.		
3. Braja M. Das., “Fundamental of Foundation Engineering”, Thomson Asia Pvt. Ltd, Singapore, 10th Edition, 2023.		

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE305	**Hydraulics and Hydraulic Structures**	**----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on basics of open channel flow.	Course Objectives	CE305.1	Able to **interpret** the basics of open channel flow including types, velocity distribution and pressure distribution.	Understand
	To provide some knowledge about various methods for calculating critical flow depths in open channel flow.		CE305.2	Able to **demonstrate** the ability to perform **analysis** of critical flow.	Understand Analyse
	To develop understanding of uniform flow concept in hydraulics.		CE305.3	Able to **understand** the concept the uniform flow.	Understand
	To make the student understand about the practical problems related with gradually varied flow.		CE305.4	Able to **estimate** gradually varied flow.	Evaluate
	To provide knowledge about rapidly varied flow problems and hydraulic structures.		CE305.5	Able to **formulate** and **solve** rapidly varied flow problems.	Create Apply
			CE305.6	Able to **understand** the concept of working and **design** principles of various hydraulic structures.	Understand Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE305.1	**3**	**3**	**1**		**1**			**1**			**1**			**1**	
CE305.2	**3**	**3**	**3**												**3**
CE305.3	**3**	**3**	**3**									**1**			**3**
CE305.4	**3**	**3**	**3**	**1**				**1**				**1**	**1**		**3**
CE305.5	**3**	**3**	**3**	**2**		**2**	**3**	**1**		**2**		**1**	**1**	**3**	**3**
CE305.6	**3**	**3**	**3**	**3**		**2**	**3**			**2**				**3**	**3**
CE305	**3**	**3**	**2.67**	**2**	**1**	**2**	**3**	**1**		**2**	**1**	**1**	**1**	**2.33**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Definition and classification of open channel flows, velocity and pressure distributions, energy and momentum coefficients in open channel flow and their needs.	**2**	**CE305.1**
II	**Critical flow** Conservation of mass, conservation of momentum and conservation of energy, specific energy and specific force concepts, introduction to critical flow and computation, various methods for critical depth estimation.	**8**	**CE305.2**
III	**Uniform flow** Introduction to uniform flow, flow resistance formulas, roughness coefficient, computation of uniform flow using different methods, hydraulically most efficient channel sections, most economical channel design.	**8**	**CE305.3**
III	**Gradually varied flow** Introduction to gradually varied flow, governing equation of gradually varied flow, classification and characteristics of water-surface profiles, sketching of water-surface profiles, computation of gradually varied flow: direct-step method and standard step method, numerical methods for calculation of gradually varied flow.	**8**	**CE305.4**
V	**Rapidly varied flow** Introduction to rapidly varied flow, hydraulic jump, classification and practical application of hydraulic jump, ratio of sequent depths, height and length of jump, energy loss and jump location.	**8**	**CE305.5**
VI	**Channel design** Erodible and non-erodible channels, their design principles and various design methods.	**4**	**CE305.6**
VII	**Hydraulic structures** Introduction to hydraulic structures, different types of hydraulic structures, dam engineering, classification of dams, design of spillway, cross drainage structures.	**4**	**CE305.6**
	Total Hours	**42**	

Essential Readings

1. M. H. Chaudhry, "Open Channel Flow", Prentice Hall, 2nd Edition, 2008
2. K. G., RangaRaju, "Flow Through Open Channels", Tata McGraw Hill, 2nd Edition 1993.

Supplementary Readings

1. F. M. Henderson, "Open Channel Flow", Tata McGraw Hill, 1st Edition, 1992.

2. V.T. Chow, "Open Channel Hydraulics", Tata McGraw Hill, 3rd Edition, 2009.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE311	**Theory of Structures**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To acquire the knowledge to solve statically indeterminate structures by displacement methods	Course Outcomes	CE311.1 Able to **analyse** framed structures using classical displacement methods	**Analyse**
	To acquire the knowledge to approximately solve framed structures		CE311.2 Able to **analyse** framed structures using approximate methods of analysis	**Analyse**
	To provide the basic framework of matrix methods of structural analysis		CE311.3 Able to **analyse** statically determinate and indeterminate structures using classical matrix methods such as stiffness and flexibility methods.	**Analyse**
	To provide the basic concepts of plastic structural analysis in the understanding of different collapse mechanisms.		CE311.4 Able to **understand** the need and importance of computational structural analysis techniques such as Matrix Methods and FEM.	**Understand**
			CE311.5 Able to **understand** the importance and application of plastic methods of structural analysis	**Understand**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE311.1	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
CE311.2	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
CE311.3	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
CE311.4	**3**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
CE311.5	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**
CE311	**3**	**3**	**1**	**1**	**1.8**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Classical methods of analysis of framed Structures** Slope deflection method, Moment distribution method, Kanis Method – application to analysis of indeterminate Beams and Building frames.	**10**	CE311.1
II	**Analysis of Building Frame** Approximate Method of Analysis of Building frame subjected to gravity loads and lateral loads, Portal Method and Cantilever method.	**10**	CE311.2
III	**Matrix Methods of Structural Analysis** **I**ntroduction to Matrix Methods-Flexibility Method and displacement method. Local and global stiffness matrices, assembly, band storage, solution of resulting simultaneous algebraic equation, boundary conditions, application to beam, plane and space truss, analysis of plane frame. Brief introduction to finite element method with its principles.	**12**	CE311.3, CE311.4
IV	**Plastic Method of Structural Analysis** Concept of Redistribution of internal forces. Shape factor, combined mechanism methods for Plastic Collapse Load of beams, plastic moment distribution, deflections at point of collapse.	**10**	CE311.5
	Total Hours	**42**	

Essential Readings

1. Kassimali, Aslam, G. V. Ramana, and Germán Rojas Orozco. Structural analysis. Stamford, CT: Cengage Learning, 2015.
2. Weaver, William, and James M. Gere. Matrix analysis framed structures. Springer science & business media, 2012.
3. Wang C.K., "Intermediate Structural Analysis", Tata McGraw Hill, 2017

Supplementary Readings

1. Reddy C.S., "Basic Structural Analysis", Tata McGraw Hill, 2017
2. Pandit G.S. and Gupta S.P. "Structural Analysis - A matrix approach", Tata McGraw Hill, 2008
3. Norris C.H. Wilbur J.B. Utku S., "Elementary Structural Analysis", Tata McGraw Hill., 1948
4. Kanchi, M.B., "Matrix Methods of Structural analysis", Wiley Eastern Limited., 1993

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE313	**Disaster Management (SWAYAM course)**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To educate on various disasters, causes, and contributing factors, focusing on community-specific vulnerabilities and hazards.	**Course Outcomes**	CE313.1	Students will be able to identify and describe various types of disasters, including their causes and contributing factors.	**Knowledge** **Understanding**
	To equip with skills to develop effective response plans, covering early warnings, evacuations, rescue operations, medical response, and agency coordination.		CE313.2	Students will create detailed plans encompassing early warnings, evacuations, search and rescue procedures, medical responses, and inter-agency coordination.	Application
	To teach risk assessment techniques to identify hazards and vulnerabilities, alongside mitigation strategies like infrastructure improvements and environmental management.		CE313.3	Students will be able to identify community vulnerabilities through risk assessments and implement effective mitigation strategies, such as infrastructure enhancements and environmental management.	**Analysis**
	To stress the importance of involving communities in disaster efforts, training in engagement with diverse stakeholders for resilience building and enhanced response capabilities.		CE313.4	Students will be able to engage diverse stakeholders to foster community involvement in disaster preparedness and response. They will also facilitate capacity-building initiatives to strengthen resilience and response capabilities.	**Application**
	To focus on post-disaster recovery, emphasizing sustainable practices in livelihood restoration, infrastructure rebuilding, psychosocial support, and addressing long-term vulnerabilities.		CE313.5	Students will be able to lead sustainable recovery efforts, including assessment of damages and needs, decision-making on precautionary measures, and focusing on livelihood restoration, infrastructure rebuilding, psychosocial support, and addressing underlying vulnerabilities to reduce future risks.	**Evaluation** **Assessment** **Decision-making**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE313.1	**3**	**1**	**1**	**1**	**1**		**1**	**1**		**2**			**1**		**2**
CE313.2	**3**	**1**	**1**	**2**	**1**		**1**	**1**		**1**			**1**	**2**	**2**
CE313.3	**3**		**1**	**1**	**1**		**1**	**1**		**1**			**1**	**3**	**3**
CE313.4	**3**	**1**	**1**	**1**	**1**		**1**	**1**		**1**			**1**	**3**	**3**
CE313.5	**3**	**1**	**1**	**1**	**1**		**1**	**1**		**2**			**1**	**3**	
CE313	**3**	**1**	**1**	**1.2**	**1**		**1**	**1**		**1.4**			**1**	**2.75**	**2.5**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction on Disasters**: Understanding the concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.	**05**	**CE313.1**
II	**Types, Trends, Causes and Consequences of Disasters:** Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.	**08**	**CE313.2**
III	**Disaster Management Cycle and Framework:** Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.– Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment.	**07**	**CE313.3**
IV	**Disaster Management in India:** Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies.	**07**	**CE313.4**

V	**Applications of Science and Technology for Disaster Management:** Geo-informatics in Disaster Management, Disaster Communication System (Early Warning and Its Dissemination), Land Use, Planning and Development, Regulations, Disaster Safe Designs and Constructions, Structural and Non Structural Mitigation of Disasters, S&T Institutions for Disaster Management in India. Study of Recent Disasters (at local, state and national level) And Preparation of Disaster Risk Management Plan of an Area or Sector Role of Engineers in Disaster Management.	**08**	**CE313.4**
VI	**Community Engagement, Recovery, and Reconstruction** Importance of community involvement in disaster management, Stakeholder analysis and engagement strategies, Building partnerships with government agencies, NGOs, and local communities for effective response and recovery, Post-disaster needs assessment for informed recovery planning, Implementing livelihood restoration initiatives to sustain communities, Infrastructure rebuilding strategies to enhance resilience, Providing psychosocial support and trauma counseling for affected individuals and communities	**07**	**CE313.5**
Total Hours		**42**	

Essential Readings

1. Pandey, M., “Disaster Management”, Wiley India Pvt. Ltd., 2014

2. J. P. Singhal, “Disaster Management”, Laxmi Publications., 2019

3. M. C. Gupta, “Manual on natural disaster management in India”, NIDM, New Delhi. Latest edition

Supplementary Readings

1. H. N. Srivastava & G.D. Gupta, “Management of Natural Disasters in developing countries”, Daya Publishers.2006

2. Singh, J., “Disaster Management: Future Challenges and Opportunities”, K W Publishers Pvt. Ltd., 2013

3. Bhattacharya, T., “Disaster Science and Management” McGraw Hill Education (India) Pvt. Ltd., 2017

4. Coppola D. P., “Introduction to International Disaster Management”, Elsevier Science (B/H).2020

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation **2024-25**
Department	**Civil Engineering**	Semester **V**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE315	**Modern Indian Architecture**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To study evolution of modern architecture in India from pre-independence to the present time. This evolution will be seen through various modern trends and building typologies. To explain the concept of different architectural solutions within the limitations imposed by prevalent social and religious customs, available building materials, climate of region, topography, complex structural problems, technology available at that time period.	CE315.1	Able to understand and summarize various Architectural and aesthetical philosophies and concepts.	Understand Summarize
Course Outcomes		CE315.2	Able to understand and relate the architecture from pre-independence to the present time.	Understand Relate
		CE315.3	Able to understand Modern and Contemporary Architecture based on study of literature and existing buildings to apply design parameters, principles, processes.	Understand Apply
		CE315.4	Able to understand Critical Regionalism to define the constructive aspects of Indian architecture.	Understand Define
		CE315.5	Able to understand and relate the relationship of modern architecture with social-cultural developments	Understand Relate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE315.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE315.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE315.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE315.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE315.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE315	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Introduction: Effect of industrialization and development of modern Indian architecture. Review of the development of Architecture on global level related to all influencing factors regarding evolution of styles. Movement of Modernism including various Architectural and aesthetical philosophies and concepts.	03	CE315.1
II	Pre-Independence, Pre-Independence to Independence, Revivalism, The First Generation 1945 – 1970 Impact of Western Architects: Le Corbusier, Louis I. Kahn and Walter Gropius	09	CE315.2
III	Communication and Interpretations of Modern and Contemporary Architecture based on study of literature and existing buildings to understand design parameters principles process, methods, and programme-formulation for design.	11	CE315.3
IV	Introduction to Critical Regionalism, Critical Regionalism: Climate Responsive Perspective and other contexts, Structure in Modern Indian Architecture, Points-Blocks and High-Rises, Housing in India, Women in Modern Indian Architecture	12	CE315.4
V	Relationship of modern architecture with social-cultural developments. Relationship of modern architecture with modern Arts. Introduction to Non-conventional architectural trends — bio mimicry, intelligent buildings, nano architecture, deconstruction etc	07	CE315.5
	Total Hours	**42**	

Essential Readings

1. Radford, A., Srivastava, A., & Morkoc, S. (2020). The elements of Modern Architecture: Understanding contemporary buildings (2nd ed.). Thames & Hudson.

2. Rewal, R., Frampton, K., & Ozkan, S. (2022). Raj Rewal: innovative architecture and tradition (1st ed.). Om books International.

3. Shah, J. (2008). Contemporary Indian architecture. Roli books.

Supplementary Readings

1. Kenneth Frampton, Modern Architecture: A Critical History, Thames & Hudson, London, 1994

2. Manfredo Tafuri, Modern Architecture, Harry N. Abrams Inc., 1980.

3. Gossel, P.and Ieuthauser, G. (2005). Architecture in the twentieth century (2nd us (slipcase, 2 vols) ed.). Taschen.

	National Institute of Technology Meghalaya An Institute of National Importance								CURRICULUM
Programme	**Bachelor of Technology**						Year of Regulation		**2024-25**
Department	**Civil Engineering**						Semester		**V**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE317	**Smart Geotechnology**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's knowledge on basics of soil foundation interaction analysis in line with relevant codal provisions	CE317.1	Able to illustrate a basic background of stress and displacement of soil, scope of soil foundation interaction analysis	Illustrate
	To make the students aware of the Finite Element Techniques applied on actual field problems in Geotechnical Engineering	CE317.2	Able to appraise different codal provisions for field tests in soil mechanics	Appraise
		CE317.3	Able to apply the FE analysis on actual problem to evaluate induced displacements, forces, stresses and strains	Apply Evaluate
	To make the student capable of modelling real-life problems in Geotechnical Engineering using real-time data collection and big-data analysis involving AI/ML tools	CE317.4	Able to plan suitable instrumentation required for describing the behaviour of structure in soils and rocks	Plan Describing
		CE317.5	Able to solve the real-life problems in Geotechnical Engineering using real-time data collection and big-data analysis involving AI/ML tools	Solve

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE317.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE317.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE317.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE317.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE317.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE317	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Introduction to soil – stresses and displacement in soils, Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil-foundation interaction analysis	05	CE317.1
II	**Interpretations and codal provisions:** Soil profiling, interpretation of exploration data and report preparation, various standards for soil investigations.	05	CE317.2
III	**FE analysis in geotechnical engineering:** Applications: In situ earth pressure, Construction and excavation sequences, Slope stability analysis (c-φ reduction), Seepage, Consolidation, Settlement analysis, Introduction to Dynamic consideration. Use of structural elements in Geotechnical systems.	14	CE317.3
IV	**Instrumentations in Geotechnology**: Types of instruments used for Measurement of water table, pore pressure, LVDT, dial gauges, pressure gauges, non-contact-based settlement measurements	05	CE317.4
V	**AI/ML Based Applications in Geotechnical Engineering:** Data Collection, Data Management, Big data, taxonomy of machine learning algorithms, Supervised Learning: Classification – Bayesian Classifier, K-nearest neighbors, Regression- Linear Regression, Multivariate Regression, Logistic regression. Support Vector Machine (SVM) Algorithm. Unsupervised Learning: Clustering- K-means clustering algorithm and Hierarchical clustering algorithm. Reinforcement Learning: Q-Learning algorithm. Rainfall-runoff modelling, Climate change monitoring, Soil liquefaction, forecasting foundation related parameters, Collection of sensor data and storing to Database, Cloud computing.	13	CE317.5
	Total Hours	**42**	

Essential Readings

1. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geotechnics (7th Edition), Prentice Hall, 2014.
2. Reddy JN, An Introduction to the Finite Element Method, McGraw-Hill, New Delhi, 2005.
3. Puzrin, A. M. (2012). Constitutive Modelling in Geomechanics: Introduction, Springer-Verlag, Berlin.
4. Machine Learning using Python, by Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019.

Supplementary Readings

1. Zienkiewicz OC, Taylor RL and Zhu JZ, The Finite Element Method Its Basis and Fundamentals, Elsevier, Amsterdam, 2014.
2. Nakai, T. (2013). Constitutive Modeling of Geomaterials: Principles and Applications, CRC Press, Boca Raton.
3. Clayton, C. R. I., Matthews, M. C. and Simons, N. E. (1995) Site Investigation (Second Edition). Oxford, Blackwell Sciences.

