



**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY**  
**Guwahati**  
**Course Structure and Syllabus**

**(From Academic Session 2018-19 onwards)**

**B.TECH**  
**CIVIL ENGINEERING**

**3<sup>rd</sup> SEMESTER**



# ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

## Course Structure

(From Academic Session 2018-19 onwards)

### B.Tech 3<sup>rd</sup> Semester: Civil Engineering

#### Semester III/B.TECH/CE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P		C	CE
<b>Theory</b>								
1	MA181301A	Mathematics III-A (for branches other than CSE and ECE/ETE)	2	1	0	3	30	70
2	CE181302	Solid Mechanics	2	1	0	3	30	70
3	CE181303	Fluid Mechanics	3	1	0	4	30	70
4	CE181304	Building Construction and Planning	3	0	0	3	30	70
5	CE181305	Engineering Survey-I	3	1	0	4	30	70
6	CE181307	Structural Analysis-I	3	1	0	4	30	70
7	MC181306	Constitution of India	2	0	0	0 (PP/NP)	-	100
<b>Practical</b>								
1	CE181318	Civil Engineering Drawing and CAD Lab	0	0	2	1	15	35
2	SI181321	Internship-I (SAI - Social)	0	0	0	1	-	100
<b>TOTAL</b>			18	5	2	<b>23</b>	<b>195</b>	<b>655</b>
Total Contact Hours per week : 25								
Total Credits: 23								

**N.B. MC181306 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)**

### Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
MA181301A	Mathematics III-A (for branches other than CSE and ECE/ETE)	2-1-0	3

#### MODULE 1: Partial Differential Equation: (15 Hours)

Formation of Partial Differential equations, Linear partial differential equation of first order, Non-linear partial differential equations of first order, Charpit's method, Method of separation of variables, boundary value problem with reference to the one dimensional heat and wave equation.

#### MODULE 2: Probability Theory: (15 Hours)

Review of basic probability and Bayes' theorem, Probability distribution, Binomial, Poisson and normal distribution, Joint distribution, Test of significance, fitting of straight line by least square method, Elementary concept of Markov Chain.

#### MODULE 3: Laplace Transform: (10 Hours)

Laplace transform of elementary function, Properties of Laplace transform, inverse Laplace transform, convolution theorem, Solution of ordinary differential equations with the help of Laplace transform.

#### Textbooks/References:

1. Advanced Engineering Mathematics: Erwin Kreyszig
2. Higher Engineering Mathematics: B V Ramana
3. Theory and problems of Probability: Seymour Lipschutz
4. A text book of engineering Mathematics: N. P. Bali & M. Goel
5. Statistical Methods: An Introductory Text- J.Medhi, New Age International Publishers

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181302	Solid Mechanics	2-1-0	3

### **MODULE 1: Simple Stress and Strain**

Simple stress and strain: Tensile, compressive and shear stress, principal stresses and strains; Mohr's circle for plane stress and plane strain Hook's law. Young's modulus, Poisson's ratio, elastic constants and their relationship.

Hook's law; Stress-strain diagrams for brittle and ductile materials

Generalized stress and strain: Analysis of plane stress and plane strain, Mohr's circle of stress and strain.

### **MODULE 2: Bending Stress and Shear Stress in Beam**

Theory of Simple Bending - Bending stresses in beams.

Shear stress distribution in various shapes of cross section of beams.

### **MODULE 3: Columns**

Empirical formula, Rankine's formula, slenderness ratio, Concentric and eccentric load. Columns with initial curvature. Equivalent eccentricity, Beam column.

### **MODULE 4: Thin Cylinders and Shells**

Hoop stress, Thin Cylinders and Shells under internal fluid pressure – Riveted Joint Connection - Wire wound thin cylinders.

### **MODULE 5: Torsion of Circular Shafts**

Theory of Pure Torsion in Solid and Hollow circular shafts - Torsional Shear Stresses - transmission of Power- Strength of shaft or torsional rigidity.