	National Institute of Technology Meghalaya An Institute of National Importance								CURRICULUM
Programme	**Bachelor of Technology**				Year of Regulation				**2024-25**
Department	**Civil Engineering**				Semester				**V**
Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution		
			L	T	P	C	INT	MID	END	Total
CE371	**Waste Management**	**-----**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives	Understand the types and impacts of solid waste, including municipal, industrial, and hazardous waste, on the environment and public health.	**Course Outcomes**	**CO's**	**Statement** / **Bloom's Taxonomy**
	Develop skills in designing, operating, and managing solid waste management systems, covering collection, transportation, treatment, and disposal.		**CE371 .1**	Students will acquire **knowledge** and demonstrate the ability to identify and classify different types of solid waste, understand their sources, and assess their environmental and public health impacts. — **Knowledge**, **Analysis**
	Analyse local, national, and international regulatory frameworks and policies for solid waste management and comprehend the roles of government agencies and stakeholders.		**CE371.2**	Students will be able to acquire skills to design, implement, and manage effective solid waste management systems, including collection, transportation, treatment, and disposal methods. — **Synthesis**, **Application**
	Evaluate the social, economic, and environmental effects of various solid waste management approaches on communities, ecosystems, and resource conservation.		**CE371.3**	Students will be able to analyze and interpret regulatory frameworks and policies related to solid waste management at various levels (local, national, international), and assess their implications on waste management practices. — **Analysis**
	Explore innovative technologies and strategies for waste minimization, recycling, resource recovery, and circular economy principles to promote sustainable solid waste management practices and mitigate environmental impacts.		**CE371.4**	Students will be able to evaluate the social, economic, and environmental outcomes of solid waste management strategies, including their effects on communities, ecosystems, and sustainable resource use. — **Evaluation**
			CE371.5	Students will understand, **design**, and implement innovative technologies and strategies for waste minimization, recycling, resource recovery, and circular economy principles in real-world waste management scenarios, emphasizing sustainability and environmental impact reduction — **Design**, **Implementation**

No. COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE371 .1	**2**	**2**	**3**	**2**	**3**		**3**	**2**	**1**	**2**	**2**	**2**	**3**	**2**	**3**
CE371.2	**3**	**3**	**3**	**3**	**3**		**3**	**1**	**1**	**1**	**3**	**2**	**3**	**2**	**2**
CE371.3	**3**	**3**	**3**	**3**	**2**		**3**		**1**		**3**		**2**	**2**	**3**
CE371.4	**2**	**2**	**2**	**2**	**1**		**3**	**1**	**1**	**2**	**2**	**2**	**1**	**1**	**1**
CE371.5	**1**	**1**	**1**	**1**	**1**		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CE371	**2.2**	**2.2**	**2.4**	**2.2**	**2**		**2.6**	**1.25**	**1**	**1.5**	**2.2**	**1.75**	**2**	**1.6**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Solid Waste Management:** Definition and types of solid waste, Origin, Overview of the solid waste management hierarchy (reduce, reuse, recycle, dispose), Importance of proper solid waste management for public health and environmental protection, generation rates and composition; physical, chemical, biological and thermal characteristics.	**04**	**CE371.1** **CE371.2**
II	**Waste Generation and Characterization** Factors influencing waste generation rates,Methods for waste characterization (composition studies, waste audits), Understanding the composition and characteristics of different types of solid waste (municipal, industrial, hazardous, etc.)	**05**	**CE371.2** **CE371.3**
III	**Waste Collection and Transportation** Principles and practices of waste collection systems (curbside pickup, centralized collection, etc.), storage, Transportation, Treatment / processing, final disposal techniques, Equipment and vehicles used in waste collection and transportation Optimization of collection routes and schedules for efficiency and cost-effectiveness	**06**	**CE371.3** **CE371.4**
IV	**Landfill Design, Operation, Closure, and Waste Minimization** Principles of landfill siting and design, including liner systems, leachate collection, and gas management, Landfill operation and maintenance practices, Closure and post-closure care requirements for landfills, Strategies for waste minimization at the source, encompassing reduce, reuse, and recycle approaches, Overview of resource recovery options, such as energy recovery and material recovery, Case studies of successful waste minimization and resource recovery initiatives.	**05**	**CE371.3** **CE371.4**
V	**Waste Regulations, Policy, Impacts, and Emerging Trends** Overview of national and international waste management regulations, Role of government agencies in waste management oversight and enforcement, Compliance requirements and implications for waste generators, handlers, and processors, Socio-economic implications of poor waste management practices, Environmental impacts of different waste management approaches, Cost-benefit analysis of solid waste management options, Innovations in waste management technologies (smart waste bins, sensor-based monitoring systems, etc.), Circular economy principles and their application to waste management, Future directions and challenges in sustainable solid waste management.	**08**	**CE371.4** **CE371.5**
Total Hours		**28**	

Essential Readings

1. Tchhobanoglous, G., Theisen and Vigil, "Solid Waste Management: Engineering Principles and Management issues", ,McGraw Hill.2009

2. Peavy, H. S., Rowe, D. R. and Tchhobanoglous, G,."Environmental Engineering", McGraw Hill International Ed., 2009
3. Vesilind, P. A., Worrell, W. A. and Reinhart,D. R., "Solid Waste Engineering", Thomson Brooks/Cole., 2012
4. Wentz, C. A., "Hazardous Waste Management" , McGraw Hill., 1989

Supplementary Readings

1. John Pichtel, "Waste Management Practices: Municipal, Hazardous and Industria", CRC Press, Taylor and Francis Group., 2014
2. LaGrega, M.D. Buckingham, P.L. and Evans, J.C., "Hazardous Waste Management", McGraw Hill. 2010
3. Richard J. Watts, "Hazardous Wastes - Sources, Pathways, Receptors", John Wiley and Sons, New York.2011
4. Manual on municipal solid waste management. Central Public Health and Environmental Engineering Organization, CPHEEO, New Delhi. http://www.indiawaterportal.org/articles/manual-municipal-solid-wastemanagement-cpheeo-moud

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE351	**Transportation Engineering 1 Lab**	**Nil**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

Course Objectives	To carry out tests on construction materials for their suitability to be used in pavement constructions.	Course Outcomes	**COs**	**Statement** / **Bloom's Taxonomy**
	To identify and classify the pavement materials into different groups according to their characteristics.		**CE351.1**	To Evaluate pavement structures. — Evaluate
	To understand and monitor quality control of pavement material and mixes		**CE351.2**	Differentiate pavement materials for use in highways, airports and railways. — Differentiate
	To invigilate quality checks and prepare testing report related to transportation engineering		**CE351.3**	Students will understand the details of bituminous mix design and testing of samples — Understand
	To make the students understand the various testing protocols for pavement materials as per relevant standard codes		**CE351.4**	Students will be able to prepare and evaluate the testing reports related to highway engineering works. — evaluate
			CE351.5	Students will develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes. — understanding

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CE351.1	**3**	**3**	**3**									**2**	**3**	**3**	**1**
	CE351.2	**3**	**3**	**3**			**1**	**1**					**1**	**3**	**3**	**1**
	CE351.3	**3**	**2**	**1**										**1**	**3**	**2**
	CE351.4	**3**	**3**	**2**				**2**						**1**	**3**	**1**
	CE351.5			**1**		**1**		**2**					**1**	**1**	**2**	**3**
	CE 351	**2.4**	**2.2**	**2**		**0.2**		**1**					**0.8**	**1.8**	**2.8**	**1.6**

SYLLABUS

No.	Content	Hours	COs
1.	Atterberg Limit Test	01	
2.	Proctor Density Test	02	
3.	California Bearing Ratio Test	02	
4.	Impact test of Aggregates	02	
5.	Aggregate crushing value test	01	
6.	Elongation and Flakiness index test	01	
7.	Water absorption and Specific Gravity of Aggregates	01	**C351.1**
8.	Bitumen Penetration test	01	**C351.2**
9.	Ductility test of bitumen	01	**C351.3**
10.	Softening point test	01	**C351.4**
11.	Flash and fire point test	02	**C351.5**
12.	Stripping test of aggregates	01	
13.	Gradation of aggregates for flexible pavement	02	
14.	Marshal Mix design method for bituminous mixes	02	
	Total Hours	**20**	

Essential Readings

1. Venkatappa, G. R, Ramachandra, K. R, Kaushik, P, Bhavanna, D.V. R, "Highway Material Testings and Quality Control" Dreamtech Press 2019

2. Khanna, S.K. and Justo, "Highway Engineering", C.E.G.,Nemchand Bros 2022

Supplementary Readings

1. MORT& H, "Specifications of Road and Bridge Works",. 2013

2. Harold, N. A., "Highway Materials, Soil and Concrete", Prentice Hall, 2004

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Department of Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution		
			L	T	P	C	INT	Continuous Assesment	Total
CE353	**Soil Dynamics and Foundation Engineering Lab**	**……**	**0**	**0**	**2**	**1**		**Experiment, Quiz**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To familiarize the students with the analysis of the various test methodologies for evaluating the soil shear strength both under laboratory and field conditions.	Course Outcomes	CE353.1	Able to understand and evaluate the shear strength parameters of given soil using various laboratory investigations	Understand Evaluate
			CE353.2	Able to understand and evaluate the settlement calculations and consolidation properties of soil	Understand Evaluate
			CE353.3	Able to understand and analyse real life geotechnical problems with the help of site visits and field tests	Understand Analyse
	To develop ability and skill for analysing Geotechnical Engineering related issues using computational techniques		CE353.4	Able to evaluate the California bearing ratio of the soil and to implement the concepts on the strength of the subgrade of a road or other paved area	Evaluate, Implement
			CE353.5	Able to use suitable computer software to analyse and interpret Geotechnical Engineering related problems	Analyse Interpret

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE353.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE353.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE353.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE353.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE353.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE353	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Determination of Shear strength parameters using direct shear tests and tri-axial tests	**4**	**CE353.1**
II	Determination of the soil's consolidation properties by conducting oedometer test.	**4**	**CE353.2, E353.4**
III	Standard penetration test (SPT) / Dynamic cone penetration test (DCPT), Static cone penetration test (SCPT), Report based on the field visit.	**5**	**CE353.3, CE353.4**
IV	Determination of the California bearing ratio by conducting a load penetration test in the laboratory.	**4**	**CE353.3, CE353.4**
V	Use of suitable computer software for analysis and design of sub-structure, stability of slopes, retaining structure or any other Geotechnical Engineering related problems.	**5**	**CE353.5**
	Total Hours	**22**	

Essential Readings

1. Ranjan, G and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age International, 2022.
2. Terzaghi K., Peck R. B. and Mesri G., "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1996.
3. SP 36 (Part-II): 1987 Compendium of Indian Standard on Soil Engineering: Part-I & II (Laboratory & Field) testing of soils Civil Engineering purposes.

Supplementary Readings

1. Kaniraj S.R.,"Design Aids in Soil Mechanics & Foundation Engineering", Tata McGraw Hill, 1988.
2. Lambe T.W and Whitman R.V., "Soil Mechanics", John Wiley & Sons, 1969.
3. Punmia B.C., "Soil Mechanic and Foundation Engineering", Laxmi Publication Pvt. Ltd, 2015.
4. Braja M. Das., "Fundamental of Foundation Engineering", Thomson Asia Pvt. Ltd, Singapore, 10th Edition, 2023.
5. Bardet J., "Experimental soil mechanics", Upper Saddle River, Prentice Hall, USA, 1997.
6. Liu, C. and Evett, J. B. , "Soil properties: testing, measurement and evaluation", Upper Saddle River, Prentice Hall, USA, 2008.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE355	**Hydraulics and Hydraulic Structures Lab**	**----**	**0**	**0**	**2**	**1**	**Experiment, Quiz, Viva**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on basics of open channel flow.	Course Objectives	CE355.1	Able to **interpret** the basics of open channel flow including types, velocity distribution and pressure distribution.	Understand
	To provide some knowledge about various methods for calculating critical flow depths in open channel flow.		CE355.2	Able to **demonstrate** the ability to perform **analysis** of critical flow.	Understand Analyse
	To develop understanding of uniform flow concept in hydraulics.		CE355.3	Able to **understand** the concept the uniform flow.	Understand
	To make the student understand about the practical problems related with gradually varied flow.		CE355.4	Able to **estimate** gradually varied flow.	Evaluate
	To provide knowledge about rapidly varied flow problems and hydraulic structures.		CE355.5	Able to **formulate** and **solve** rapidly varied flow problems.	Create Apply
			CE355.6	Able to **understand** the concept of working and **design** principles of various hydraulic structures.	Understand Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE355.1	**3**	**3**	**1**		**1**			**1**			**1**			**1**	
CE355.2	**3**	**3**	**3**												**3**
CE355.3	**3**	**3**	**3**									**1**			**3**
CE355.4	**3**	**3**	**3**	**1**				**1**				**1**	**1**		**3**
CE355.5	**3**	**3**	**3**	**2**		**2**	**3**	**1**		**2**		**1**	**1**	**3**	**3**
CE355.6	**3**	**3**	**3**	**3**		**2**	**3**			**2**				**3**	**3**
CE355	**3**	**3**	**2.67**	**2**	**1**	**2**	**3**	**1**		**2**	**1**	**1**	**1**	**2.33**	**3**

SYLLABUS

No.	Content	Hours	COs
1	Calibration of flow channel	04	**CE355.1** **CE355.2** **CE355.3** **CE355.4** **CE355.5** **CE355.6** **CE355.6**
2	Determination of roughness coefficient of an experimental flume	02	
3	To determine the specific energy, Critical depth and plot the specific energy curve	02	
4	To determine the coefficient of a crump weir & broad crested weir	02	
5	To determine the coefficient of a sharp crested weir & ogee weir	02	
6	Determination of sequent depths in a hydraulic jump	02	
7	Comparison of experimental and computed Gradually Varied flow profile	02	
8	To determine the coefficient of discharge of a Venturi flume	02	
9	Flow under a sluice gate	02	
10	Viva-voce and exam	04	
Total Hours		**24**	

Essential Readings

1. M. H. Chaudhry, "Open Channel Flow", Prentice Hall, 2nd Edition, 2008
2. K. G., RangaRaju, "Flow Through Open Channels", Tata McGraw Hill, 2nd Edition 1993.

Supplementary Readings

1. F. M. Henderson, "Open Channel Flow", Tata McGraw Hill, 1st Edition, 1992.

2. V.T. Chow, "Open Channel Hydraulics", Tata McGraw Hill, 3rd Edition, 2009.

SIXTH SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE302	**Reinforced Concrete Design**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To introduce the design philosophies of various methods of design.
- To carry out the analysis of reinforced concrete elements.
- To undertake design of various reinforced concrete elements by working stress and limit state method.
- To introduce to codal provisions of IS 456, SP 16, SP 34 and IS:13920.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE302.1	Able to design and **analysis** of reinforced concrete structures and use Working Stress Method (WSM) in the design and analysis of RCC beams in bending.	Analysis
CE302.2	Able to **analyse** differentiate between WSM and LSM and Apply Limit State Method (LSM) in the design and analysis of RCC beams in bending.	Analyse
CE302.3	Able to **evaluate** the behaviour of RCC beams in shear and torsion and their design using LSM.	Evaluate
CE302.4	Able to **analyse** and design one-way and two-way slab and Use LSM in Design of one-way and two-way slab in shear, bending and torsion.	Analyse
CE302.5	Able to **understand** various assumptions used in design of columns, evaluate effective length and slenderness ratio of column and analyse and design a short column under axial load, and uni-axial and bi-axial bending.	Understand
CE302.6	Able to design rectangular and square footing.	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE302.1	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**3**
CE302.2	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**2**
CE302.3	**2**	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**
CE302.4	**2**	**2**	**3**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**2**	**3**	**2**
CE302.5	**2**	**2**	**2**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**3**	**3**	**3**
CE302.6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CE302	**2.0**	**2.0**	**1.2**	**0.5**	**1.0**	**0.8**	**1.0**	**0**	**1.3**	**0**	**0**	**0.3**	**1.8**	**1.5**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction To Various Design Philosophies** Design of Rectangular Singly and doubly Reinforced Sections by Working Stress Method, Limit State Method, Design and analysis of T-Beams, L-Beams by Limit State Design Method.	5	CE302.1
II	**Behaviour of RC Beam in Shear** Shear Strength of Beams with and without Shear Reinforcement, Minimum and Maximum Shear Reinforcement, Design of Beam in Shear, Development Length, Anchorage Bond, Flexural Bond, Failure of Beam Under Shear, Concept of Equivalent Shear and Moments.	12	CE302.2 CO3
III	**Design of Slab** Design of One Way and Two-Way Solid Slabs, Circular Slab by Limit State Design Method, Serviceability, Control of Deflection, Cracking and Vibrations. Introduction to Flat Slabs	6	CE302.3 CE302.4
IV	**Design Of Columns** Limit State Design Method, Effective Height of Columns, Minimum Eccentricity, Short Column Under Axial Compression, Requirements for Reinforcement, Column with Helical Reinforcement, Short Column Under Axial Load and Uni-Axial Bending, Design of Columns Under Bi-Axial Loading by Design Charts.	13	CE302.4 CE302.5
V	**Design Of Footing** Rectangular and square isolated and combined footing.	6	CE302.5 CE302.6
	Total Hours	**42**	

Essential Readings

1. Dayaratnam P. Limit State Design of Reinforced Concrete Structures New Delhi: Oxford Publishers;2008
2. GambhirM.L Fundamentals of Reinforced Concrete Design New Delhi: PHI Publisher; 2009.

Supplementary Readings

1. IS: 456:2000 Plain and Reinforced Concrete - Code of Practice New Delhi: Bureau of Indian Standards.
2. Krishna Jai Plain and Reinforced Concrete Vol.1 Roorkee: Nem Chand Brothers;2007.
3. Jain A.K. Reinforced Concrete: Limit State Design Roorkee: Nem Chand and Brothers; 2007.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE304	**Design of Steel Structures**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO`s	**Statement**	**Bloom`s Taxonomy**
Course Objectives	1. To introduce steel structures and its basic components	Course Outcomes	CE304.1	Able to **understand** and **identify** the basic elements of a steel structures	Understand Identification
	2. To introduce structural steel fasteners like welding and bolting		CE304.2	Able to **identify** and **analyse** structural steel fasteners	Identification Analyze
	3. To design tension members, compression members, beams and beam-columns		CE304.3	Able to **design** and **determine** basic elements of steel structure like tension members, compression members	Design Determine
	4. To design column splices and bases		CE304.4	Able to **design** and **determine** basic elements of steel structure like beams and beam-columns	Design Determine
			CE304.5	Able to **design** and **evaluate** column splices and bases.	Design Evaluate

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CE304.1	3	1	1									2		3	2
2	CE304.2	3	3	2	2								2		3	2
3	CE304.3	3	3	2	2								2		3	2
4	CE304.4	3	3	2	2								2		3	2
5	CE304.5	3	3	2	2								2		3	2
CE304		**3.0**	**2.6**	**1.8**	**1.6**								**2**		**3.0**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Types of Structural Steel, Mechanical Properties of Steel, Types of Structural Steel, Mechanical Properties of Steel, Cold Work and Strain Hardening, Advantages of Steel as a Structural Materials, Types of Steel Structures, Codes and Specifications.	02	CE304.1
II	**Design Approach** Factor of Safety, Permissible and Working Stresses, Elastic Method, Plastic Method, Introduction to Limit States of Design	02	CE304.1
III	**Connections** Type of Connections, Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Modes of Failure of a Riveted Joint, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, Design of Eccentric Connections.	07	CE304.2
IV	**Tension Members** Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of Member Subjected to Axial Tension and Bending.	08	CE304.3
V	**Compression Members** Modes of Failure of a Column, Buckling Failure:Euler'sTheory,EffectiveLength, Slenderness Ratio,Design Formula: I.S. Code Formula, Design of Compression Members, Design of Built-Up Compression Members: Laced and Battened Columns.	08	CE304.3
VI	**Beams** Design Procedure, Built-Up Sections, Plate Thickness, Web Crippling, Web Buckling, Connections nd Curtailment of Flange Plates	07	CE304.4
VII	**Beam-Column** Eccentricity of Load, Interaction Formulae, Design Procedure, Eccentrically Loaded Base Plates.	04	CE304.4
VIII	**Column Base** Design of base plates, load transfer mechanism, design of slab base, gusseted base and anchorage	04	CE304.5
Total Hours		**42**	

Essential Readings

1. Subramanian, N.,"Design of Steel Structures", Oxford University Press, 2018.
2. Negi, L. S., "Design of Steel Structures", Tata McGraw Hill, 2017.
3. M.R.Shiyekar Limit state design of steel structures, PHI Learning,2010.

Supplementary Readings

1. Raz, S. A., "Structural Design in Steel", New Age International Publisher, 2002
2. Edwin, M., Gaylord, J., and Stallmeyer, J. E., "Design of Steel Structures", McGraw-Hill, 1991.
3. Dayaratnam, P., "Design of Steel Structures", Chand S. & Co., 2012.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE312	**Fluid Dynamics and Hydraulic Machines**	**----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce the student to the fundamentals of fluid dynamics giving emphasis on the different laws and principles of viscous flow and turbulent flow.	Course Objectives	CE312.1	Able to **summarise** the basic competence in viscous flow dynamics.	Understand
	To understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbines.		CE312.2	Able to **analyse** the turbulent flow behaviour of fluids.	Analyse
			CE312.3	Able to **understand** the concept of boundary layer theory.	Understand
	To formulate and analyze problems related to calculation of forces in fluid structure interaction.		CE312.4	Able to **develop** and **deduce** the forces on submerged bodies.	Apply Evaluate
			CE312.5	Able to **analyse** and **design** various hydraulic machines.	Analyse Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE312.1	**3**	**3**					**3**							**3**	**1**
CE312.2	**3**	**3**					**3**						**2**	**3**	**3**
CE312.3	**2**	**1**	**1**				**2**							**2**	**1**
CE312.4	**3**	**3**					**1**						**3**	**3**	**2**
CE312.5	**3**	**3**	**3**				**3**						**1**	**3**	**3**
CE312	**2.8**	**2.6**	**2**				**2.4**						**2**	**2.8**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Dynamics of Viscous Flows** Viscosity- dynamic and kinematic, Navier Stoke equation, plane Poiseuille flow and its application, Couette flow, Hagen Poiseuille flow, kinetic energy and momentum correction factor, determination of co-efficient of viscosity.	**2**	**CE312.1, CE312.2, CE312.3**
II	**Turbulent Flow** Classification of turbulence, Reynolds stresses, Eddy viscosity, Prandtl mixing length theory, velocity distribution over smooth and rough surfaces, continuity equation for turbulence flow, Reynolds Navier-stockes equation.	**8**	**CE312.3**
III	**Boundary Layer Theory** Boundary layer thickness-displacement, momentum and energy thickness, laminar sub-layer, Von-Karman integral momentum equation, turbulent boundary layer over a flat plate, separation of boundary layer.	**8**	**CE312.3**
IV	**Forces on Submerged Bodies** Force exerted by flowing fluid on a stationary body-drag and lift, drag on a sphere, terminal velocity, lift on a circular cylinder, stagnation point, magnus effect, lift on an airofoil.	**8**	**CE312.4**
V	**Impact of Jet and Hydraulic Machines – Turbines** Impact of jet on stationary plane and curved surface, impact of jet on hinged surface, impact of jet on moving surface, jet propulsion. Classification of turbines, head and efficiency of a turbine, Pelton wheel, radial flow impulse turbine, Kaplan turbine, mixed flow turbine, surge tank, performance of hydraulic turbine, unit quantities, specific speed.	**8**	**CE312.5**
VI	**Centrifugal and Reciprocating Pumps** Working principle of centrifugal pump, efficiency, minimum starting speed, multi stage pump, characteristic curve, maximum suction lift, cavitation. Working principle of reciprocal pump, slip of reciprocating pump, variation of velocity and acceleration, maximum speed of the rotating crank, air vessels.	**8**	**CE312.5**
Total Hours		**42**	

Essential Readings

1. S. K. Sam, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", McGraw Hill Education. 2012
2. C. S. P. Ojha, R. Berndtsson and P. N. Chandramouli, "Fluid Mechanics and machinery", Oxford University Press, 2010

Supplementary Readings

1. C. Pozrikidis, "Introduction to Theoretical and Computational Fluid Dynamics", Oxford University Press., 2011
2. B. F. White, "Fluid Mechanics", McGraw Hill. 2015
3. J. Frabzini, "Fluid Mechanics with Engineering Applications", McGraw Hill Education.2002

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE314	**Construction methods and equipment management**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	Understand the factors influencing equipment selection and the planning process for equipment utilization.		CE314.1	Able to **understand** the factors influencing equipment selection and effectively **plan** equipment utilization for construction projects.	**Understand, Plan**
	Estimate the ownership and operating costs of construction equipment using various methods.		CE314.2	Capable of **estimating** ownership and operating costs of construction equipment **using** various methods, including the Average Annual Investment and Time value methods.	**Estimating, Using**
	Analyze equipment life and replacement strategies, considering economic and operational factors.		CE314.3	Proficient in **analyzing** equipment life and replacement strategies based on economic considerations, utilizing methods such as economic life determination and equivalent annual cost calculation.	**Using**
	Explore the engineering fundamentals of moving earth and operating earthmoving and excavating equipment.		CE314.4	Competent in **assessing** machine performance and **applying** engineering fundamentals to **operate** and **estimate** production of earthmoving and excavating equipment.	**Assessing, Applying, Operate, Estimate**
	Examine different types of piles, pile driving equipment, lifting equipment, and concreting equipment used in construction projects.		CE314.5	Able to **identify** different types of piles and pile driving equipment, and **analyze** factors affecting pile hammer selection and production estimation.	**Identify, Analyze**
	Develop practical skills in estimating production, productivity, and balancing interdependent machines in construction operations .		CE314.6	Skilled in **understanding** the operation and lifting mechanisms of various types of cranes, and capable of **applying** range diagrams to **determine** lifting capacity.	**Understanding, Applying, Determine**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE314.1	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314.2	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314.3	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314.4	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314.5	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314.6	3	3	2	3	2	2	3	1	1	1	1	2	1	3	3
CE314	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction and Planning Process of Equipment:** Factors affecting equipment selection, Planning equipment utilization, Equipment utilization chart.	**03**	CE314..1
II	**Cost of Owning and Operating Construction Equipment:** ***Estimation of Ownership cost (Average Annual Investment method):*** Elements of ownership cost, Depreciation accounting methods, Cost Estimation using Average Annual Investment method. ***Estimation of Ownership cost (Time value method):*** Use of compounding factors in Equipment cost estimation based on time value method. ***Operating cost of Equipment:*** Operating cost components, Illustrations on estimation of operating cost. ***Equipment cost estimation:*** Caterpillar & Peurifoy method – Illustrations on use of Caterpillar method and Peurifoy method for estimation of total equipment cost.	**08**	CE314.2
III	**Equipment Life and Replacement Analysis:** ***Equipment Life and Replacement Analysis (Part 1):*** Physical life, Profit life, Economic life, Illustrations on determination of economic life of equipment. ***Equipment Life and Replacement Analysis (Part 2)***: Equipment Replacement analysis- Intuitive method, Minimum cost method, Maximum profit method. ***Equipment Life and Replacement Analysis (Part 3)***: Determination of economic life based on equivalent annual cost (using time value concept).	**08**	CE314.3

IV	**Engineering Fundamentals of Moving Earth:** ***Engineering Fundamentals of Moving Earth:*** Machine Performance-Required power, Available power, Usable power, Rolling resistance, tractive force, co-efficient of traction, Effect of grade on tractive effort, Effect of altitude on performance of IC engines, Performance chart, ways to define payload of equipment. ***Earthmoving and Excavating equipment:*** *Bull Dozers: Bull Dozers-Types of dozer blades, blade adjustments, Blade performance, production estimation. Scrapers (Part 1): Scrapers, Scraper operation, types of scraper, Components of production cycle of scraper and pusher. Scrapers (Part 2): Illustrations on production estimation of scraper and balancing interdependent machines.* *Front End loaders: Front-End loaders –loader attachments, productivity estimation. Excavators: Excavators-Front shovels and backhoes, operation, factors affecting selection, production estimation. Trucks: Production cycle, cycle time estimation, Productivity of trucks, balancing interdependent machines.*	**08**	CE314.4
V	**Piles and Pile driving equipment:** ***Piles and Pile driving equipment (Part 1):*** Pile types: Precast and cast in situ piles, pile hammers, principle of pile hammer, factors affecting pile hammer selection. ***Piles and Pile driving equipment (Part 2):*** Types of pile hammer: Drop hammer, Single acting and double acting steam hammers, Diesel hammers, Vibratory pile drivers.	**05**	CE314.5
VI	**Lifting equipment:** ***Cranes (Part 1):*** Cranes, Crane motions, Principles of lifting mechanism of crane, types of cranes-lattice boom crawler crane, lattice boom truck mounted cranes, telescopic boom crane. ***Cranes (Part 2):*** Types of cranes-Tower cranes, Factors affecting lifting capacity of crane, Range diagram.	**05**	CE314.6
VII	**Concreting equipment:** ***Concreting equipment (Part 1):*** Steps in concrete making process, types of concrete mixer machines. **Concreting *equipment (Part 2) & Conclusion:*** Methods of handling and transporting concrete, Consolidation of concrete, Methods of finishing and curing of concrete.	**05**	CE314.7
Total Hours		**42**	

Essential Readings

1. Construction Planning, Equipment, and Methods (8th Ed.), R. Peurifoy, C. Schexnayder, A. Shapira, R. Schmitt (2011), McGraw Hill
2. Construction Equipment Management for Engineers, Estimators, and Owners (2nd Ed.), D. D. Gransberg, C. M. Popescu, R.C. Rayan (2006), CRC Press

Supplementary Readings

1. Construction equipment guide (2nd Ed.), D.A. Day, N.B.H. Benjamin (1991), John Wiley & Sons.
2. Modern construction and ground engineering equipment and methods (2nd Ed.), F. Harris (1991), Pearson Longman.
3. Construction methods and management, S. W. Nunnally (2011), Prentice Hall.
4. Heavy Construction: Planning, Equipment and Methods (2nd Ed.), J. Singh (2001), Taylor & Francis.
5. Construction materials, methods and techniques, W. P. Spence (1998), Delmar Publishers.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE316	**Environmental Geotechnics**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**100**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To enable the students to learn emerging topics related to Environmental Geotechnics.		CE316.1	Students will be able to understand the importance of soil-water-contaminant interaction. investigations.	Understand
	To make students aware about sources of contamination and remediation of contaminated sites		CE316.2	Students will be able to identify and apply the factors affecting the soil-groundwater-waste pollution.	Identify Apply
	To make the students understand and explore the feasibility of rehabilitation of waste dumps and re-use of waste.		CE316.3	Students will be able to comprehend and illustrate the methods for deciding the fate of contaminants in the Geoenvironment for contaminated land management.	Comprehend Illustrate
			CE316.4	Students will be able to design and evaluate the Waste Management facilities.	Design Evaluate
			CE316.5	Students will be able to create methods for reuse of waste.	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE316.1	**3**	**3**					**1**	**1**						**1**	**3**
CE316.2	**3**	**1**					**1**	**1**						**1**	**3**
CE316.3	**3**						**1**	**1**						**1**	**3**
CE316.4	**3**	**3**					**1**	**1**						**1**	**3**
CE316.5	**3**						**1**	**1**						**1**	**3**
CE316	**3**	**1.4**					**1**	**1**						**1**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Need and scope for Geoenvironmental Engineering; Sources of Contamination, Environmental impacts of contaminants within soils- Multiphase behaviour of soil.	**06**	CE316.1
II	**Soil-Waste interaction:** Physical, chemical, and biological characteristics of wastes; Soil-waste interaction; Impact of soil pollution on clay minerals.	**08**	CE316.1, CE316. 2
III	**Transport of Contaminants:** Contaminant transport in sub surface; Transport Mechanisms and Principles- Advection, Diffusion, Dispersion, Assess exposure pathways in environment	**08**	CE316. 2, CE316.3
IV	**Waste Management Facilities:** Waste containment facilities and disposal practices, Landfills: Types of landfills, Guidelines and recommendations for waste containment system, Site Selection, Layers of waste containment liners, Types of barrier materials; Leachate collection system, Cover system, Gas collection system.	**12**	CE316.3, CE316.4
V	**Waste Utilization:** Engineering Properties of mined waste and geotechnical reuse, mine-site restoration; Regulations; Case studies.	**08**	CE316.4, CE316.5
	Total Hours	**42**	

Essential Readings

1. Sharma, H.D., and Reddy, K.R., Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, John Wiley and Sons, INC, USA, 2004.
2. Qian, X., Koerner, R., and Gray, D.H., Geotechnical aspects of landfill design and construction, Prentice Hall, 2002
3. Sarsby, R., Environmental Geotechnics, Thomas Telford, 2000

Supplementary Readings

1. Bouazza, A., and Bowders J.J., Geosynthetic Clay Liners for Waste Containment Facilities, CRC Press, 2010.
2. Reddi, L.N., and Inyang H.I., Geoenvironmental Engineering: Principles and Applications, Marcel Dekker Inc Publication, 2000.
3. Daniel, D.E., Geotechnical Practice for waste disposal. Chapman and Hall, London,1993

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE318	**Industrial Pollution Control Engineering**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To industrial pollutants, their types, sources, and assess their environmental and health effects.	**Course Outcomes**	CE318.1	Students will acquire **knowledge** of industrial pollution's effects on ecosystems and human health, understanding its causes and interactions with the environment. They will develop and apply technologies and strategies for waste reduction, recycling, resource recovery, and sustainable waste management practices.	**Knowledge**
	To analyze case studies to understand real-world examples of industrial pollution incidents.		CE318.2	Students will cultivate critical assessment skills in industrial pollution scenarios, identifying key pollutants and their sources. They will propose effective solutions to mitigate environmental impacts through informed analysis and evaluation.	**Analysing** **Evaluating**
	To explore regulatory frameworks and policies aimed at controlling industrial pollution.		CE318.3	Students will explore innovative approaches, including technological advancements and policy interventions, to address challenges posed by industrial pollution and promote sustainability.	**Creating**
	To evaluate the effectiveness of different pollution control technologies and techniques.		CE318.4	Students will synthesize knowledge from diverse fields such as environmental science, engineering, policy, and economics. They will understand how these factors interconnect to influence pollution. They will then analyze this information to develop and evaluate holistic strategies for effective pollution management.	**Analyzing**
	To discuss emerging trends and innovations in industrial pollution prevention and control.		CE318.5	Enhanced design skill will empower students to advocate effectively for addressing industrial pollution. They will articulate persuasive arguments and foster awareness of sustainable practices in industrial settings, promoting informed dialogue and action.	**Design**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE318.1	**3**	**3**								**1**					**0**
CE318.2	**3**	**3**	**3**	**1**	**1**					**1**					**3**
CE318.3	**3**	**3**	**3**	**1**	**2**					**1**					**3**
CE318.4	**3**	**3**	**3**	**1**	**1**					**1**					**3**
CE318.5	**3**	**3**	**3**		**1**		**3**			**1**				**3**	**3**
CE318	**3**	**3**	**3**	**1**	**1.25**		**3**			**1**				**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Industrial Pollution** Definition and types of pollution, Sources of industrial pollution, Historical perspectives and global trends, Environmental impacts of industrial pollution, Environmental degradation: air, water, and soil pollution, Human health effects, Ecological consequences and biodiversity loss.	08	CE318.1
II	**Regulatory Framework and Environmental Legislation** Overview of environmental laws and regulations (e.g., Clean Air Act, Clean Water Act), Compliance requirements for industrial facilities, Permitting processes and environmental impact assessments, International agreements and conventions, National environmental regulations and enforcement mechanisms, Corporate social responsibility and accountability.	08	CE318.2
III	**Technological Innovations for Pollution Prevention and Control** Cleaner production techniques, Pollution control technologies: air, water, and soil remediation, Emerging trends in sustainable industrial practices, Principles and design of air pollution control devices (e.g., scrubbers, electrostatic precipitators, catalytic converters)	09	CE318.3
IV	**Emerging Technologies and Sustainable Practices:** Resource efficiency and waste minimization, Circular economy principles, Green engineering principles for pollution prevention, Life cycle assessment and sustainable design, Emerging trends in pollution control technologies (e.g., nanotechnology, bioremediation)	08	CE318.4

V	**Environmental Management Systems and Risk Assessment** Introduction to ISO 14001 and other environmental management standards, Implementation of environmental management systems in industrial settings, Integration of pollution control measures into overall environmental management strategies, Methods for assessing environmental risks associated with industrial activities Environmental impact assessment techniques for proposed projects, Mitigation measures for minimizing environmental impacts	09	CE318.5
Total Hours		**42**	

Essential Readings

1. Peavy, H. S., Rowe, D. R., and Tchobanoglous, G., "Environmental Engineering", McGraw-Hill Education, 5th Edition, 2014.
2. Rao, C. S., "Environmental Pollution Control Engineering", Wiley, 1st Edition, 2004.

Supplementary Readings

1. Vesilind, P. A., Peavy, H. S., and Harriott, P., "Environmental Engineering: Fundamentals, Sustainability, Design", Wiley, 2nd Edition, 2009.
2. Masters, G. M., "Introduction to Environmental Engineering and Science", Pearson, 3rd Edition, 2007.
3. Tchobanoglous, G., Burton, F. L., and Stensel, H. D., "Wastewater Engineering: Treatment and Reuse", McGraw-Hill Education, 5th Edition, 2013.
4. Culp, G. L., and Culp, D. C., "Principles of Water Quality Management", CRC Press, 1st Edition, 2003.
5. Sawyer, C. N., McCarty, P. L., and Parkin, G. F., "Chemistry for Environmental Engineering and Science", McGraw-Hill Education, 5th Edition, 2002.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 322	**Intelligent Transport Systems**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes	CO	Statement	Bloom's Taxonomy
To gain knowledge about fundamental traffic parameters and their relationship.		CE 322.1	Demonstrate the clear understanding of the factors influencing road vehicle performance	Demonstrate
To design traffic signal timing		CE 322.2	To design traffic signal timing as per prevailing traffic condition.	design
To learn about ITS system and its need		CE 322.3	Understand the use of ITS in traffic planning and management	Understand
To learn about different tools and techniques of ITS		CE 322.4	To apply ITS techniques as per requirement	apply
To develop understanding of airport planning process, plan and design basic airport facilities such as runways, taxiways, etc.		CE 322.5	Understand the basics of airport engineering and use of ITS in airport	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**1**	**1**								**1**	**1**	**3**	**1**
CO2	**3**	**1**										**1**	**1**	**3**	**1**
CO3	**2**	**2**	**1**	**1**		**2**						**1**	**2**		**1**
CO4	**2**	**2**	**1**									**1**	**3**	**2**	**1**
CO5						**1**						**1**	**1**	**1**	**1**
CE 322	**2**	**1.4**	**0.6**	**0.4**		**0.6**						**1**	**1.6**	**1.8**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Traffic Engineering**: Introduction, Road User and Vehicle Characteristics and their effect on Road Traffic; Fundamental Traffic parameters, Speed Studies, Origin-Destination studies. Junction, round about, Traffic signals, Parking study	**16**	CE322.1 CE322. 2
II	**Introduction to Intelligent Transport System**: What is ITS, need, ITS architecture. Detection and Data collection methods	**08**	CE322.1 CE322.3
III	**ITS Techniques:** Route Travel Time Estimation Models, ITS for Traffic Management system, Crash Prevention systems, Safety systems, ITS for public transportation system, Advance Traffic Management System, phase for implementation of ITS, ITS around the world, latest development in ITS technology	**12**	CE322.4
IV	**Airport Engineering:** Requirements of airport and airport Planning, Airport Classifications, Factors in Airport Site Selection,, Planning of Terminal Area, and different Layouts, Runway, Taxiway, Exit or Turnaround Taxiways, Apron and Hangers, use of ITS in airports	**06**	CE322.5
	Total Hours	**42**	

Essential Readings

1. Chakraborty, P and Das , D "Principles of Transportation Engineering" 2017
2. McShane, W.R and Roess, R.P, "Traffic Engineering", Prentice-Hall, Inc..Newjersey 1990
3. Pradip Kr. Sarkar, Amit Kr. Jain, Intelligent Transport System, PHI Learning 2018
4. Saxenna SC ,Airport Engineering: Planning and Design, CBS Publication, 2008

Supplementary Readings

1. IRC: SP:110-2017 Application of Intelligent Transport system for urban roads
2. SK Khanna, SS Jain, MG Arora, " Airport Planning and Design", Nem Chand and Bros 2017

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE324	**River Engineering (NPTEL Course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on basics of River engineering.	Course Outcomes	CE324.1	Student will be able to remember the basics of River engineering.	Remember
	To provide some knowledge about behaviour of Rivers.		CE324.2	Student will be able to understand the unsteady flow process in River.	Understand
	To develop understanding of River morphology.		CE324.3	Student will be able to compute and examine river morphology.	Compute Examine
	To make the student understand about unsteady flow in Rivers.		CE324.4	Student will be able to comprehend and correlate the concepts of River behaviour.	Comprehend Correlate
	To provide knowledge about River training works.		CE324.5	Student will be able to understand and predict the need of different types of River training works.	Understand Predict

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE324.1	**3**	**3**													
CE324.2	**3**	**3**			**3**										**3**
CE324.3	**3**	**3**											**3**		**3**
CE324.4	**3**	**3**	**3**				**3**								**3**
CE324.5	**3**	**3**	**3**		**3**									**3**	**3**
CE324	**3**	**3**	**3**		**3**		**3**						**3**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Physical properties and equations, properties of water and sediment, river flow kinematics, conservation of mass, equations of motion, hydraulic and energy grade lines	04	CE324.1
II	**Steady flow in rivers:** Steady river flow, steady-nonuniform river flow, sediment transport in rivers	04	CE324.2
III	**Unsteady flow in rivers:** River continuity equation, river momentum equations, river flood waves, loop-rating curves, river flood routing, river flow and sediment-duration curves	05	CE324.2
IV	**River equilibrium:** Particle stability, channel stability, regime relationships, equilibrium in river bends, downstream hydraulic geometry, bars in alluvial rivers, river meandering, lateral river migration	07	CE324.3
V	**River dynamics:** Introduction to rapidly varied flow, hydraulic jump, classification and practical application of hydraulic jump, ratio of sequent depths, height and length of jump, energy loss and jump location	05	CE324.4
VI	**River stabilization and river training work:** Riverbank stability, riverbank riprap revetment, riverbank protection, river flow-control structures, river training along braided rivers	05	CE324.5
VII	**River engineering:** River flood control, river closure, canal headworks, bridge scour, navigation waterways	06	C324.5
VIII	**River modelling:** Rigid-bed model, mobile-bed river models, finite-difference approximations, one-dimensional river models, multidimensional river models	06	C324.5
	Total Hours	42	