### **Text Books/References:**

1. R. Subramanian- Strength of Materials, Oxford
2. Debabrata Nag and Abhijit Chanda, Strength of materials, Wiley-India Publishers,2012.
3. S Ramamrutham, Strength of Materials, Dhanpat Rai Publishing Company.
4. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, New Delhi, 1996.
5. S.B. Junarkar and H.J. Shah, Mechanics of Structures, Charotar Publishers, Anand, 1998.
6. Beer and Johnston, Mechanics of Materials, McGraw Hill International Edition, 1995.
7. E.P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Pvt. Ltd., 1998.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181303	Fluid Mechanics	3-1-0	4

**MODULE 1: Fluid Properties:**

Fluid- definition, types; physical properties of fluid- density, specific weight, specific volume, specific gravity, viscosity- Newton's law of viscosity, surface tension, compressibility of fluids, capillarity.

**MODULE 2: Fluid Statics:**

Hydrostatic pressure, pressure height relationship, absolute and gauge pressure, measurement of pressure- manometer; pressure on submerged plane and curved surfaces, centre of pressure; buoyancy, equilibrium of floating bodies, metacentre; fluid mass subjected to accelerations.

**MODULE 3: Fluid Kinematics:**

Types of motion- steady and unsteady flow, uniform and non uniform flow, laminar and turbulent flow, compressible and incompressible flow, one, two & three dimensional flow; stream lines, streak lines and path lines, stream tube, stream function and velocity potential, flow net and its drawing; free and forced vortex.

**MODULE 4: Fluid Dynamics:**

Basic equations- continuity equation, energy equation (Euler's equation, Bernoulli's equation), momentum equation; application of energy equation and continuity equation- Venturimeter, orifice meter, pitot tube.

**MODULE 5: Orifices and Mouthpieces:**

Classification of orifice, flow through orifice, hydraulic coefficients- definition and experimental determination, discharge through large rectangular orifice, time of emptying a tank (for both rectangular and hemispherical) through an orifice at its bottom; classification of mouthpiece, flow through an external cylindrical mouthpiece, flow through a convergent- divergent mouthpiece, mouthpiece running full and running free.

**MODULE 6: Notches and Weirs:**

Types- rectangular, triangular and trapezoidal notches and weirs, suppressed weir, Cippoletti weir, submerged weir, narrow and broad crested weir, Francis's formula with end contraction.

**MODULE 7: Flow through Pipes:**

Loss of head due to friction, Darcy Weisbach formula; minor head losses; flow through compound pipes; siphon.

**MODULE 8: Dimensional Analysis and Model Laws:**

Dimensional analysis- Rayleigh's method, Buckingham's pi-theorem; important dimensionless parameters and their significance; application of dimensional analysis to fluid flow problems: geometric, kinematic and dynamic similarities; scale ratio, prototype, distorted model.

**Text Books/References:**

1. Hydraulics and Fluid Mechanics (Including Hydraulic Machines)- by P. N. Modi and S. M. Seth
2. Hydraulics Fluid Mechanics and Fluid Machines- by S. Ramamrutham

3. A Textbook of Fluid Mechanics and Hydraulic Machines- by R. K. Bansal
4. Fluid Mechanics and Machinery- by C. S. P. Ojha, R. Berndtsson and P. N. Chandramouli
5. Fluid Mechanics- by Frank M. White
6. Fluid Mechanics and Turbomachines- by Madan Mohan Das
7. Fluid Mechanics- by A. K. Jain
8. Fluid Mechanics through Problems- by R. J. Garde
9. Theory and Application of Fluid Mechanics- by K. Subramanya

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181304	Building Construction and Planning	3-0-0	3

## 1<sup>st</sup> PART: BUILDING CONSTRUCTION

### MODULE 1: Introduction

Functional Requirements of a Building- Strength, Stability, Comforts, Convenience, Daylight, Ventilation

Types of Building: R.C.C and Assam Type; Classification as Per National Building Code of India (2005)

### MODULE 2: Building Elements

Foundation and Plinth- Deep and shallow foundation

Wall, Beam, Column, Lintel.

Damp proofing: Causes of dampness, method and materials of damp proofing, damp proofing treatment in buildings, damp proofing for roofs.

Roof and roof coverings: Classification, Material- false ceiling

Shoring, scaffolding and formwork

### MODULE 3: Circulation elements

Horizontal and Vertical transportation in Buildings

Stairs: Definition – classification of stairs- location of stairs – fixation of rise and trade– thumb rule – – stair of different materials – lift and escalators.

Doors and windows: Location of doors and windows, size, types of doors and windows, fixing and fastenings.

### MODULE 4: Brick masonry

Definition, General principle, Bonds in brick work, Merits and demerits, Defects in brick masonry, Reinforced brick work.

### MODULE 5: Flooring and Finishing

Types of flooring- Mud flooring, brick flooring, cement concrete flooring, tile flooring, mosaic flooring, marble flooring, timber flooring.

Plastering and painting: Cement and lime terracing, painting and varnishing

## 2<sup>nd</sup> PART: BUILDING PLANNING

### MODULE 1: General principles of planning

Introduction: History of Urbanisation and Urban Development, need for Building Planning, Development Control, Zoning Regulation

Principles of building planning: Aspect, Prospect, Privacy–. Orientation, Ventilation, Lighting, sanitary planning of buildings.

## **MODULE 2: Building Bye-Laws**

Objectives of building byelaws, Provisions of National Building Code of India for Building Planning, Different terms, Building By-Laws for Residential and Commercial Buildings, set-back lines, open spaces, carpet area, Floor area Ratio (FAR) and Floor Space Index (FSI), Building height limitations, minimum sizes of different rooms etc.

Procedure for obtaining Permission for Construction, Site selection and site plan.

Principle of Vastu Shastra, Concept of Green buildings- LEED and GRIHA provisions.

## **MODULE 3: Building services**

Water supply, Sewerage and drainage services.

Electrical Services.

Fire and Safety Services.

Heating, ventilation and air conditioning services.

### **Text Books/References:**

1. “Building Construction”- B.C. Punmia, Laxmi Publications (P) Ltd.
2. GMDA Building Byelaw
3. GMDA Master Plan
4. National Building Code of India (2005), BIS
5. “Building Construction”, P.C. Vargesse, Practice hall of India, New Delhi
6. “Civil Engineering Drawing”– Malik & Meo, Computech Publication Ltd.
7. :Building Planning, Designing & Scheduling”– Gurcharan Singh / Jagdish Singh, Standard Publications,
8. “Alternative Building Materials and Technologies” by Jagdish, Reddy and Rao, New Age International (P) ltd.



Course Code	Course Title	Hours per week L-T-P	Credit C
CE181305	Engineering Survey-I	3-1-0	4

### **MODULE 1: Introduction**

Definition, Classification of survey, General principles, Basic terms, Use of survey.

### **MODULE 2: Chain Surveying**

Linear measurement-chain and tape, Instruments for chaining, ranging out survey line, Different methods, Errors in chaining, Tape corrections, Locating ground features, Field book.

### **MODULE 3: Compass Surveying**

Introduction, Angular measurement using compass, Bearing & meridian-types, Classification of compass, Traversing with compass, Measurement and numerical problems, Magnetic declination, Errors in compass survey, Adjustments of closing errors.

### **MODULE 4: Levelling**

Introduction to Leveling, Definition of basic terms, Level Book, entries, observation and reduction of Levels. Numerical problems. Classification- Profile & Cross-section, Fly Leveling, Reciprocal Leveling, Errors in Leveling and accuracy, Curvature and refraction, Trigonometrical levelling - Introduction, base of objects accessible and inaccessible, difference of elevation.

### **MODULE 5: Plane Table Surveying**

Equipment & accessories, working operations, Methods of plane tabling- radiation, intersection, traversing and resection, Advantages and disadvantages of plane table surveying.

### **MODULE 6: Theodolite Surveying**

Measurement of horizontal angle- method of repetition and reiteration, Various types of theodolites, traversing by Theodolite- closed traverse, plotting traverse, closing error, balancing a traverse, Computation of independent Coordinates-Gale's Traverse Table.