Essential Readings

1. H. H. Chang, "Fluvial Processes in River Engineering", Krieger Publishing Company, 1st Edition, 2008.
2. W. Wu, "Computational River Dynamics", Taylor & Francis, 1st Edition, 2007.
3. P Y Julien River Mechanics, Cambridge university press, 2nd edition, 2018

Supplementary Readings

1. M. H. Chaudhry, "Open channel flow", Springer, 2nd Edition, 2008.
2. M. B. N. Al-BaghdadiK, "Progress in River Engineering & Hydraulic Structures", CreateSpace Independent Publishing Platform, 1st Edition, 2018.
3. M M Das Open channel flow, PHI, 3rd edition, 2011

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Department of Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE326	**Urban Planning and Design**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO	Statement	Blooms Taxonomy
Course Objectives	Understand the principles and theories of urban planning and design.	Course Outcomes	CE326.1	Understand the details of urban planning and Design	Understand
	Analyse urban environments and identify key issues and challenges.		CE326.2	Develop an understanding about urban environment, key issues and challenges	Understand
	Apply planning and design techniques to create sustainable and livable urban spaces.		CE326.3	Apply Knowledge about various design techniques to create sustainable urban space.	Apply
	Evaluate the impact of transportation systems on urban development.		CE326.4	Identify factors to asses the impact of transportation on urban development	Identify

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE326.1				**1**		**1**	**1**						**1**	**1**	
CE326.2	**1**	**2**		**2**		**2**		**1**				**1**		**1**	
CE326.3	**1**	**2**		**2**		**2**		**1**				**1**	**3**	**1**	
CE326.4	**1**	**2**		**1**		**2**		**1**				**1**		**1**	
CE326	**0.75**	**1.5**		**1.5**		**1.75**	**0.25**	**0.75**				**0.75**	**1**	**1**	

SYLLABUS

No.	Content	Hours	Cos
1	**Urban Resilience and Climate Adaptation** :Introduction to Urban Planning: Overview of urbanization and its challenges, Key concepts in urban planning and design, Climate change evidence and impact. Innovative solution for Urban resilient structures	**07**	**CE326.1**
2	**Sustainable Urban Mobility**: Sustainable development principles, Transit-oriented development (TOD), Sustainable transportation solutions,	**08**	**CE326.1**
3	**Land Use Planning:** Principles of land use planning, Urban design guidelines, Mixed-use development concepts Case studies on effective land use planning strategies	**09**	**CE326.2**
4	**Smart Cities and Sustainable Urban Planning:** Smar City, Green infrastructure and urban sustainability, Climate change resilience in urban planning, Sustainable building design and construction	**09**	**CE326.3**
5	**Participatory Urban Planning:** Principles of community design, Participatory planning techniques Social equity in urban planning, Stakeholder engagement and public participation	**09**	**CE326.4**
		42	

Essential Readings

1. "The Comprehensive Plan: Sustainable, Resilient, and Equitable Communities for the 21st Century" by David Rouse and Rocky Piro, Routledge Publication, 2021
2. "The Geography of Urban Transportation" by Susan Hanson and Genevieve Giuliano, Guliford Press, 2017

Supplementary Reading

1. "Designing the City: Towards a More Sustainable Urban Form" by Charles J. Hoch and Linda C. Dalton
2. "Dream States: Smart Cities, Technology, and the Pursuit of Urban Utopias", John Lorinc, 2022

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE328	**Introduction to Pavement Design**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes			
		Cos	**Statement**	**Bloom's Taxonomy**
To gain basic understanding of the basic principles and philosophy of pavement analysis and design.		CE328.1	Students will be able to understand the various philosophies and principles of pavement design.	Understand
To analyze and design flexible and rigid pavements using different Empirical, semi-empirical and theoretical approaches		CE328.2	Students will be able to analyze and design flexible pavements as per relevant practices.	Analyze
To inculcate in students the basic concepts of Reliability and its use in the field of pavement engineering		CE328.3	Students will develop the ability to analyze and design rigid pavements as per relevant practices.	Analyze
To gain knowledge about the various methodologies of drainage design.		CE328.4	Students will understand the reliability analysis procedure for pavement structures.	Understand, Analyze
		CE328.5	Students will be able to Understand the drainage features of pavements.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE328.1	2					1	1	3				1			
CE328.2	2	1	3		3			1	2			2		**3**	**2**
CE328.3	2	1	3		3			1	2			2		**3**	**2**
CE328.4	2	1	1		2			1				2		**2**	**2**
CE328.5	2		3		1	2	2	1				2		**3**	**2**
CE328	**2**	**0.6**	**2**		**1.8**	**0.6**	**0.6**	**1.4**	**0.8**			**1.8**		**2.2**	**1.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Types of pavements, Introduction to various methods of pavement design: Empirical, mechanistic and mechanistic empirical, Failure criteria and reliability.	**07**	CE328.1
II	**Design of flexible pavements**: Bituminous mixes, strength and durability parameters, introduction to homogenous and layered elastic systems, Stresses and deflections in homogenous masses, Introduction to flexible pavement analysis using IIT-PAVE, Design of flexible pavements as IRC 37:2018	**12**	CE328.2
III	**Analysis and design of rigid pavements** Concrete pavement types, Types of Stresses and Causes, Factors influencing Stresses in rigid pavements;, Types of Joints in Cement Concrete Pavements Design of rigid pavements as per IRC 58:2015, Analysis of rigid pavements in IITPAVE.	**12**	CE328.2, CE328.5
IV	**Reliability:** Introduction to reliability in pavement design, Variability in pavement input parameters, Incorporation of variability into pavement systems	**06**	CE328.4
V	**Drainage Design:** General considerations in pavement drainage, Drainage materials, considerations and design of drainage in urban roads and highways as per Indian practices.	**05**	CE328.2
	Total Hours	**42**	

Essential Readings

1. "Pavement Engineering: Principles and Practice" Rajib B. Mallick, Tahar El-Korchi, CRC Press, 4th Edition (2022)
2. "Pavement Design: Materials, Analysis, and Highways" M. Rashad Islam, Rafiqul Tarefder, McGraw-Hill, 1st Edition (2021)
3. "Principles of Pavement Engineering" Nick Thom, ICE Publishing, 3rd Edition (2020)

Supplementary Readings

1. "Mechanistic-Empirical Pavement Design Guide: Implementation of the AASHTO Mechanistic-Empirical Pavement Design Guide" Applied Research Associates, Inc. Transportation Research Board, NCHRP Report 1-37A (2020)
2. MORT& H, "Specifications of Road and Bridge Works"
3. Relevant IRC codes.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE372	**Introduction to Finite Element Method**	-----	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the basic concept of finite element analysis and the steps involved.	Course Outcomes	CE372.1 The students will be able to **describe** different steps in finite element analysis and **understand** basic concepts involved.	Describe, Understand
	To have the knowledge of finite element formulation techniques		CE372.2 Able to **analyse** framed structures using approximate methods of analysis	Analyse
	To provide the basic framework of matrix methods of structural analysis		CE372.3 The students will be able to **outline** the types of finite element formulation techniques.	Outline
	To understand the types of element and its formulation, and numerical integration		CE372.4 Able to **understand** the need and importance of computational structural analysis techniques such as Matrix Methods and FEM.	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE372.1	2	2	3	2	3	3	3	2	1	2	2	2	**As per the respective Programme**		
CE372.2	3	3	3	3	3	3	3	1	1	1	3	2			
CE372.3	3	3	3	3	2	3	3	1	1	2	3	2			
CE372.4	2	2	2	2	1	3	3	1	1	2	2	2			
CE372	**2.5**	**2.5**	**2.75**	**2.5**	**2.25**	**3**	**3**	**1.25**	**1**	**1.75**	**2.5**	**2**			

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Introduction; Basic Concepts of Finite Element Analysis; Introduction to Elasticity; Steps in Finite Element Analysis.	**02**	DP37X.1 CE372.2
II	**Finite Element Formulation Techniques:** Virtual Work and Variational Principle; Galerkin Method; Finite Element Method: Displacement Approach; Stiffness Matrix and Boundary Conditions.	**06**	CE372.2 CE372.3
III	**Element Properties:** Natural Coordinates; Triangular Elements; Rectangular Elements; Lagrange and Serendipity Elements; Solid Elements; Isoparametric Formulation; Stiffness Matrix of Isoparametric Elements;	**10**	CE372.3 CE372.4
IV	**Numerical Techniques:** Numerical Integration: One- and two-Dimensional problems.	**04**	CE372.3 CE372.4
V	**FEM for Two Dimensional Solids:** Constant Strain Triangle; Linear Strain Triangle; Rectangular Elements; Numerical Evaluation of Element Stiffness; Computation of Stresses.	**06**	CE372.3 CE372.4
	Total Hours	**28**	

Essential Readings

1. J.N. Reddy, J. N., "An Introduction to the Finite Element Method", Tata McGraw Hill, 2nd Ed,2003.
2. Krishnamoorthy, C. S., "Finite Elements Analysis: Theory and Programming", Tata McGrawHill, 2nd Ed, 1994.
3. Cook, R. D., Malkus, D. S., and Plesha, M. E., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, 4th Ed, 2002.

Supplementary Readings

1. Zienkiewicz, O. C., Taylor, R. L., and Zhu, J. Z., "Finite Element Method Its Basis andFundamentals", Elsevier, 6th Ed, 2005.
2. Rao, S. S., "Finite Element Method in Engineering", Butterworth Heinemann, 3rd Ed, 1999.
3. Kanchi, M. B., "Matrix Method of Structural Analysis", Wiley Eastern Limited, 2nd Ed, 1993.
4. Bathe, K. J., "Finite Element Procedures", Prentice Hall of India Pvt. Ltd., 2002.

	National Institute of Technology Meghalaya An Institute of National Importance							CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**					Year of Regulation		**2024-25**
Department	**Civil Engineering**					Semester		**VI**
Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE352	**Software based modelling, design, and detailing Lab**	**-----**	**0**	**0**	**2**	**1**	**Experiments, Quiz, etc.**	**100**

Course Objectives		Course Outcomes			
	To introduce students to various software tools utilized in the analysis and design of structures, enabling them to understand their functionalities and applications.			**CO's**	**Statement**	**Bloom's Taxonomy**
	To provide hands-on experience in modelling and designing structures such as RCC and steel residential buildings, foundation modelling, slope stability analysis allowing students to apply theoretical knowledge to practical situations.		CE352.1	Able to **develop** comprehensive understanding and proficiency in utilizing various structural analysis and design software tools for practical applications.	**Develop**
			CE352.2	Able to **apply** software-based simulations to **analyze** and **design** diverse structural elements like columns and steel frames under varying loading and support conditions effectively.	**Apply, Analyze, Design**
			CE352.3	Able to **demonstrate** adeptness in modelling and designing both RCC and steel structures for G+3 buildings using specialized structural software tools.	**Demonstrate**
			CE352.4	Able to **demonstrate** effectively and **estimate** reinforcement schedules for RCC building components.	**Demonstrate, Estimate**
			CE352.5	Able to proficiently **develop** model and **analyze** foundations, retaining walls, and slope stability to ensure structural integrity, stability, and safety in civil engineering projects.	**Develop, Analyze**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE352.1	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**
CE352.2	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**
CE352.3	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**
CE352.4	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**
CE352.5	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**
CE352	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to various software for the analysis and design of Civil structures	**02**	CE352.1
II	Analysis of a simple RCC and Steel column with different loading and support conditions, Analysis of a simple RCC and steel frame with different loading and support conditions.	**02**	CE352.2
III	G+3 RCC building modelling and design as per relevant codes	**02**	CE352.3
IV	G+3 steel building modelling, design, and detailing as per relevant codes	**02**	CE352.3
V	Demonstration and estimation of the reinforcement schedule of the RCC foundation.	**02**	CE352.4
VI	Demonstration and estimation of the reinforcement schedule of RCC columns and beams.	**02**	CE352.4
VII	Demonstration and estimation of reinforcement schedule of RCC beam-column joints.	**02**	CE352.4
VIII	Demonstration and estimation of the reinforcement schedule of RCC slabs and staircases.	**02**	CE352.4
IX	Foundation modelling and design	**02**	CE352.5
X	Slope stability analysis and Retaining wall modelling and design	**02**	CE352.5
Total Hours		**20**	

Essential Readings
1. Guide to Structural Engineering using Staad Pro. Connect (General theory & Practical Application), Sukanta Adhikari, Dr. Alka Pisal
2. Reinforced Concrete, Vol. II, H.J. Shah, Charotar Publication
3. Soil Mechanics and Foundation Engineering, K. R. Arora, Standard Publishers Distributors
4. Textbook of Soil Mechanics and Foundation Engineering, V.N.S. Murthy, CBS Publishers & Distributors/ Alkem Company (S).
Supplementary Readings
1. Staad Pro. Connect Edition- Seismic Analysis using IS 1893 (Part-1)-2016, Sanjib Das, Bentley Institute Press.
2. Principles of structural Analysis- Static and Dynamic Loads, Krishnan Sathia, Bentley Institute Press.
3. Reinforced Concrete: Limit State Design, A. K. Jain, Nem Chand & Bros.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Program	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
CE354	**Transportation Engineering 2 Lab**	**Nil**	**0**	**0**	**1**	**2**	**Experiment, Quiz, Viva**	**100**

Course Objectives		Course Outcomes	Cos	Statement	Bloom's Taxonomy
	To learn and use traffic related software		CE354. 1	To understand the application of traffic related software	understand
	Understand the need and procedure of traffic survey		CE354. 2	To execute traffic survey efficiently	Execute
	To understand practical application of theoretical relations.		CE354. 3	To understand the fundamental of traffic engineering	Understand
	Learn to design traffic signal based upon raw traffic survey data		CE354. 4	To evaluate and give solution to practical traffic related problem.	Evaluate
	Learn to carryout parking study		CE354. 5	Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CE 354.1	**2**	**2**		**2**	**2**				**1**			**3**	**2**	**3**	**1**
CE 354.2	**2**		**2**	**2**		**1**	**1**			**1**	**1**	**3**	**1**	**2**	**1**
CE 354.3	**2**	**2**	**2**	**3**						**1**		**3**	**2**	**3**	**1**
CE 354.4	**2**	**2**	**2**		**1**		**1**		**1**	**1**		**3**	**2**	**3**	**1**
CE 354.5	**2**	**2**	**1**	**1**	**1**		**1**					**3**	**2**	**2**	**1**
CE354	**2**	**1.6**	**1.4**	**1.6**	**0.8**	**0.2**	**0.6**		**0.4**	**0.6**	**0.2**	**3**	**1.8**	**2.6**	**1**

SYLLABUS

No.	Content	Hours	COs
1.	To perform Traffic Volume study of moving traffic	02	CE354.1 CE354.2 CE354.3 CE354.4 CE354.5
2.	To perform Spot speed of moving traffic	02	
3.	To determine PCU and peak hour factor of a traffic stream.	02	
4.	To estimate the running speed and journey speed.	02	
5.	To design traffic signal as per IRC method.	04	
6.	To conduct Parking studies.	04	
7.	To assess vehicle turning movement counts in an intersection	04	
8.	To identify, classify, and record various traffic control devices such as signsand signals installed along a street/ corridor.	04	
9.	Introduction to software	02	
	Total Hours	**24**	

Essential Readings

1. C.A.O. Flaherty, "Transportaion Planning and Traffic Engineering", Butterworth-Heinemann; 4th edition
2. Kadiyali L.R. "Traffic Engineering and Transportation Planning", Khanna Publications
3. IRC,BIS, ISO codes and specifications.

Supplementary Readings

1. McShane, W.R and Roess, R.P, "Traffic Engineering", Prentice-Hall, Inc..Newjersey 1990
2. Relevant IRC Codes, Indian Roads Congress, Delhi
3. Khisty, C.J. and Lall, B.K., "Introduction to Transportation Engineering", Prentice-Hall India

SEVENTH SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation: **2024-25**
Department	**Civil Engineering**	Semester: **VII**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE411	**Dynamics of Structures (NPTEL Course)**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- Study the various types as well as characteristics of loading and formulate the equations of motion.
- Learn the response of un-damped and damped SDOF and MDOF systems under various loadings.
- Use the seismic codes in analysis and design of civil engineering structures.
- Evaluate dynamic response using numerical methods
- Learn the response of continuous system under dynamics loading and formulate the equations of motion.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE411.1	Remember the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems	Remember
CE411.2	Understand various type degree of freedom systems in structures.	Understand
CE411.3	Understand the modeling approach of dynamic response in civil engineering applications and its corresponding analysis.	Understand Analysis
CE411.4	Interpret the dynamic analysis results for design of civil engineering structures	Analysis
CE411.5	Able to apply the structural dynamics theory to earthquake analysis, response, and design of structures.	Apply Analysis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE411.1	3	3	2	1	1	1								3	3
CE411.2	3	3	2	1	1	1								3	3
CE411.3	3	3	2	1	1	1								3	3
CE411.4	3	3	2	1	1	1								3	3
CE411.5	3	3	2	1	1	1								3	3
CE411	3.0	3.0	2.0	1.0	1.0	1.0								3.0	3.0

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Structural Dynamics** Introduction of Structural Dynamics, Differential Equations in Civil Engineering, Types of Analysis/Static and Dynamic load, Degrees of Freedom (Ex: Generation of Stiffness matrix, Dynamic Equilibrium Equation, Solution of Equilibrium Equation	6	CE411.1
II	**Free Vibration of SDOF** Undamped free Vibration, Solution, Natural Period/Frequency, Energy in Free Vibration, Damped Free Vibration, Types of damping, Logarithmic decrement equation	4	CE411.1,CE411.2
III	**Forced Vibration of SDOF** Undamped Forced vibration, Amplitude & Phase Angle, Dynamic amplification factor for deflection (Rd), Damped Forced vibration, Relationship between Rd, Rv and Ra	4	CE411.2,CE411.3
IV	**Force Transmission, Vibration Measurement** Resonant frequency and Half power band width, Force Transmission and Isolation, Design of Vibration Measuring Instruments	3	CE411.2,CE411.3
V	**Response to Arbitrary Motions** Response to Unit Impulse, Response to Arbitrary Force (Duhamel's Integral), Response to Step and Ramp Forces, Response to Rectangular Pulse, Half Sinusoidal wave	3	CE411.3
VI	**Numerical Methods of Solution** Time Stepping Methods, Central Difference Method, Newmark's Method	3	CE411.3
VII	**Response Spectrum** Concept of Response Spectrum, Uses of Response Spectrum, Special Cases in Spectrum, Development of Tripartite Plot, Example: Base Shear and Base Moment, Response of Structure in Frequency Domain	4	CE411.2,CE411.4
VIII	**Multi-Degree of Freedom Systems** Equation of Motion for MDOF System, Solution of Equation, Natural Frequencies and mode Shapes (60), Modal Orthogonality, Approximate Method for finding Natural frequency	4	CE411.2,CE411.3
IX	**Earthquake Response of MDOF Systems** Time History Analysis, Response Spectrum Analysis, 3D Dynamic Analysis	3	CE411.3,CE411.4

X	**Dynamic Response of Continuous Systems** Vibration of Continuous systems, Shear behavior and bending behavior, Generalized SDOF	2	CE411.3,CE411.4
XI	**Dynamics of Rigid Blocks** Dynamics of Rigid Blocks, Non-Structural Elements, Floor Response Spectrum	2	CE411.4,CE411.5
XII	**Vibration Control** Introduction to Vibration Control, Active Control, Passive Control, Design of Tuned Mass Damper	4	CE411.4,CE411.5
Total Hours		42	

Essential Readings

1. A. K. Chopra, “Dynamics of Structures: Theory and Applications to Earthquake Engineering”, PHI Ltd.
2. P. Mario, “Structural Dynamics”, CBS Publishers.
3. R. W. Clough and J. Penzien, “Dynamics of Structures”, McGraw-Hill International Edition.

Supplementary Readings

1. K. Rao, “Vibration Analysis and Foundation Dynamics”, Wheeler.
2. J. Biggs and J. M. Biggs, “Introduction to Structural Dynamics”, McGraw-Hill.
3. L. Meirovitch, “Elements of Vibration Analysis”, McGraw-Hill.

	National Institute of Technology Meghalaya An Institute of National Importance								CURRICULUM
Programme	**Bachelor of Technology**					Year of Regulation			**2024-25**
Department	**Civil Engineering**					Semester			**VII**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE413	**EngineeringGeology (NPTEL Course)**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce basic geology to civil engineering students		CE413.1	Able to acquire knowledge about the importance and scope of Engineering Geology in the field of Civil Engineering, introduction to town planning, Infrastructure development and various disciplines involved in Engineering Geology	Knowledge Planning
	To acquire the knowledge of the most important rocks and minerals		CE413.2	Able to describe various minerals and rocks, their classification and usage in various civil Engineering structures	Describe Classification
			CE413.3	Able to identify various rock deformations such as folds, faults, joints and unconformities with special reference to their classification, genesis and their significance inCivil Engineering projects	Identify Classification
	To understand the seismicity and earthquake associated with geology		CE413.4	Able to get a comprehensive understanding on Earth's interior, seismology, plate tectonics, seismicity of India, theory of continental drift, Elastic rebound theory, various Earthquake hazards, magnitude and intensity of earthquakes	Understanding
			CE413.5	Able to get acquainted with geological investigations on important Civil Engineering structures and help them to take decision while planning, design and execution stage of the structures in their professional life	Planning Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE413.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE413.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE413.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE413.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE413.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE413	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Advances in engineering geology, significance and kinds of geo-ground, geomorphology of river valley and mountainous regions and landforms. Rock-water interaction, weathering, weathering indices, erosion, and deposition.	07	CE413.1
II	Engineering geological properties of rocks, concept of geological strata and geo-mechanical classification of rock strata. Geological construction materials, deleterious rocks, and cement-aggregates reactions.	07	CE413.2

III	Engineering Geology of dams and forces acting on dams, tunnels and methods of tunneling, treatment and anchoring of geological strata. Effect of geological structures such as folds, faults, beddings, foliations and lineations on stability of dams foundation and tunnels Rock-load/ground pressure, factors affecting ground pressure, method for determination of ground pressure, and support system.	12	CE413.3
IV	Engineering geological investigations for roads and highways, bridges and buildings foundations Engineering Geological Natural hazards and mitigations: landslide, earthquakes and induced seismicity	08	CE413.4
V	Geomorphology of sea and seashore, shoreline engineering geology, hazards and mitigation Engineering geological aspects of geothermal energy, Coal bed methane (CBM), Gas hydrate, shale gas, Carbon Capture, Usage and Storage (CCUS).	08	CE413.5
Total Hours		**42**	

Essential Readings

1. Parthasarathy A., Panchapakesan V. and Nagarajan R., “Engineering Geology”, Wiley India Pvt. Ltd. 2013

2. Duggal S.K., Pandey H.K., RawatN., “Engineering Geology”, McGraw Hill Education. 2017

3. Varghese P.C.,"Engineering Geology for Civil Engineers", Prentice Hall India Learning Private Limited., 2012

Supplementary Readings

1. Krynine D.P. and Judd W.R., “Principles of Engineering Geology and Geotechnics”, CBS Publishers and Distributors. 2018

2. Singh P., “Engineering & General Geology”, S.K. Kataria and Sons., 2008

3. Reddy D. V., “Engineering Geology”, Vikas Publishing., 2017

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation: **2024-25**
Department	**Civil Engineering**	Semester: **VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE415	**Continuum Mechanics (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamental concepts and principles of continuum mechanics, including stress, strain, deformation, and conservation laws.	CE415.1	Students will be able to demonstrate a thorough grasp of fundamental continuum mechanics concepts, including knowledge and applicationof stress, strain, deformation, and conservation laws.	**Knowledge** **Application**
	To develop proficiency in applying mathematical and computational methods to analyse and solve problems related to the behaviour of continuous media, including solids and fluids.	CE415.2	Students able to utilize mathematical and computational methods proficiently to solve complex problems in the mechanical behaviour of continuous media.	**Analyzing** **Evaluating**
	To gain knowledge of constitutive equations and material models used to describe the mechanical behaviour of materials under various loading conditions.	CE415.3	Students will be able to apply constitutive equations and material models effectively to predict material responses under varying loading conditions, accounting for material properties and boundary conditions.	**Application** **Analysis**
	To learn about practical applications of continuum mechanics in engineering fields such as solid mechanics, fluid mechanics, and biomechanics.	CE415.4	Students will be able to employ continuum mechanics principles to solve real-world engineering problems across solid mechanics, fluid mechanics, and biomechanics domains.	**Application** **Analysis**
	To explore advanced topics in continuum mechanics, including nonlinear elasticity, viscoelasticity, and plasticity, and their applications in engineering design and analysis.	CE415.5	Students will be able to analyze advanced topics in continuum mechanics, such as nonlinear elasticity and viscoelasticity, to critically evaluate their implications for engineering design and analysis.	**Analysis** **Evaluation**

Course Outcomes

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE415.1	**3**	**3**	**3**	**1**	**2**				**1**		**1**		**1**	**3**	**1**
CE415.2	**3**	**3**	**3**	**1**	**1**		**3**		**2**				**1**	**3**	**3**
CE415.3	**3**	**3**	**2**	**1**	**1**				**2**		**2**		**1**	**3**	**2**
CE415.4	**3**	**3**	**3**	**1**	**2**				**1**				**1**	**3**	**2**
CE415.5	**3**	**3**	**3**	**1**	**1**		**3**				**2**			**3**	**2**
CE415	**3**	**3**	**2.8**	**1**	**1.4**		**3**		**1.5**		**1.66**		**1**	**3**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Continuum Mechanics** Introduction, Vector space, Cauchy-Schwartz inequality, and Triangle inequality, Dot product, Cross product, Outer product, Kronecker delta, Permutation symbol, Definition of tensor, Summation convention, Free index, Dummy index, Examples to understand notations, Operations on second-order tensors (SOT), Cofactor tensor, Invariants of SOT, Inverse of SOT, Eigenvalues and Eigenvectors, Geometric interpretation of eigenvectors, Cayley-Hamilton theorem.	09	CE415.1
II	**Tensor Analysis and Calculus** Skew-symmetric, Orthogonal, and Symmetric tensors, Additive decomposition, Polar decomposition, square root tensor, Calculus of tensors	08	CE415.1 CE415.2
III	**Kinematics** Mapping function, Deformation gradient, Length, Area, and Volume, Material and spatial description Rate of deformation, Spin tensors, Strain tensors, Rigid transformation	08	CE415.3
IV	**Concepts in Continuum Mechanics and Thermodynamics** Leibniz rule of integration, Transport theorems, Cauchy hypothesis and Cauchy theorem, Equation of motion, Angular momentum balance, Equation of motion in material coordinates, PiolaKirchhoff stress tensor, Energy balance, Second law of thermodynamics	09	CE415.4
V	**Continuum Mechanics Application** Principle of material frame-indifference, Constitutive equations, Linear elasticity, Fluid mechanics	08	CE415.5
	Total Hours	**42**	

Essential Readings
1. "Continuum Mechanics: Concise Theory and Problems" by P. Chadwick
2. "Introduction to Continuum Mechanics" by W. Michael Lai, David Rubin, and Erhard Krempl
3. "Continuum Mechanics: Advanced Topics and Research Trends" by Ellad B. Tadmor, Ronald E. Miller, and Ryan S. Elliott
Supplementary Readings
1. "Introduction to the Mechanics of Solids" by E. H. Netwon
2. "An Introduction to the Mechanics of Solids" by Stephen H. Crandall
3. "Introduction to Fluid Mechanics" by Robert W. Fox, Philip J. Pritchard, and Alan T. McDonald
4. "Fluid Mechanics" by Frank M. White
5. "Mechanics of Materials" by Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, and David F. Mazurek

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE417	**Bridge Engineering (NPTEL Course)**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	Course Outcomes		
To familiarize with the types, suitability, selection, design criteria of various types of bridges.	**CO's**	**Statement**	**Bloom's Taxonomy**
To impart knowledge for analysis and design of various types of bridges.	CE417.1	Understand the load distribution and IRC standards.	Understand
	CE417.2	Able to analyse and design Box culvert, pipe culvert and design of various types of bridges.	Analyse
	CE417.3	Able to analyse and design Piers and abutments.	Analyse
	CE417.4	Understand the various uses of bearings, hinges and expansion joints and	Understand
	CE417.5	To have knowledge on the construction, maintenances and rehabilitation of various bridges	Knowledge
	CE417.6	Understand the various advance type of bridges	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE417.1	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**3**
CE417.2	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**2**
CE417.3	**2**	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**
CE417.4	**2**	**2**	**3**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**2**	**3**	**2**
CE417.5	**2**	**2**	**2**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**3**	**3**	**3**
CE417.6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CE417	**2.0**	**2.0**	**1.2**	**0.5**	**1.0**	**0.8**	**1.0**	**0**	**1.3**	**0**	**0**	**0.3**	**1.8**	**1.5**	**2.0**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Components, Materials, Forms, Evolutions and Classifications of Bridge, Site Selection, Subsoil Exploration and Traffic Projections for Bridges, Hydraulic Characteristics, Economical Span and Choice of Bridge Type, Standard Specifications for Road Bridges, Standard Specifications for Rail Bridges	4	CE417.1
II	**Reinforced Concrete Slab Bridge Decks** Design of Slab Culverts, Design of T-Beam and Slab Bridge, Voided Slab Bridges, Skew Slab Culverts and Curved Bridge Decks	3	CE417.1,CE417.2
III	**Box Culverts and Pipe Culverts** Design of Box Culverts, Design of Pipe Culverts	3	CE417.1,CE417.2
IV	**Steel Truss Bridges** Design of Steel Truss Bridges, Design Example of Steel Truss Bridges	3	CE417.1,CE417.2
V	**Plate Girder Bridges** Design of Plate Girder Bridges, Design Example of Plate Girder Bridges	3	CE417.1,CE417.2
VI	**Arch Bridges, Suspension Bridges, Cable-Stayed Bridges, Balanced Cantilever Bridges** Masonry Arch Bridges, Concrete Arch Bridges, Suspension Bridges, Cable-Stayed Bridges, Balanced Cantilever Bridges	4	CE417.1,CE417.2
VII	**Prestressed Concrete Bridges and Composite Bridges** Design of Prestressed Concrete Bridges, Composite Bridges	3	CE417.1,CE417.2
VIII	**Rigid Frame Bridges and Continuous Girder Bridges** Rigid Frame Bridges, Continuous Girder Bridges, Design Example of Continuous Girder Bridges	4	CE417.1,CE417.2
IX	**Piers, Abutments and Foundations** Bridge Piers, Bridge Abutments, Pile Foundations for Bridges, Well and Pneumatic Caisson Foundations for Bridges	3	CE417.3
X	**Bridge Bearings, Joints, and Appurtenances** Bridge Bearings, Bridge Joints, Bridge Appurtenances	3	CE417.4

XI	**Construction, Maintenance and Rehabilitation of Bridges** Bridge Construction, Maintenance and Rehabilitation of Bridges, Rebuilding of Bridges, Dynamic Response of Bridge Decks, Seismic Design of Highway Bridges, Seismic Design of Railway Bridges, Lessons from Bridge Failures	5	CE417.5
XII	**Advanced Topics in Bridge Engineering** Fatigue and Fracture of Bridges, Use of Shape memory Alloys in Bridges, Use of Engineered Cementitious Composite (ECC) in Bridges, 3D Printing of Bridges, High Speed Railway Bridges	4	CE417.6
Total Hours		**42**	

Essential Readings

1. N Krishna Raju, “Design of Bridges, Oxford and IBH publishing company, 2019
2. T R Jagadeesh and M A Jayaram, “Design of bridge structures”, Prentice Hall ofIndia, 2019

Supplementary Readings

1. Jain and Jaikrishna, “Plain and Reinforced Concrete”, Vol.2., Nem Chand Brothers, 2007
2. Standard specifications and code of practice for road bridges, IRC section I,II, IIIand IV.(Latest Publication)
3. “Concrete Bridges”, The Concrete Association of India, latest edition

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE419	**Transportation Engineering II (NPTEL Course)**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To identify the various railways components and their function		CE419.1	Understanding of components of Railways, their use and standard parameters	**Understand**
	To learn about the aspect of railway geometric design and track layouts		CE419.2	Comprehension of parameters of rail and track layout	**Understand**
	To learn about techniques railways safety		CE419.3	Understanding of signals and interlocking used in railway engineering	**Understand**
	To learn about Airport planning		CE419.4	Learn the technicality required for airport planning	**Understand**
	To understand the components of airport and their specification		CE419.5	Comprehension of various airport parameters	**Understand**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE419.1				**1**		**1**	**1**						**1**	**1**	
CE419.2	**1**	**2**		**2**		**2**		**1**				**1**		**1**	
CE419.3	**1**	**2**		**2**		**2**		**1**				**1**	**3**	**1**	
CE419.4	**1**	**2**		**1**		**2**		**1**				**1**		**1**	
CE419.5	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**1**				**3**		**2**	
CE419	**0.8**	**1.4**	**0.2**	**1.4**	**0.4**	**1.8**	**0.4**	**0.8**				**1.2**	**0.8**	**1.2**	

SYLLABUS

No.	Content	Hours	COs
I	Introduction: History, Recent Development in India and World, Railway Gauge, Alignment of Railway lines	**02**	CE419.1
II	Gauges and Permanent Way, Wheel and Axles, Conning of wheels, Track Resistance, Hauling Capacity, Track Modulus, Stresses in Track, Stresses in component of Tracks	**07**	CE419.2
III	Rails, Creep in Rails. Wear and Failure in Rails, Jointed or Welded rails, Sleepers, Ballast, Fastenings	**07**	CE419.2
IV	Geometric Design-Alignment of Track, horizontal Curve and Super elevation, Speed in Track, Transition Curve and Widening of Track, Vertical Curve and Gradients	**07**	CE419.2
V	Turnouts-Components, Crossing and Design of Turnouts, Track Junctions and Design, Signal Part 1, 2. Train control systems interlocking of track, high speed tracks	**07**	CE419.3
VI	Introduction to air transport, Aircraft characteristics, Aircraft control, site and size selection, Airport obstructions.	**04**	CE419.4
VII	Runway orientation, Length, Geometric Design, Taxiway, Exit Taxiway, Apron and aircraft parking, terminal area and building, Terminal Planning and Hangers, Visula Aid Marking, Visual Aids Lighting and Sinage	**08**	CE419.5
Total Hours		**42**	

Essential Readings

1. Chandra, Satish and Agarwal, M. M., "Railway Engineering", OxfordUniversity Press, New Delhi. 2nd Edition (2013)
2. Arora, S. P. and Saxena, S. C, "A Textbook on Railway Engineering",Dhanpat Rai Publications (P) Ltd., New Delhi , 2013
3. Mundrey, J. S., "Railway Track Engineering", Tata McGraw-HillPublishing Company, New Delhi, 2009
4. M M Agarwal, "Indian Railway Track", Prabha & Co. Delhi, 2018
5. M M Agarwal, "Railway Works Engineering", Prabha & Co. Delhi, 2018

Supplementary Readings

1. Clifford F. Bonnett, "Practical Railway Engineering", Imperial College Press, 2005
2. Francesco Flammini, "Railway safety, reliability and security: Technologies and system engineering", IGI Global, 2012
3. Marco Guerrieri, "Fundamentals of Railway Design" Springer Publication, 2023

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE421	**Design of Masonry Structures(NPTEL Course)**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop a comprehensive understanding of masonry design principles, including historical context, codes, standards, and structural-functional requirements.	CE421.1	Students will **analyze** historical significance, **understand** design methods, **identify** structural requirements, **classify** construction types, **evaluate** material properties, and**analyze** loads for effective masonry design.	**Analyze, Understand, Identify, Classify, Evaluate**
	To analyze the properties of masonry materials through experimental testing and evaluate their suitability for structural applications.	CE421.2	Students will**demonstrate** proficiency in **analyzing** masonry strength and behaviour under various loading conditions, including axial and eccentric compression, flexural tension, shear, and biaxial stresses.	**Demonstrate, Analyze**
	To assess the strength and behaviour of masonry under various loading conditions, including axial compression, flexure, tension, and shear.	CE421.3	Students will **apply** basic principles and methods of reinforcement to design reinforced masonry structures, considering working stress, limit state design, serviceability, and detailing requirements.	**Apply**
	To apply reinforced masonry design methods, considering working stress and limit state design principles, serviceability requirements, and detailing for structural integrity.	CE421.4	Students will **understand** the development and application of confined masonry, assess its response under seismic loads, verify its seismic resistance, and adhere to practical and normative provisions for effective design and construction.	**Understand**
	To investigate advanced topics such as confined masonry, infill masonry behaviour and design, and techniques for the assessment and strengthening of existing masonry structures.	CE421.5	Students will **analyze** infill masonry behaviour, **develop** mathematical models for its response within structural systems, and **design** infill masonry elements considering structural integrity and performance requirements.	**Analyze, Develop, Design**
		CE421.6	Students will **assess** existing masonry structures, **identify** deficiencies, and **develop** strengthening strategies to enhance their structural performance and longevity.	**Assess, Identify, Develop**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE421.1	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421.2	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421.3	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421.4	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421.5	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421.1	3	3	3	2	2	1	2	1	1	1	1	2	2	3	2
CE421	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction, Masonry Materials and Properties:** Overview of masonry in ancient and modern times, Methods of design- codes and standards, Structural- functional requirements of masonry buildings, Classification of masonry construction, Loads (including seismic). Properties and experimental testing of components (masonry units, mortars, grout, reinforcement).	**04**	CE421.1
II	**Strength and Behaviour of Masonry:** Axial Compression, eccentric compression, Direct and flexural tension, Shear and compression, biaxial state of stresses, P-M interaction, Deformation characteristics.	**10**	CE421.2
III	**Design of Reinforced Masonry:** Basic Principles and methods of reinforcing, Working stress and limit state design, Serviceability limit states (deflection, cracking, stability), Design for axial compression, Design for combined out of plane bending and axial compression and Detailing requirements, Design for in plane flexure and Detailing requirements, Design for shear walls and Detailing requirements, Sigle story building design, Multi story building design	**10**	CE421.3

IV	**Confined Masonry:** Development and Application, Configuration, Response under seismic loads, Seismic resistance verification, Practical aspects, and normative provisions	**08**	CE421.4
V	**Infill Masonry:** Behaviour, Modelling, Design	**05**	CE421.5
VI	**Special Topic:** Assessment and strengthening of existing masonry structures	**05**	CE421.6
Total Hours		**42**	

Essential Readings

1. Design of Reinforced Masonry Structures, Narendra Taly, McGraw-Hill Professional, 2010
2. Masonry Structures: Behavior and Design, Robert G. Drysdale and Ahmad A. Hamid, Prentice-Hall, latest edition