### **MODULE 7: Contouring**

Definition, Characteristics of contours, Direct and indirect methods of contouring, Use of contour maps

### **MODULE 8: Tacheometric surveying**

Basic systems of Tacheometric measurement, Methods of tachometry, Fixed hair method, anallactic lens, subtense method, tangential method. Derivation of formulae and numerical problems.

### **MODULE 9: Computation of area and volume**

Units and conversion factor, area bounded by irregular boundaries- Mid ordinate rule, average ordinate rule, trapezoidal rule, Simpson's rule, Formulae for circulation of Cross-Sectional Area, Formulae for calculation of volume. Numerical problems.

### **Text Books/References:**

1. Surveying Vol I, II: Punmia, Jain & Jain, Laxmi publications, 2016
2. Surveying Vol I, II: S.K. Duggal, McGraw-Hill Education Pvt. Ltd., 2013
3. Surveying and Leveling – R. Subramanian, Oxford University Press, 2015
4. Surveying & Leveling – N N Basak, McGraw-Hill Education Pvt. Ltd., 2014

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181307	Structural Analysis-I	3-1-0	4

### MODULE 1: Structural Systems

Introduction to analysis of truss, moment of inertia.

Introduction, Forms of Structure, Load Path, Linear and Non-linear structure, Introduction to Indeterminate Structures, Static and Kinematic Indeterminacy.

### MODULE 2: Shear Force and Bending Moment

Introduction to shear force and bending moment, Applications to simply supported beam, cantilever beam and overhanging beam for different loading conditions like Point load, uniformly distributed load, uniformly varying load. The loading diagrams from bending moments diagrams.

### MODULE 3: Deflection in Beams

Computation of slope and deflection in Simply supported and cantilever beams by double integration, Moment Area method, Macaulay's method, Conjugate beam method, Applications to simply supported, overhang and cantilever beams.

### MODULE 4: Work and Energy Principle

Strain Energy Expression, Castigliano's First theorems and their applications to find deflection and redundant forces in simple cases. Principle of virtual work, Maxwell's Reciprocal Theorem, Maxwell-Betti's Theorem, Unit load method.

Statically indeterminate structure, Castigliano's 2<sup>nd</sup> theorem, Analysis of Redundant truss, Analysis of Frames with redundant members.

### MODULE 5: Arch Structure

3 Hinged Arches, Normal thrust, Radial Shear, Horizontal Reactions, Temperature effect on Arch, two hinged arch - Circular and Parabolic, Horizontal Reactions, Normal Thrust, Radial Shear, Yielding of support.

### MODULE 6: Cable Structure

Analysis of Cable Structure, Reactions on Piers, Length of Cable, Analysis of two hinged and three hinged stiffening girder.

### Text Books/References:

1. Structural Analysis: T S Thandavamoorthy, Oxford University Press
2. Basic Structural Analysis- C S Reddy, McGraw Hill Education (India) Private Limited, New Delhi
3. Theory of Structure- S Ramamrutham, Dhanpat Rai Publishing Company, New Delhi
4. Theory of Structure- B C Punmia, Laxmi Publications (P) Ltd.
5. Intermediate Structural Analysis –Wang C.K., Tata Mc Graw Hill Publishers, 2010.
6. Theory and Problems of Strength of materials- Nash, William A. Tata McGraw Hill, New Delhi

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181306	Constitution of India	2-0-0	0 (PP/NP)

**Course Objectives: Students will be able to:**

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Course Outcomes: Students will be able to:**

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

**MODULE 1: History of Making of the Indian Constitution:**

- a) History
- b) Drafting Committee, (Composition & Working)

**MODULE 2: Philosophy of the Indian Constitution:**

- a) Preamble
- b) Salient Features

**MODULE 3: Contours of Constitutional Rights & Duties:**

- a) Fundamental Rights
- b) Right to Equality
- c) Right to Freedom
- d) Right against Exploitation
- e) Right to Freedom of Religion
- f) Cultural and Educational Rights
- g) Right to Constitutional Remedies □ Directive Principles of State Policy □ Fundamental Duties.