Supplementary Readings

1. Design of Masonry Structures, A.W. Hendry, B.P. Sinha, S.R. Davies, Spon Press, 2004
2. Mechanics of Masonry Structures, Maurizio Angelillo (eds.), Springer-Verlag Wien, 2014
3. Earthquake-resistant design of masonry buildings, Miha Tomaževič, Imperial College Press
4. Masonry Structures: Behavior and Design, Robert G. Drysdale, Ahmad A. Hamid, Lawrie R. Baker, Prentice-Hall Inc.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE423	**Ground Water Hydrology (NPTEL Course)**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop the students' knowledge on groundwater utilization, budgeting, and flow dynamics of groundwater.**	Course Outcomes	**CE423.1**	**Able to acquire knowledge about groundwater utilization, and budget, ground water level fluctuation and environmental impacts, aquifer characteristics, and flow dynamics of groundwater within porous media.**	**Knowledge**
	To develop the students' knowledge on advanced well hydraulics.		**CE423.2**	**Able to acquire knowledge about the principles and applications of advanced well hydraulics.**	**Knowledge Application**
	To provide the knowledge about evaluation of groundwater pollution, surface and sub-surface groundwater investigation methods.		**CE423.3**	**Able to acquire knowledge about the sources, causes, evaluation methods, and criteria for pollution, the analysis techniques and graphical representations of groundwater quality.**	**Knowledge Analysis**
	To provide the knowledge about artificial groundwater recharge, wastewater reuse, saline water intrusion control for groundwater sustainability, and ground water modelling and management.		**CE423.4**	**Able to acquire knowledge about various surface and sub-surface investigation methods for groundwater.**	**Knowledge**
			CE423.5	**Able to acquire knowledge about the concept, methods, and implications of artificial groundwater recharge, wastewater reuse and control measures for saline water intrusion in aquifers.**	**Knowledge**
			CE423.6	**Able to acquire knowledge about the principles and methods of ground water modelling and management.**	**Knowledge Modelling**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE423.1	**1**	**1**		**1**		**1**	**3**	**1**		**1**		**1**	**1**	**1**	**3**
CE423.2	**1**	**1**		**1**	**1**	**1**	**3**	**1**		**1**		**1**	**1**	**1**	**3**
CE423.3	**1**	**1**		**1**	**1**	**2**	**3**	**1**		**1**		**1**	**1**	**1**	**3**
CE423.4	**1**	**1**		**1**	**1**	**2**	**3**	**1**		**1**		**1**	**1**	**1**	**3**
CE423.5	**1**	**1**		**1**	**1**	**2**	**3**	**1**		**1**		**1**	**1**	**1**	**3**
CE423.6	**1**	**1**	**2**	**1**	**1**	**2**	**3**	**1**		**1**	**2**	**1**	**1**	**1**	**3**
CE423	**1**	**1**	**0.33**	**1**	**0.83**	**1.67**	**3**	**1**		**1**	**0.33**	**1**		**1**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Ground water utilization & historical background, ground water in hydrologic cycle, ground water budget, ground water level fluctuations & environmental influence, literature/ data/ internet resources.	05	CE423.1
II	**Occurrence and Movement of Ground Water** Origin & age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration & saturation, aquifers and their characteristics/classification, groundwater basins & springs, Darcy's Law, permeability & its determination, Dupuit assumptions, heterogeneity &anisotropy, Ground water flow rates & flow directions, general flow equations through porous media.	05	CE423.1
III	**Advanced Well Hydraulics** steady/ unsteady, uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer, well flow near aquifer boundaries/ for special conditions, partially penetrating/horizontal wells & multiple well systems, well completion/ development/ protection/ rehabilitation/ testing for yield.	05	CE423.2
IV	**Pollution And Quality Analysis of Ground Water** Municipal /industrial /agricultural /miscellaneous sources & causes of pollution, attenuation/ underground distribution / potential evaluation of pollution, physical /chemical /biological analysis of ground water quality, criteria & measures of ground water quality, ground water salinity & samples, graphical representations of ground water quality.	05	CE423.3
V	**Surface/ Sub-Surface Investigation of Ground Water** Geological /geophysical exploration/ remote sensing / electric resistivity /seismic refraction based methods for surface investigation of ground water, test drilling & ground water level measurement, sub-surface ground water investigation through geophysical / resistivity /spontaneous potential /radiation / temperature / caliper / fluid conductivity / fluid velocity /miscellaneous logging.	05	CE423.4
VI	**Artificial Ground Water Recharge** Concept & methods of artificial ground water recharge, recharge mounds & induced recharge, wastewater recharge for reuse, water spreading.	05	C423.5

VII	**Saline Water Intrusion in Aquifers** Ghyben-Herzberg relation between fresh & saline waters, shape & structure of the fresh & saline water interface, upcoming of saline water, fresh-saline water relations on oceanic islands, seawater intrusion in Karst terrains, saline water intrusion control.	06	CE423.5
VIII	**Modeling and Management of Ground Water** Ground water modeling through porous media /analog / electric analog / digital computer models, ground water basin management concept, hydrologic equilibrium equation, ground water basin investigations, data collection & field work, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifers, stream-aquifer interaction.	06	CE423.6
Total Hours		**42**	

Essential Readings

1. D.K. Todd and L. F. Mays,"Groundwater Hydrology", John Wiley and sons, 2005.
2. K. R.Karanth,"Hydrogeology", TataMcGraw Hill Publishing Company, 1989.

Supplementary Readings

1. S. Ramakrishnan,"Ground water", 1998.
2. Literature of the Central Ground Water Board (CGWB); Relevant National/International Journal and/or Conference publications.

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE425	**AIR POLLUTION AND CONTROL (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	Introduce sources, types, and distribution patterns of air pollution.	CE425.1	Students will acquire knowledge and be able to identify major natural and human-made sources of air pollutants across various sectors	**Knowledge** **Identification**
	Enable assessment of environmental, health, and socio-economic impacts of air pollution.	CE425.2	Students will proficiently collect, analyze, and interpret air quality data using statistical and computational methods to assess pollution levels and trends.	**Application** **Analysis**
	Familiarize with techniques and instruments for measuring air pollutants.	CE425.3	Students will evaluate the environmental, health, and economic impacts of air pollution on ecosystems, human health, and economies	**Evaluation** **Synthesis**
	Explore national and international policies for controlling air pollution.	CE425.4	Students will design effective strategies and technologies for mitigating air pollution, considering factors like efficiency, cost-effectiveness, and environmental sustainability.	**Evaluation**
	Examine health implications of exposure to various air pollutants.	CE425.5	Students will design and apply relevant regulations and standards to assess compliance and enforce measures for controlling air pollution in diverse sectors and regions	**Application** **Design**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE425.1	**3**	**3**	**0**	**1**	**1**	**1**			**0**	**0**	**1**	**0**	**0**		**0**
CE425.2	**3**	**3**	**3**	**1**	**2**	**1**			**0**	**0**	**1**	**0**	**0**		**3**
CE425.3	**3**	**3**	**3**	**1**	**1**	**1**			**0**	**0**	**1**	**0**	**0**		**3**
CE425.4	**3**	**3**	**3**	**1**	**1**	**2**			**0**	**0**	**1**	**0**	**0**		**3**
CE425.5	**3**	**3**	**3**	**1**	**2**	**1**	**3**		**0**	**0**	**1**	**0**	**0**	**3**	**3**
CE425	**3**	**3**	**3**	**1**	**1.4**	**1.2**	**3**				**1**			**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction&Overview of Air Quality and Impacts:** Understanding Air Pollution and Its Impacts: Overview of air pollution effects on human health, ecosystems, structures, and the environment.Sources, Classification, and Transformation of Air Pollutants: Exploration of air pollutant sources, types, and transformation processes.Meteorology and Atmospheric Stability: Discussion on meteorological factors affecting air quality, including plume behavior and atmospheric stability.Air Quality Monitoring and AQI Interpretation: Introduction to air quality monitoring methods and interpretation using the Air Quality Index (AQI)	09	CE425.1 CE425.2
II	**Air Quality Modelling and Emissions Inventory** Air Quality Modeling: Introduction to modeling techniques for assessing air quality. Gaussian Dispersion Models: Understanding point, line, and area source models used in Gaussian dispersion modeling. Emissions Inventory: Examination of emissions from various sectors including transport, industrial, agricultural, residential, and commercial activities."	08	CE425.2 CE425.3
III	**Advanced Techniques in Air Quality Assessment** Utilizing Remote Sensing and Satellite Data for Emission Inventory. Source Apportionment Through Receptor Modeling. Understanding Indoor Air Pollution and Health Implications. Techniques for Indoor Air Quality Sampling and Evaluation.	08	CE425.3 CE425.4
IV	**Environmental Impacts and Control Technologies in Air Pollution** Global and regional environmental issues include air pollution, such as ozone depletion, climate change, global warming, and acid rain, as well as air pollution control devices, equipment, and their design	08	CE425.4 CE425.5
V	**Air Pollution Regulations and Emerging Technologies** Air pollution emission standards, national and international policies, acts, rules, and regulations. Emerging technologies	09	CE425.4 CE425.5

	and strategies to mitigate air pollution, current challenges, and the way forward. Lab-based measurements of air pollutants and modeling		
Total Hours		**42**	

Essential Readings

1. Air Pollution Control: A Design Approach" by C. David Cooper and F.C. Alley, 4th Edition (2010)
2. "Fundamentals of Air Pollution" by Daniel Vallero, 5th Edition (2014)
3. "Air Pollution: Measurement, Modelling, and Mitigation" by Renato Baciocchi, et al., 1st Edition (2007)
4. "Air Pollution Control Engineering" by Noel de Nevers, 3rd Edition (2010)
5. "Principles of Air Quality Management" by Roger D. Griffin, 2nd Edition (2006)

Supplementary Readings

1. "Air Quality Management" by Graeme J. T. Cooper and David W. Johnson, 2002
2. "Air Pollution: Problems and Solutions" by S.C. Rao, 1988
3. "Introduction to Air Pollution Science: A Public Health Perspective" by Robert F. Phalen and Robert N. Phalen, 2012
4. "Handbook of Air Pollution Prevention and Control" edited by Nicholas P. Cheremisinoff, 2002
5. "Urban Air Pollution: Monitoring and Control Strategies" edited by Rajasekhar Balasubramanian, et al., 2022

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE427	**Composite Materials and Structures (NPTEL Course)**	**3**	**0**	**3**	**3**	**50**	**50**	**100**	**200**

			CO`s	**Statement**	**Bloom`s Taxonomy**
Course Objectives	1.To introduce various types of composites and lamination theory	Course Outcomes	CE427.1	**Able to understand the basicsof composites and laminates.**	Understand
	2.To introduce 3D constitutive equations, micromechanics and failure mechanisms		CE427.2	**Able to apply fundamentals of failure and damage of composites**	Apply
	3.Designing with laminates and various test methods		CE427.3	**Able to design laminates and process of testing.**	Design
	4.Understanding various failure and damage mechanics of composites		CE427.4	**Able to identify damage and fractures in composites**	Identify
	5. Nanocomposites, Stitched and 3D composites				

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CE427.1	3	1		1		1						2		**3**	
2	CE427.2	3	3		3		2						2		**3**	
3	CE427.3	3	3	3	3		2						2		**3**	
4	CE427.4	3	3		3		2						2		**3**	
CE		**3.0**	**2.5**	**0.75**	**2.5**		**1.75**						**2**		**3.0**	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Fibre, matrix: materials, properties and fabrication processes,types/classification of composites, fabrication methods of composites, advantages and applications	04	CO1
II	**Constitutive Equation** 3D constitutive equations (principal material and globaldirections), thermal, hygroscopic effects and hygrothermoelasticconstitutive equation, Plane stress (or reduced) constitutive equations (principalmaterial and global directions) and hygrothermoelasticconstitutive equation, lamina engineering constants.	08	CO1, CO2
III	**Theory and Test Methods of Laminates** Lamination theory, hygrothermoelastic lamination theory, Designing with laminates, Quality assessment, physical and mechanicalproperty characterization.	07	CO3, CO4
IV	**Micromechanics** Strength of materials and continuumapproaches for effective properties.	06	CO3, CO4
V	**Failure and Fracture Mechanisms** Lamina failure theories, Damage mechanics of composites, Fracture mechanics of composites.	07	CO3, CO4
VI	Interlaminar stresses and Composite joints	05	CO3, CO4
VII	**Composites** Nanocomposites, Stitched composites, 3D composites.	05	CO3, CO4
Total Hours		**42**	

Essential Readings

1. Mechanics of Fibrous Composites, C.T. Herakovich, John Wiley & Sons, Inc. New York, 1998.
2. Analysis and Performance of Fibre Composites, B.D. Agarwaland L.J. Broutman, John Wiley & Sons, Inc. New York, 2017.
3. Mechanics of Composite Materials, R.M. Jones, TechnomicPublication, 1998.
4. Mechanics of Composite Materials, RM Christensen, KriegerPublishing Company, Florida, USA, 2005.
5. Mechanical Testing of Advanced Fibre Composites, J.M.Hodgkinson, Woodhead Publishing Limited, Cambridge, 2000.

Supplementary Readings

1. ASTM standards.
2. Research articles.

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE429	**Watershed Management (NPTEL Course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on need for watershed development.	Course Outcomes	CE429.1	**Student will be able to remember and understand the concepts, public policies and practices of watershed planning and development**	Remember Understand
	To provide some knowledge about the different characteristics of watershed, GIS & Applications in watershed management		CE429.2	**Student will be able to understand and interpret the reasons for the erosion from the watershed and the methods to monitor it.**	Understand Interpret
	To develop understanding of Integrated Water Resources Management.		CE429.3	**Student will be able to examine different models of water harvesting**	Examine
	To make the student understand about water quality, conservation, recycling aspects		CE429.4	**Student will be able to understand and analyse the role of ecosystem in bringing the best water use practices and apply the knowledge to plan watershed development activities**	Understand Analyse
			CE429.5	**Student will be able to design and create watershed focused land-use planning concepts**	Design Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE429.1	**3**	**3**													
CE429.2	**3**	**3**													**3**
CE429.3	**3**	**3**											**3**		**3**
CE429.4	**3**	**3**	**3**				**3**							**3**	**3**
CE429.5	**3**	**3**	**3**											**3**	**3**
CE429	**3**	**3**	**3**				**3**						**3**	**3**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Watershed Management & Stakeholder Analysis, Watershed Management Policies	02	CE429.1
II	**Sustainable Watershed Management:** Agricultural Practices & Watershed Management, Soil Erosion & Conservation, Watershed Management in Arid Regions & Strategic Planning,	04	CE429.2
III	**Integrated Water Resources Management:** Conjunctive Use of Water Resources, Rainwater Harvesting System, Rainwater Harvesting & Roof Catchment System	04	CE429.2
IV	**Watershed Modeling:** Watershed Delineation & Modeling, Hydrologic Processes, Watershed Modeling, Hydrologic Modeling, Numerical Watershed Modeling, Subsurface & Groundwater Flows	06	CE429.3
V	**Social & Community Aspects of Watershed Management**: Socio-economy, Private Sector Participation & Gender Issues, Integrated Development, Water Legislation & Implementation Issues	04	CE429.4
VI	**Applications of Knowledge Based Models in Watershed Management:** GIS & Applications, Remote Sensing & Applications, Decision Support Systems & Applications, Integrated Watershed Modeling Using Numerical Methods	06	CE429.4
VII	**Management of Water Quality:** Surface Water Quality & Pollution Issues, Groundwater Pollution Problems & Transport Processes, Water Quality Modeling, Environmental Guidelines	04	CE429.5
VIII	**Storm Water Management:** Urban Drainage System, Flood Routing, Flood Control & Management	04	CE429.5
IX	**Drought Management:** Drought Assessment, Drought Analysis, Drought Mitigation	04	CE429.5
X	**Water Conservation and Recycling:** Water Conservation,Water Recycling, Water Reclamation & Reuse	04	CE429.5
	Total Hours	42	

Essential Readings

1. J.V.S. Murthy, "Watershed Management", New age international, 1st Edition, 1998.
2. K. Lillesand, "Remote Sensing and Image Interpretation", John Wiley & Sons, 1st Edition, 1979.
3. E.M. Tideman, "Watershed Management – Guidelines for Indian Conditions", Omega Scientific Publishers, 1st Edition, 1996.
Supplementary Readings
1. FAO, "Watershed management and Field manual", 13/1, 13/2,13/3,13/4,13/5 FAO, UN, Rome, 1988.
2. R.G. Reeves," Manual of Remote Sensing, Volume I and II", American Society of Photogrammetry, Falls Church, 1975.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE431	**Rock Engineering (NPTEL Course)**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To acquire the knowledge of overall behaviour of rocks and rock masses.		CE431.1	**Able to acquire knowledge about the importance and scope of rock Engineering in the field of Civil Engineering, introduction to town planning, infrastructure development and various disciplines involved in Engineering Geology**	Knowledge
			CE431.2	**Able to understand various laboratory tests conducted on rocks to evaluate various strength parameters of rocks**	Understand Evaluate
			CE431.3	**Able to acquire knowledge about various rock deformations such as folds, faults, joints and unconformities with special reference to their classification, genesis and their significance in Civil Engineering projects**	Knowledge Classification
	To enable the students to acquire basics of analysis and design of tunnels, caverns, slopes, and foundations on rocks.		CE431.4	**Able to get a comprehensive understanding on Tunnelling technologies**	Understanding
			CE431.5	**Able to get knowledge of various geological investigations on rock Slope stability analysis and foundations of weak rocks**	Knowledge Analysis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE431.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE431.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE431.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE431.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE431.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE431	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** rock forming minerals, identification, geological classification of rock, geological structures, faults, folds, joints. **Stereographic Project of Geological Data:** Principle of equal area net, representation of a line, plane, intersection of two planes, other applications.	07	CO1
II	**Laboratory Testing of Rocks:** Determination of physical properties, uniaxial compressive strength test, tensile strength test, oblique shear test, triaxial test, slake durability test, stress-strain responses of rocks. **Strength Criteria for Rocks & Rock Mass:** Mohr-Coulomb criterion, Hoek and Brown criterion, Barton's theory.	07	CO2
III	**Engineering Classification of Rocks & Rock Mass:** Deere and Miller classification, concept of rock mass, rock quality designation, rock mass rating, rock mass quality, geological strength index and applications in civil engineering projects.	08	CO3
IV	**Tunneling:** Ground conditions in tunneling, application of stereographic projections, elastic analysis under uniaxial, biaxial and hydrostatic conditions, Concrete lining: elastic analysis, elasto-plastic analysis: Tresca criterion, rock mass-tunnel support interaction analysis, design of support system.	09	CO4
V	**Rock Slope Stability Analysis and Foundations of Weak Rocks:** Modes of failure, limit equilibrium approaches, application of stereographic projections, remedial measures. Bell's approach, bearing capacity based on classification approaches, UCS, plate load test, special considerations, dam foundations.	11	CO5
	Total Hours	**42**	

Essential Readings

1. Goodman, RE (1989). Introduction to Rock Mechanics, Canada, John Wiley & Sons.
2. Hoek, E and Brown, ET (1988). Underground Excavations. Spon Press.
3. Ramamurthy, T (2007). Engineering in Rocks for Slopes, Foundation and Tunnels. N. Delhi, PHI Pvt. Ltd.

Supplementary Readings

1. Sivakugan, N, Shukla, SK and Das, BM (2013). Rock Mechanics: an introduction. Boca Raton, FL, CRC Press.
2. Wyllie, DC and Mah CW (2004). Rock Slope Engineering, Civil and Mining. NY, Spon Press.
3. Singh, B and Goel RK (2011). Engineering Rock Mass Classification. Oxford, UK, Elsevier Inc.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE433	**Probability Methods in Civil Engineering (NPTEL course)**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand the fundamentals and significance of probability and statistics in civil engineering applications.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To equip students with the necessary skills, they will learn to define random events and variables and apply probability theory effectively in addressing uncertainty and variability in civil engineering problem-solving.		CE433.1	Able to **understand** the significance of probability and statistics in civil engineering. — **Understand**
	To apply probability distributions, moments of functions of random variables, and central limit theorem concepts, students will engage in practical exercises relevant to civil engineering contexts.		CE433.2	This course aims to equip students with the ability to **define** random events and variables, **apply** probability theory, including set operations and axioms, and **analyze** real-life civil engineering examples to address uncertainty and variability in problem-solving. — **Define, Apply, Analyze**
	To analyze and apply a comprehensive range of discrete and continuous probability distributions, along with sampling distributions, students will explore various civil engineering challenges, ensuring their ability to make informed decisions.		CE433.3	Enable students to**understand** and **apply** probability distributions and moments of functions of random variables in civil engineering contexts. — **Understand, Apply**
			CE433.4	Students will adeptly**analyze** and**apply**a range of discrete and continuous probability distributions—including binomial, Poisson, exponential, gamma, normal, lognormal, and extreme value distributions—as well as grasp the central limit theorem, to tackle civil engineering challenges. — **Analyze, Apply**
			CE433.5	Able to **demonstrate** the application of random samples, statistics, and sampling distributions, including the Chi-square distribution, t-distribution, and F-distribution, through relevant examples in civil engineering problems. — **Demonstrate**
			CE433.6	Students will enhance their ability to **make informeddecisions** in civil engineering applications and be able to **demonstrate**proficiency in performing point and confidence interval estimation and conducting hypothesis tests for parameters such as mean and variance. — **Make informed decisions, Demonstrate**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS O2	PSO3
CE433.1	**3**	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433.2	3	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433.3	3	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433.4	3	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433.5	3	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433.6	3	3	3	3	2	2	1	1	2	2	2	2	1	3	1
CE433	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**3**	**1**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Role of probability and statistics in civil engineering.	**03**	CE433.1
II	**Random events and Random Variables:** Definition of basic random events; Application of set theory in definition of composite event operations. Probability of events and definition of probability axioms; Solution of real-life examples from civil engineering Definition of random variables - discrete and continuous; Probability definitions - PMF, PDF, CDF; Moments and expectations	**12**	CE433.2
III	**Functions of random Variables:** Definition of probability distributions of functions of single and multiple random variables - exact methods and approximate methods; Moments and expectations of functions - direct and indirect methods.	**08**	CE433.3
IV	**Probability Distributions:** Discrete distributions - binomial distribution, Poisson's distribution; Continuous distributions - exponential distribution, gamma distribution; Central limit theorem; Normal and lognormal distributions; Extreme value distributions.	**09**	CE433.4
V	**Random samples and statistics and Sampling distributions:** Examples on various civil engineering problems, Chi-square distribution, t - distribution, F distribution.	**05**	CE433.5

VI	**Parameter estimation and Hypothesis Testing:** Point estimation, confidence interval estimation, Tests of hypotheses on the mean and variance.	**05**	CE433.6
Total Hours		**42**	

Essential Readings

1. Ang, A. H-S., and Tang, W., H. “Probability concepts in engineering: Emphasis on applications in civil and environmental engineering.” Wiley
2. Kottegoda, N. T., and Rosso, R. “Applied Statistics for Civil and Environmental Engineers.” Wiley.
3. Ross, S. “A first course on probability.” Prentice Hall.
4. Johnson, R. A., and Gupta, C. B. “Miller and Freund’s Probability and Statistics for Engineers.” Pearson Education.