**MODULE 4: Organs of Governance:**

- a) Parliament
- b) Composition

- c) Qualifications and Disqualifications
- d) Powers and Functions
- e) Executive
- f) President
- g) Governor
- h) Council of Ministers
- i) Judiciary, Appointment and Transfer of Judges, Qualifications
- j) Powers and Functions

**MODULE 5: Local Administration:**

- a) District's Administration head: Role and Importance,
- b) Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
- c) Pachayati raj: Introduction, PRI: Zila Pachayat.
- d) Elected officials and their roles, CEO Zila Pachayat: Position and role.
- e) Block level: Organizational Hierarchy (Different departments),
- f) Village level: Role of Elected and Appointed officials,
- g) Importance of grass root democracy

**MODULE 6: Election Commission:**

- a) Election Commission: Role and Functioning.
- b) Chief Election Commissioner and Election Commissioners.
- c) State Election Commission: Role and Functioning.
- d) Institute and Bodies for the welfare of SC/ST/OBC and women.

**Text Books/References:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181318</b>	<b>Civil Engineering Drawing and CAD Lab</b>	<b>0-0-2</b>	<b>1</b>

### **Doors and Windows**

Glazed and panelled doors of standard sizes; Glazed and panelled windows of standard sizes

### **Stairs**

Proportioning and design of dog-legged and open well RCC stair case for an office / Residential building

### **Foundations**

Spread foundation for walls and columns; Footing for an RCC column, raft and pile foundations

### **Roofs and Trusses**

Types of sloping roof, King post and Queen post trusses

### **Functional Design of Buildings**

To draw the line diagram, plan, elevation and section of residential buildings (flat, pitched roof) with schedule of openings

### **Computer Aided Designing**

Prepare blue print of a two-storey residential building in AutoCAD

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**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY  
Guwahati**

**Course Structure and Syllabus**

**(From Academic Session 2018-19 onwards)**

**B.TECH**

**CIVIL ENGINEERING**

**4<sup>th</sup> SEMESTER**



## ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

### Course Structure

(From Academic Session 2018-19 onwards)

#### B. Tech 4<sup>th</sup> Semester: Civil Engineering

##### Semester IV/ B. TECH/CE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit C	Marks	
			L	T	P		CE	ESE
<b>Theory</b>								
1	CE181401	Hydraulics and Hydraulics Machines	3	1	0	4	30	70
2	CE181402	Structural Analysis-II	3	1	0	4	30	70
3	CE181403	Engineering Survey-II	3	0	0	3	30	70
4	CE181404	Engineering Geology	3	0	0	3	30	70
5	CE181405	Construction Materials and Concrete Technology	3	0	0	3	30	70
6	MC181406	Environmental Science	2	0	0	0 (PP/NP)	-	100
<b>Practical</b>								
1	CE181411	Hydraulics and Hydraulic Machines Lab	0	0	2	1	15	35
2	CE181413	Engineering Survey Lab	0	0	4	2	15	35
3	CE181414	Engineering Geology Lab	0	0	2	1	15	35
4	CE181415	Construction Materials and Concrete Technology Lab	0	0	2	1	15	35
<b>TOTAL</b>			17	2	10	<b>22</b>	210	590
Total Contact Hours per week : 29								
<b>Total Credits: 22</b>								

**N.B. 1. MC181406 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)**

**2. 2-3 weeks Mandatory Academia Internship need to be done in the 4<sup>th</sup> semester break and the report is to be submitted and evaluated in 5<sup>th</sup> semester**

### Detail Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181401	Hydraulics and Hydraulics Machines	3-1-0	4

#### **MODULE 1: Viscous flow:**

Viscosity- dynamic and kinematic; equation of motion- Navier- Stokes equation; laminar flow in circular pipes- Hagen Poiseuille equation; laminar flow between parallel plates- Couette flow.

#### **MODULE 2: Turbulent flow:**

Smooth and rough pipes or surfaces, Pandtler mixing length theory, velocity distribution for turbulent flow over smooth and rough surfaces, friction factor for smooth and rough pipes, Moody's diagram.