Supplementary Readings

1. Papoulis,A, and S. U.Pillai (2002),Probability, Random Variables and Stochastic Processes, McGraw-Hill, New York.
2. West M. and J. Harrison (1997), Bayesian Forecasting and Dynamic Models, Springer-Verlag, New York

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE435	**Construction Planning and Management (NPTEL Course)**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop student's knowledge on civil engineering project and contract management, and different project management techniques.**	Course Outcomes	**CE435.1**	**Able to acquire knowledge about civil engineering project and contract management.**	**Knowledge**
	To develop the student's knowledge on estimation and rate analysis.		**CE435.2**	**Able to acquire knowledge about estimation and rate analysis and it's application.**	**Knowledge Application**
	To develop the student's knowledge on construction technology and IT in construction planning management.		**CE435.3**	**Able to acquire knowledge about network based project management techniques and it's application.**	**Knowledge Application**
			CE435.4	**Able to acquire knowledge about construction technology and it's application.**	**Knowledge Application**
			CE435.5	**Able to acquire knowledge about information technology and it's application in construction planning management.**	**Knowledge Application**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE435.1	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2
CE435.2	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2
CE435.3	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2
CE435.4	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2
CE435.5	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2
CE435	1	2	2	2	2	2	2	2	2	2	3	2	1	3	2

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** General overview of civil engineering projects	03	CO1
II	**Civil Engineering Project Management:** General, Grouping, some useful terms, Life cycle, Construction as industry, Challenges in construction, Learning requirement of construction industry.	04	CO1
III	**Contractual Relation and Contract Management:** Various parties involved, contracts, Types of contracts, Stages of awarding contract, Disputes and arbitrations.	04	CO1
IV	**Estimation and Rate Analysis:** Estimation, Rate analysis, Measurement in civil engineering.	08	CO2
V	**Network Based Project Management Techniques:** Project planning, Activity time, Event.	08	CO3
VI	**Construction Technology:** Quality in construction, Safety in construction, Earthwork, Drilling and blasting, Tunneling, Piling, Dewatering, Concreting.	07	CO4
VII	**Information Technology in Construction Planning Management:** IT in construction, Database management system, Spatial data management, Communication and computer network.	08	CO5
Total Hours		**42**	

Essential Readings

1. Construction Planning & management By P S Gahlot & B M Dhir , New Age International Limited Publishers, 1992.
2. Construction Project planning & Scheduling By Charles Patrick, Pearson, 2012

Supplementary Readings

1. Construction Project Management Theory & practice Kumar Neeraj Jha, Pearson,2012
2. Construction management Fundamantals by Knutson, Schexnayder, Fiori, Mayo, Tata McGraw Hill, 2nd Edition, 2008.
3. Modern construction management--.Harris, Wiley India, 2013.
4. Construction Management and Planning by Sengupta and Guha-Tata McGraw Hill publication, 1995.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE437	**Machine Learning for Engineering and Science Application (NPTEL course)**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To be able to perform basic mathematical computation related to Machine Learning (ML)		CE437.1	**Gain Knowledge and perform basic mathematical computation related to ML.**	Knowledge
	To develop an understanding of Machine Learning techniques.		CE437.2	**Demonstrate a clear knowledge and understanding of ML techniques**	Knowledge
	To develop skill for applying the ML techniques judiciously.		CE437.3	**To compute the problem and use suitable ML technique**	Compute
	To introduce the advance ML methods in context of specific engineering application		CE437.4	**Gain Knowledge of advance ML methods and its specific application**	Knowledge
	T				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE437.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE437.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE437.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE437.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE437	**2.0**	**2.4**	**2.6**	**2.25**	**2.0**	**1.8**	**1.6**	**1.0**	**2.0**			**2.0**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Machine Learning, Linear Algebra, Probability	07	CO1
II	Computational Basics – Numerical computation and optimization, Introduction to Machine learning packages. Linear and Logistic Regression – Bias/Variance Tradeoff, Regularization, Variants of Gradient Descent, MLE, MAP, Applications	07	CO1
III	Neural Networks – Multilayer Perceptron, Backpropagation, Applications, Convolutional Neural Networks – CNN Operations, CNN architecture, Training, Transfer Learning, Applications	10	CO2
IV	Recurrent Neural Networks RNN, LSTM, GRU, Applications	04	CO2,CO3
V	Classical Techniques – Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, Applications, k-Means, kNN, GMM, Expectation Maximization, Applications	07	CO3
VI	Advanced Techniques 1 – Structured Probabilistic Models, Monte Carlo Methods, Autoencoders, Generative Adversarial Network	07	CO4
	Total Hours	**42**	

Essential Readings

1. Deep Learning, Goodfellow et al, MIT Press, 2017.
2. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2009

Supplementary Readings

1. 1. Machine Learning Methods for Engineering Applications Development: by Prasad Lokulwar, Basant Verma, N. Thillaiarasu, Kailash Kumar, Mahip Bartere, Dharam Singh
2. 2. Deep Learning: by Goodfellow, et al, MIT Press, 2017
3. 3. Pattern Recognition and Machine Learning: by Christopher Bishop, Springer, 2009

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE441	**Infrastructure Planning and Management (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop an understanding planning and management of infrastructure system.	Course Outcomes	CE441.1	Able to acquire knowledge on urban and rural infrastructural system of India and identify related problems	Knowledge Identification
	To understand the Evaluation of infrastructure investment, risk and risk management for infrastructure project		CE441.2	Able to acquire knowledge on the key Issues of provision of Infrastructure system and identify its solutions.	Knowledge Identification
	To understand the fresh and hardened concrete behaviour:		CE441.3	Able to estimate key Issues of provision of Infrastructure system.	Estimate
	To analyse long term performance issues, related to creep, shrinkage and durability of concrete		CE441.4	Able to compute Supply and Demand for Infrastructure Issues of demand and supply management	Compute
			CE441.5	Able to design the Risk and Risk management framework for infrastructure project implementation	Design
			CE441.6	Able to estimate/analysethe case studies include both Indian and international cases, with emphasis on Indian cases.	Estimate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE441.1	**3**	**3**		**2**	**2**										
CE441.2	**3**	**3**	**3**	**2**	**1**									**0**	**3**
CE441.3	**3**	**3**	**3**	**2**	**2**									**0**	**3**
CE441.4	**3**	**3**	**3**	**2**	**2**									**2**	**3**
CE441.5	**3**	**3**	**3**	**2**	**2**		**3**							**3**	**3**
CE441.6	**3**	**3**	**3**	**2**	**2**		**3**							**3**	**3**
CE441	**3**	**3**	**2.5**	**2**	**1.8**		**1**							**1.33**	**2.5**

SYLLABUS

No.	Content	Hours	COs
I	Class Introduction, Introduction to Infrastructure and to the Transportation, power and telecom sectors. Rural and Urban Infrastructure Sectors, Players and Phases in an Infrastructure Project	8	CO1
II	Project Finance and Public Private Partnerships, Construction and Economic Risks, Political and Social Risks	8	CO2
III	Stakeholder Management, Design Thinking and Negotiations Socio-Economic Analysis and Good Governance for Infrastructure	10	CO3, CO4
IV	Modeling Flexible Project Arrangements Tales from the Field: Guest Lectures from Infrastructure Practitioners	08	CO4, CO5
V	Case studies include both Indian and international cases, with emphasis on Indian cases.	08	CO6
	Total Hours	**42**	

Essential Readings

1. Infrastructure Planning Handbook' by Prof Makarand Hastak, ASCE Press, 2006.
2. Strategic Management of Large Engineering Projects' by Miller, 2004.

Supplementary Readings

1. Infrastructure Planning and Management: An Integrated Approach by Virendra Proag, Springer Nature Switzerland AG; 1st ed. 2021 edition (7 November 2021)
2. Planning Major Infrastructure: A Critical Analysis by Tim Marshall, Routledge; 1st edition (3 July 2012).

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE443	**Energy efficiency, acoustics and daylighting in building (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To make the student aware about the concepts of functional design of building for thermal aspects and energy efficiency.		CE443.1	Able to **explain** the significance and benefits of energy efficiency in buildings.	Understand
	To make the student capable of performing fenestration design for natural ventilation and daylighting & design of space for external and internal noise control.		CE443.2	Able to **develop** methodology used to determine the energy efficiency of buildings.	Apply
			CE443.3	Able to **analyse** the different mechanisms for financing energy efficiency measures.	Analyse
			CE443.4	Able to **decide** policies in regards to daylighting in building.	Evaluate

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE443.1	**3**														
CE443.2	**3**	**2**		**3**											
CE443.3	**3**	**3**		**2**					**1**						
CE443.4	**3**	**3**	**3**	**3**		**1**			**1**					**3**	**2**
CE443	**3**	**2.67**	**3**	**2.5**		**1**			**1**					**3**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Environmental Factors** Factors and their representation, tropical environments and site environments, human response to environment, Factors affecting human comfort, Human response to thermal environment, noise, visual environment, Comfort indices	7	**CO1**
II	**Response of building to thermal environment** Processes of heat exchange of building with environment; Effect of solar radiation, Thermal properties of material and sections and their influence, Steady and periodic heat transfer in buildings	7	**CO1, CO2**
III	**Heat flow computations** Transmission matrix, Admittance method, heat flow computations	7	**CO2**
IV	**Structural control and design for energy efficiency** Selection of envelope elements, Orientations, shape, Glasses and shading devices, Natural ventilation, Purpose of ventilation, Mechanisms, Fenestration Design for natural ventilation	7	**CO3**
V	**Noise and Building** Basic acoustics and noise, Planning, Sound in free field, protection against external noise, Internal noise sources and protection against air borne & structure borne noise.	7	**CO3, CO4**
VI	**Day lighting** Lighting principles and fundamentals, Sky, Indian sky, daylight prediction and design of fenestration.	7	**CO4**
	Total Hours	**42**	

Essential Readings

1. O. H. Koenigsberger, T. G. Ingersoll, A. Mathew and S. V. Szokolay "Manual of Tropical Housing and Building: Climate Design", Universities Press (1975).
2. S. V. Szokolay, "Introduction to architectural science", Taylor & Francis group (2008).

Supplementary Readings

1. B. Givoni, "Man, Climate and Architecture", John Wiley & Sons (1998).
2. M. D. Egan, "Architectural Lighting", McGraw-Hill (2002).

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE471	**Introduction to Optimization Techniques (NPTEL course)**	**----**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop the student's knowledge on basics of optimization process	Course Objectives	CE471.1	Able to **outline** the basics of optimization process.	Understand
			CE471.2	Able to **develop** and perform **analysis** of single and multivariable unconstrained problems.	Apply Analyse
	To impart knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimizationproblems		CE471.3	Able to **evaluate** the concept of nonlinear constrained optimization techniques.	Evaluate
			CE471.4	Able to **solve** linear programming problems	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE471.1	**3**	**3**		**2**	**2**								**1**	**2**	**3**
CE471.2	**3**	**3**			**3**	**1**							**1**	**2**	**3**
CE471.3	**3**	**3**	**1**	**2**		**1**		**3**					**1**	**2**	**3**
CE471.4	**3**	**3**	**1**					**3**					**1**	**2**	**3**
CE471	**3**	**3**	**1**	**2**	**2.5**	**1**	**3**	**3**					**1**	**2**	**3**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Optimization problem formulation, types of optimization problems, objective function, design variables, constraints and variable bounds.	**2**	CE471.1
II	**Single variable optimization methods** Optimality criteria, necessary and sufficient conditions, bracketing methods, region elimination methods, gradient based methods.	**6**	CE471.2
III	**Multivariable optimization methods** Optimality criteria, necessary and sufficient conditions, unidirectional search, direct search methods, gradient based methods.	**8**	CE471.2
IV	**Constrained optimization methods** Direct substitution techniques, transformation methods, Lagrange multipliers methods, Kuhn-Tucker conditions.	**7**	CE471.3
V	**Linear programming problem** Graphical methods, formulation of LPP, simplex method, big M method.	**5**	CE471.4
	Total Hours	**28**	

Essential Readings

1. K. Deb, "Optimization for Engineering Design", PHI Learning, 2nd Edition, 2014.
2. S. S. Rao, "Engineering Optimization Theory and Practice", John Wiley and Sons, 4th Edition, 2009.

Supplementary Readings

1. J. S. Arora, "Introduction to Optimum Design", McGraw Hill Education, 4th Edition, 2017.
2. E. K. P. Chong and S. H. Zak, "An Introduction to Optimization", John Wiley and Sons, 4th Edition, 2013.

EIGHTH SEMESTER COURSES

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE412	**Introduction to Earthquake Engineering (NPTEL Course)**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To provide the fundamental concepts, principles and application of earthquake engineering in seismic analysis and design of structures as per the relevant codal provisions for earthquake resistant design of structures as per Indian Standards		CE412.1	Able to acquire knowledge about seismology and Earthquake inputs	Knowledge
			CE412.2	Able to understand thedynamics for earthquake analysis and response analysis for specific Ground motion	Understand Analysis
			CE412.3	Able to acquire knowledge about response spectrum method of analysis	Knowledge Analysis
	To provide the knowledge of the causes of occurrence of earthquake and its characterization		CE412.4	Able to describeseismic soil-structure interaction and in-elastic response of structures for earthquake forces	Describe
			CE412.5	Able to get an understandingonbase isolation for earthquake resistant design of structures	Understanding Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE412.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE412.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE412.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE412.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE412.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE412	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.		Hours	COs
I	**Seismology:** Earth's Interior and Plate Tectonics; Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters; Modification of Earthquake due to the Nature of Soil; Seismic Hazard Analysis I; Seismic Hazard Analysis II; Discussion on Tutorial Problems.	04	CE412.1
II	**Earthquake Inputs:** Time History Records and Frequency Contents of Ground Motion; Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake; Combined D-V-A Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard Spectrums; Predictive Relationships for earthquake parameters; Discussion on Tutorial Problems.	06	CE412.1
III	**Dynamics for Earthquake Analysis:** Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems; Mode Shapes and Frequencies of MDOF System; Rayleigh Damping Matrix; Direct Time Domain Analysis of MDOF System; Direct Frequency Domain Analysis of MDOF System; Modal Analysis in Time and Frequency Domain; Discussion on Tutorial Problems.	06	CE412.2
IV	**Response Analysis for Specific Ground Motion:** Equations of Motion for Single and Multi- Support Excitations and Solutions; Equations of Motion in State Space and Solutions; Computational Steps for the Solutions using MATLAB I; Computational Steps for the Solutions using MATLAB II; Time History Analysis of 3D Tall Buildings; Discussion on Tutorial Problems.	05	CE412.2
V	**Response Spectrum Method of Analysis:** Concept of Equivalent Lateral Force for Earthquake; Modal Combination Rules; Response Spectrum Method of Analysis of Structures and codal Provisions; Response Spectrum Method of Analysis for torsionally Coupled Systems; Response Spectrum Method of Analysis for Non-Classically Damped Systems; Discussion on Tutorial Problems.	05	CE412.3
VI	**Seismic Soil - Structure Interaction:** Fundamentals of Seismic Soil-Structure Interaction; Direct Method of Analysis of Soil-Structure 6 Interaction using FEM and Use of ABAQUS Software I; Direct Method of Analysis of Soil-Structure Interaction using FEM and Use of ABAQUS Software II; Sub-structuring Method of Analysis of Soil- Structure Interaction Problem I; Sub-structuring Method of Analysis of Soil- Structure Interaction Problem II; Discussion on Tutorial Problems.	07	CE412.4
VII	**Inelastic Response of Structures for Earthquake Forces:** Fundamental Concepts of Inelastic Response Analysis for Earthquake Forces; Solutions of Incremental Equations of Motions for SDOF Systems; Solutions of Incremental Equations of Motions for MDOF Systems; Push over Analysis; Concepts of Ductility and Inelastic Spectrum; Discussion on Tutorial Problems.	05	C412.4
VIII	**Base isolation for earthquake resistant design of structures:** Base isolation concept, isolation systems and their modelling; linear theory of base isolation; stability of elastomeric bearings; codal provisions for seismic isolation, practical applications.	04	CE412.5

Total Hours	**42**	
Essential Readings		
1. Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.,' Prentice Hall, 1971.		
2. Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition, 1992.		
Supplementary Readings		
1. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.		
2. Ellis L. Krinitzsky, J.M. Gould and Peter H. Edinger, 'Fundamentals of Earthquake Resistant Construction', John Wiley, 1993.		
3. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI, 2008.		

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE414	**Advanced Concrete Technology (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To develop an understanding of the advanced concepts of concrete technology along with the basic concept.	Course Outcomes	CE414.1	Able to acquire knowledgerole of ingredients in cement concrete	Knowledge
	To understandthe roles ofadmixtures in concrete and the various types of special concrete and their importance in construction		CE414.2	Able to estimate parameter and compute the functions of the various types of admixtures in concrete	Estimate Compute
	To understand the fresh and hardened concrete behaviour:		CE414.3	Able to acquire knowledge on fresh and hardened stage properties of concrete.	Knowledge
	To analyse long termperformance issues, related to creep, shrinkage and durability of concrete		CE414.4	Able to design cement and fly ash based concrete mix using IS Code	Design
			CE414.5	Able to acquire knowledgeon the need for and importance of special concrete in construction	Knowledge

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE414.1	**3**	**3**												**0**	**0**
CE414.2	**3**	**3**	**3**				**1**							**1**	**3**
CE414.3	**3**	**3**	**3**				**1**							**1**	**3**
CE414.4	**3**	**3**	**3**											**0**	**3**
CE414.5	**3**	**3**	**3**				**3**							**3**	**3**
CE414	**3**	**3**	**2.4**				**1**							**1**	**2.4**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Definition and ingredients of concrete, Hydration of cementcompounds, Alkali aggregate reaction, water requirement in concrete and curingof concrete.	04	CE414.1
II	**Chemical Admixtures:** Definition, types and effect of chemical admixtures onconcrete, Detailed study of Plasticizers, Superplasticizer, New generationsuperplasticizer and Air entraining admixtures, Curing compounds and its types.	06	C414.2
III	**Mineral Admixtures:** Definition and types, Effect of Fly ash, Silica fume and Ground granulated blast furnace slag on concrete properties.	08	C414.2
IV	**Properties of concrete:** Segregation and Bleeding, strength, elasticity, creep, shrinkage and durability.	08	CE414.3
V	**Concrete Mix Design:** Methods of mix design, Concept of mix design, Mix design for cement concrete, Fly ash cement concrete and pumpable concrete, sampling and acceptance criteria	08	CE414.4
VI	**Special Concrete:** Geopolymer / Alkali activated concrete, Light weight concrete, No fines concrete, Fiber reinforced concrete, Roller compacted concrete, Self compacting concrete and Bacterial concrete	08	CE414.5
	Total Hours	**42**	

Essential Readings

1. Neville A.M and Brooks J.J., Concrete Technology: Second Technology, Pearson India Education Services Pvt Ltd.; 2020
2. Gambhir M.L Concrete Technology: Theory and Practice,TMH Publisher; 2013.

Supplementary Readings

1. Shetty M.S. and Jain A.K., Concrete Technology: Theory and Practice S. Chand Publication; 2018
2. Bhavikatti S.S., Concrete Technology; Dreamtech Press; 2019

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE416	**Retrofitting and Rehabilitation of Civil Infrastructure (NPTEL course)**	**Nil**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives

- To give an in-depth understanding of the various methods of repair, retrofitting and rehabilitation techniques for masonry and concrete structures
- To impart knowledge for assessment of distressed structures for retrofitting

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE416.1	Understanding the distress structures and their associated loading.	Understanding
CE416.2	Understanding the various retrofitting/rehabilitation materials.	Understanding
CE416.3	Familiarize and understandingthe different retrofitting techniques.	Understanding
CE416.4	Familiarize the assessment techniques and able to apply the corresponding tests.	Apply
CE416.5	Application of different retrofitting techniques	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE416.1	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**3**	**0**	**3**
CE416.2	**3**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**1**	**0**	**2**
CE416.3	**2**	**3**	**2**	**1**	**2**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**
CE416.4	**2**	**2**	**3**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**2**	**3**	**2**
CE416.5	**2**	**2**	**2**	**0**	**2**	**2**	**3**	**0**	**2**	**0**	**0**	**1**	**3**	**3**	**3**
CE416	**2.4**	**2.4**	**1.4**	**0.6**	**1.2**	**1.0**	**1.2**	**0**	**1.6**	**0**	**0**	**0.4**	**2.2**	**1.8**	**2.4**

SYLLABUS

No.	Content	Hours/Lecture	COs
I	**Overview of Retrofitting and Rehabilitation of Civil Infrastructure** Causes of Deterioration, Materials Related Distresses, Other Distresses in Concrete, Load Associated Distresses	4	CE416.1
II	**Condition Evaluation and Testing** Identification of Distresses, Semi - destructive Testing, Non - destructive Tests, Other Tests	4	CE416.2
III	**General Repair and Strengthening of Concrete Structures** Considerations for Repair and Retrofitting, Repair Techniques, Strengthening of Structural Components	4	CE416.2, CE416.3
IV	**Fiber Reinforced Polymer Composites (FRPC) and its Characteristics** Introduction to Composites, Types and Characteristics, Properties of Fibers, Resins and FRP Composite, Micromechanics of Composites, Manufacturing of FRP Composites	4	CE416.2, CE416.3
V	**Retrofitting by FRP Composites** FRPC in Flexural Strengthening of Structural Members-I& II, FRPC in Shear Strengthening of Structural Members, FRPC in Axial Strengthening of Structural Members – I & II, Near Surface Mounted FRP Reinforcement, FRPC in Strengthening of Beam-Column Joints, Anchorage Systems for FRP Strengthening, Installation of FRP, Design Considerations, Design Approach for Flexural Strengthening, Design of Flexural Strengthening, Design Approach for Shear Strengthening, Design of Shear Strengthening,Design Approach for Axial Strengthening,Design of Axial Strengthening	9	CE416.3, CE416.4
VI	**Concrete Overlay for Pavement Rehabilitation** Concepts of Concrete Overlay, Distresses in Existing Pavement, Evaluation of Pavement, Design Considerations for Concrete Overlay, Construction of Concrete Overlay	4	CE416.3, CE416.4
VII	**Retrofitting of Masonry Structures** Retrofitting Steps, Review of Materials and Test Methods, Review of Analysis Method, Some aspects of Seismic Retrofitting	3	CE416.3, CE416.4
VIII	**Retrofitting of Building structures damaged due to seismic event** Introduction, A Few Retrofitting Techniques, A Few Seismic Retrofitting Techniques, Retrofitting steps and Techniques	3	CE416.3, CE416.4
IX	**Retrofitting of Special structures damaged due to seismic events** Retrofitting Techniques for Structural Elements, Seismic Strengthening of structural elements	4	CE416.3, CE416.4
X	**Retrofitting of Steel Structures** Introduction and Overview, Retrofitting of Structural Members, A case study of Retrofitting	3	CE416.3, CE416.4
	Total Hours	**42**	

Essential Readings

1. Neville, A. M. and Brooks, J. J., Concrete Technology, Prentice Hall, 2010
2. Thomas Dyer, Concrete Durability, Taylor & Francis Group, 2014

Supplementary Readings

1. Bank L. C. Composites for Construction, John Wiley & Sons, Inc., 2006
2. ACI 440.2R-08. Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, American Concrete Institute, 2008

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE418	**Irrigation and Drainage (NPTEL course)**	**----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To make the student understand the knowledge ofirrigation engineering science.	Course Objectives	CE418.1	Able to **interpret** the need, benefits and ill effects of irrigation process.	Evaluate
			CE418.2	Able to **outline** the various types of water application methods in farms along with their advantages and disadvantages.	Understand
			CE418.3	Able to **make use of** soil-moisture-irrigation relationships to find irrigation requirement.	Apply
	To make the student aware of various hydraulic structures.		CE418.4	Able to **design** canal irrigation system.	Create
			CE418.5	Able to **analyse** and **interpret** functions of various hydraulic structures.	Analyse Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE418.1	**3**	**3**			**1**		**3**							**3**	**1**
CE418.2	**3**	**3**			**1**		**3**						**2**	**3**	**3**
CE418.3	**2**	**1**	**1**		**1**		**2**			**2**				**2**	**1**
CE418.4	**3**	**3**			**1**		**1**			**2**			**3**	**3**	**2**
CE418.5	**3**	**3**	**3**		**1**		**3**			**2**			**1**	**3**	**3**
CE418	**2.8**	**2.6**	**2**		**1**		**2.4**			**2**			**2**	**2.8**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Soil-Water-Plant-Atmosphere Relationship** Definition and aim of irrigation, Necessity, Benefits and ill effects of irrigation, Types of irrigation, Soil-moisture-irrigation relationship, Depth and frequency of irrigations.	**2**	**CE418.1**
II	**Crop Water Requirement and Irrigation Scheduling** Crop period, Base period, Duty, Delta, Relationship between duty and delta, Irrigation requirements, Irrigation efficiencies	**4**	**CE418.1, CE418.2**
III	**Irrigation Water Conveyance, Measurement of Irrigation Water and Water Application Methods** Definition, Surface and subsurface irrigations, Free flooding, Border flooding, Check flooding, Basin flooding, Furrow irrigation method, Sprinkler irrigation method, Drip irrigation method, Advantages and disadvantages of various types	**4**	**CE418.1, CE418.2**
IV	**Irrigation Systems Design-1** Lift irrigation: definition, types, sources, advantages and disadvantages, comparison of well irrigation with canal irrigation, design	**4**	**CE418.2**
V	**Irrigation Systems Design-2** Canal Irrigation: Introduction, Alluvial and non-alluvial canal, Alignment of canals, Curves in canals, Design capacity of an irrigation canal, Canal losses, Canal linings, Advantage of linings, Different types of linings.	**4**	**CE418.2, CE418.3**
VI	**Performance Evaluation of Irrigation System** Definition, Types of different headworks, Layout and components of storage and diversion head works, Weir and barrage, Head regulator, Silt excluder	**4**	**CE418.3**
VII	**Drainage of Agricultural Lands** Surface and sub-surface drains	**4**	**CE418.3, CE418.4**
VIII	**Management of Salt affected soils** Causes of water logging, Ill effects and preventive measure of water loggings	**4**	**CE418.4**
IX	**Performance Evaluation of Drainage Systems** Canal falls: Necessity, Location and various types	**4**	**CE418.4**
X	**Ground Water Hydrology** Definition of ground water, ground water balance equation, Continuum approach and representative elementary volume approach in ground water	**4**	**CE418.5**
XI	**Irrigation wells and Water-lifting devices-pumps** Wells in confined and unconfined aquifers, steady flow from a well in confined aquifer, steady flow from a well in unconfined aquifer, solution of unsteady ground water flow in confined aquifer, solution of unsteady ground water flow in unconfined aquifer	**4**	**CE418.5**
Total Hours		**42**	

Essential Readings

1. G. L. Asawa, "Irrigation and Water Resources Engineering", New Age Internationals, 2nd edition, 2005.
2. S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, 35th edition, 2019.

Supplementary Readings

1. N. N. Basak, "Irrigation Engineering", McGraw Hill Education, 4th edition, 2013.
2. M. M. Das and M. D. Saikia, "Irrigation and Water Power Engineering", PHI Learning, 6th edition, 2016.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE422	**Scheduling Techniques in Projects (NPTEL Course)**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	**To make students proficient in applying a range of scheduling techniques to effectively plan and manage project activities, optimizing resource allocation and project timelines**	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To make students develop the analytical skills necessary to assess project dependencies, identify critical paths, and implement advanced scheduling strategies to mitigate risks and adapt to changing project requirements		CE422.1	**Able to acquire knowledge about the fundamental concepts of project management and the importance of scheduling techniques in project planning and execution.** — **Knowledge**
			CE422.2	**Able to acquire knowledge about proficiency in utilizing various scheduling methods.** — **Knowledge**
			CE422.3	**Able to acquire knowledge about advanced scheduling techniques such as Information-driven scheduling and Dependency Structure Matrix.** — **Knowledge**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE422.1	1	1	1	1	1	1	1	1	1	1	3	2	2	2	1
CE422.2	1	1	1	1	1	1	1	1	1	1	3	2	2	2	1
CE422.3	1	1	1	1	1	1	1	1	1	1	3	2	2	2	1
CE422	1	1	1	1	1	1	1	1	1	1	3	2	2	2	1

SYLLABUS

No.	Content	Hours	COs
I	Introduction to projects, Inputs to scheduling, Critical path method.	10	CE422.1
II	Precedence diagramming method, Line of balance method, Resource-driven scheduling.	10	CE422.2
III	Information-driven scheduling, Dependency structure matrix–I, Dependency structure matrix–II.	11	CE422.3
IV	Dependency structure matrix–III, Beeline diagramming method, Other scheduling techniques.	11	CE422.3
	Total Hours	**42**	

Essential Readings

1. A. Baldwin & D. Bordoli, A Handbook for Construction planning and scheduling, Wiley publications, 2014
2. S. Mubarak, Construction Project Scheduling and Control, John Wiley publications, 2010

Supplementary Readings

1. E. M. Willis, Scheduling Construction Projects, John Wiley publications, 1986
2. S. D. Eppinger & T.R. Browning, Design Structure Matrix Methods and Applications, MIT Press, 2012.

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CE424	**Pre stressed concreteStructures (NPTEL course)**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**
			CO's						

Course Objectives	Tounderstand behaviour of prestressed concrete, analysis and design for strength.	Course Outcomes	CE424.1	Able to acquire knowledgeon the requirement of PSC members for present scenario.	Knowledge
	To know the serviceability-based design of prestressed concrete members		CE424.2	Able to estimate parameter and compute the stresses encountered in PSC element during transfer and at working.	Estimate Compute
	To understand theanchorage design and losses in prestress		CE424.3	Able to acquire knowledge on the effectiveness of the design of PSC after studying losses	Knowledge
			CE424.4	Able to compute and design the PSC element and finding its efficiency	Compute Design
			CE424.5	Able to design PSC beam for different requirements.	Design
			CE424.6	Able to design PSC slab for different requirements.	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE424.1	**2**	**2**	**3**				**2**			**2**			**3**		
CE424.2	**2**	**2**	**3**				**2**			**2**			**3**		
CE424.3	**2**	**2**	**3**				**2**			**2**			**3**		
CE424.4	**2**	**2**	**3**				**2**			**2**			**3**		
CE424.5	**2**	**2**	**3**				**2**			**2**			**3**		
CE424.6	**2**	**2**	**3**				**2**			**2**			**3**		
CE424	**2**	**2**	**3**				**2**			**2**			**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Introduction and Analysis of Members:** Concept of Pre-stressing - Types of Pre-stressing - Advantages - Limitations –Prestressing systems - Anchoring devices - Materials - Mechanical Properties of high strength concrete - high strength steel - Stress-Strain curve for High strength concrete. Analysis of members at transfer - Stress concept - Comparison of behavior of reinforced concrete – prestressedconcrete - Force concept - Load balancing concept - Kern point -Pressure line.	08	CE424.1
II	**Losses in Prestress:** Loss of Prestress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss. Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force -Total deflection - Limits of deflection - Limits of span-to-effective depth ratio -Calculation of Crack Width - Limits of crack width.	10	CE424.2, CE424.3
III	**Design of Sections for Flexure**: Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1members.	08	CE424.4, CE424.5
IV	Design for Shear: **Analysis for shear - Components of shear resistance - Modes of Failure - Limit State ofcollapse for shear - Design of transverse reinforcement.**	08	CE424.5
V	**Different anchorage system and design of end block by latest IS codes:**	08	CE424.6
Total Hours		**42**	

Essential Readings

1. Krishna Raju, N. "Prestressed Concrete", Tata McGraw Hill Publishing Company, New Delhi 2006
2. Rajagopalan N, "Pre - stressed Concrete", Narosa Publishing House, New Delhi 2020

Supplementary Readings

1. P. Dayaratnam, "Prestressed Concrete Structures", Scientific International Pvt. Ltd., 2018.
2. Pundit G S and Gupta S P, "Pre - stressed Concrete", C B S Publishers, New Delhi, 2017.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE426	**Port and Harbour Structures (NPTEL Course)**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	Statement	Bloom's Taxonomy
Course Objectives	**To develop student's knowledge on port and harbour layout, breakwater design, berthing structures.**	**CE426.1**	**Able to acquire knowledge about Port layout, ship sizing, planning, harbour layout, site characteristics, navigation channels, and survey techniques.**	**Knowledge**
	To develop student's knowledge on Single buoy mooring, jetties, docks, and their construction.	**CE426.2**	**Able to acquire knowledge about breakwater design, types, dredging methods, modelling, analysis, and forces affecting berthing structures.**	**Knowledge Modelling Analysis**
	To develop student's knowledge on Coastal structures and environmental management, BOQ and cost estimate.	**CE426.3**	**Able to acquire knowledge about Single buoy mooring, jetties, docks, and their construction.**	**Knowledge**
		CE426.4	**Able to acquire knowledge about soil structure interaction, Ground improvement techniques and their application in Port and Harbour Structures.**	**Knowledge Application**
		CE426.5	**Able to acquire knowledge about UPV, Half-cell potential, Coastal structures and environmental management, BOQ and cost estimate.**	**Knowledge**
		CE426.6	**Able to design pile and diaphragm wall, empirical relationship between SPT and several soil properties and case study.**	**Design**

Course Outcomes

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE426.1	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426.2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426.3	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426.4	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426.5	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426.6	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**
CE426	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Layout of ports, Ships and size of ships, Port planning, Harbour layout.	03	CE426.1
II	Site characteristics and navigation channel, Bathymetric survey, Tide, Surge, Tsunami and wave, Wave rose diagram.	03	CE426.1
III	Breakwater, Design of breakwater, Berm breakwater, Dredging and methods of disposal.	04	CE426.2
IV	Berthing structures modeling, Berthing structures analysis, Loads, Types of berthing structures, Design of berthing, Design of offshore berthing, Estimation of mooring, berthing and seismic forces, Estimation of seismic forces, Active and passive earth pressure and differential water pressure, Load combinations and design, Fenders, Mechanical handling system.	04	CE426.2
V	Single buoy mooring and open sea jetty, Slipway, drydock, floating dock, shiplift.	04	CE426.3
VI	Soil structure interaction, Calculation of fixity depth, Pile load test, Ground improvement techniques, Analysis of pile with spring support.	04	CE426.4
VII	UPV, Half cell potential, Low high integrity test, Mooring dolphin at KPT.	04	CE426.5
VIII	Coastal structures and environmental management, BOQ and cost estimate, Proposed mega terminal Chennai, Preliminary project report on shipyard, Procedures and clearances before implementation of a project, Detailed project report, Environmental studies of a project.	04	CE426.5
IX	Design of pile.	04	CE426.6
X	Design and construction of diaphragm wall.	04	CE426.6
XI	Empirical relationship between SPT and several soil properties, Model studies for a deep water port – case study.	04	CE426.6
	Total Hours	**42**	

Essential Readings

1. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications, 2003.
2. Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels by J. W. Gaythwaite, Van Nostrand, 2004.

Supplementary Readings

1. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
2. Agerschou, H., Lundgren, H., Sorensen, T., Ernst, T., Korsgaard, J., Schmidt, L.R. and Chi, W.K., (1983). “Planning and Design of Ports and Marine Terminals”, A Wiley-Interscience Publication.
3. Per brun (1983). “Port Engineering” Gulf Publishing Co

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE428	**Underground Space Technology (NPTEL Course)**	**……**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To impart knowledge of methods of analysis and design of underground excavations in rocks and jointed rock masses for hydro-power projects and large underground storages for various purposes.	Course Outcomes	CE428.1	**Able to acquire knowledge about Rock engineering basics**	Knowledge
			CE428.2	**Able to understand stress distribution around tunnels, ground conditions in tunnelling, analysis of underground openings**	Understand Analysis
			CE428.3	**Able to understand rock mass classification system**	Understand Classification
			CE428.4	**Able to get a comprehensive understanding on rock mass-tunnel support interaction analysis,design of various support systems**	Understanding, Analysis Design
			CE428.5	**Able to plan Instrumentation and monitoring of underground excavations, during and after construction, various case studies**	Plan

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE428.1	**3**	**2**	**1**		**2**	**2**	**2**					**2**	**2**		**2**
CE428.2	**1**	**3**	**3**	**2**	**2**	**1**	**1**	**1**				**2**	**3**	**2**	**2**
CE428.3	**2**	**3**	**3**	**3**	**2**	**2**	**1**		**2**			**2**	**3**	**3**	**3**
CE428.4	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**2**	**3**	**3**
CE428.5	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**			**2**	**3**	**3**	**3**
CE428	**2**	**2.4**	**2.6**	**2.25**	**2**	**1.8**	**1.6**	**1**	**2**			**2**	**2.6**	**2.75**	**2.6**

SYLLABUS

No.		Hours	COs
I	Rock Engineering Basics: rocks and rock masses, physical and mechanical properties, classification and failure criteria. Underground excavations, ground conditions, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.	07	CE428.1
II	In-situ stress, elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels.	08	CE428.2
III	Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks, uni-axial jacking /plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian tunneling Method (NATM), Norwegian Tunneling Method (NMT).	12	CE428.3
IV	Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi's elasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts, permeability and grouting.	08	CE428.4
V	In-situ stress, flat jack, hydraulic fracturing, single and multi-point bore hole extensometers, load cells, pressure cell. Instrumentation and monitoring of underground excavations, during and after construction, various case studies.	07	CE428.5
	Total Hours	**42**	

Essential Readings

1. Goodman, RE (1989). Introduction to Rock Mechanics, Canada, John Wiley & Sons.
2. Hoek, E and Brown, ET (1988). Underground Excavations. Spon Press.
3. Ramamurthy, T (2007). Engineering in Rocks for Slopes, Foundation and Tunnels. N. Delhi, PHI Pvt. Ltd.

Supplementary Readings

1. Sivakugan, N, Shukla, SK and Das, BM (2013). Rock Mechanics: an introduction. Boca Raton, FL, CRC Press.
2. Wyllie, DC and Mah CW (2004). Rock Slope Engineering, Civil and Mining. NY, Spon Press.
3. Singh, B and Goel RK (2011). Engineering Rock Mass Classification. Oxford, UK, Elsevier Inc.