#### **MODULE 3: Boundary Layer Theory:**

Laminar and turbulent boundary layer along a flat plate; laminar sub-layer; boundary layer thickness- displacement, momentum and energy thickness; momentum integral equation; computation of boundary layer thickness, shear stress and drag force for laminar and turbulent boundary layer.

#### **MODULE 4: Flow around Submerged Bodies:**

Drag and lift; drag and lift coefficients; pressure and friction drag on sphere, cylinder and disc; separation of flow- Karman vortex street; circulation; lift on a Cylinder-Magnus effect.

#### **MODULE 5: Advanced pipe flow:**

Pipe network analysis- Hardy Cross method; water hammer in pipes- rigid and elastic water column theories, gradually and instantaneous closure of valves; surge tank.

#### **MODULE 6: Impact of Jet:**

Force of jet on stationary and moving flat plates, force of jet on hinged plate, force of jet on stationary and moving curved vanes (symmetrical and unsymmetrical), force of jet on a series of plates (flat and curved) mounted on a wheel.

#### **MODULE 7: Turbines:**

Classification- impulse and reaction turbines; Work done, power, heads and efficiencies of turbines; Pelton wheel; Francis turbine; Kaplan and Propeller turbine; draft tube; unit quantities, specific speed.

#### **MODULE 8: Pumps:**

Centrifugal pump- classification, work done, heads and efficiencies of centrifugal pump, minimum starting speed, multi stage pump; Reciprocating pump- classification, discharge, work done and power, indicator diagram, effect of acceleration and friction on indicator diagram, air vessels.

#### **Text / Reference Books:**

1. Hydraulics and Fluid Mechanics (Including Hydraulic Machines)- by P. N. Modi and S. M. Seth
2. Hydraulics Fluid Mechanics and Fluid Machines- by S. Ramamrutham
3. A Textbook of Fluid Mechanics and Hydraulic Machines- by R. K. Bansal
4. Fluid Mechanics and Machinery- by C. S. P. Ojha, R. Berndtsson and P. N. Chandramouli
5. Fluid Mechanics- by Frank M. White
6. Fluid Mechanics and Turbomachines- by Madan Mohan Das
7. Fluid Mechanics- by A. K. Jain
8. Fluid Mechanics through Problems- by R. J. Garde
9. Theory and Application of Fluid Mechanics- by K. Subramanya



Course Code	Course Title	Hours per week L-T-P	Credit C
CE181402	Structural Analysis-II	3-1-0	4

**MODULE 1: Fixed beams and Continuous Beam**

Analysis of fixed and continuous beams

**MODULE 2: Slope Deflection and Moment Distribution Method**

Principle and numerical Example, Analysis of Continuous beam for Sinking support. Moment Distribution Method – Analysis of beam, portal frames

**MODULE 3: Approximate analysis of indeterminate structures for Lateral loads**

Portal and cantilever method of analysis of building frames for lateral loads.

**MODULE 4: Plastic Analysis**

Introduction, plastic moment of inertia, plastic section modulus, characteristic of plastic hinge, concept of Moment Redistribution, Shape factors for various sections. Static and Kinematic method, Beam, Sway and Combined mechanism for plastic collapse loads of beams, single bay single storey, two storey and two bay two storey portal frames, Gable Mechanism for simple pitch roof frame, deflection at point of collapse.

**MODULE 5: Moving Loads and Influence lines**

Application to determinate Structures-Beam, Truss, 3-hinged arch, Suspension Bridges. Muller-Breslau's Principles: Influence lines for support reactions, bending moment, shear force in propped cantilever, two span continuous beams and for two hinged arch.

**Text / Reference Books:**

1. Structural Analysis: T S Thandavamoorthy, Oxford University Press.
2. Basic Structural Analysis- C S Reddy, McGraw Hill Education (India) Private Limited, New Delhi.
3. Theory of Structure- S Ramamrutham, Dhanpat Rai Publishing Company, New Delhi.
4. Theory of Structure- B C Punmia, Laxmi Publications (P) Ltd.
5. Intermediate Structural Analysis – Wang C.K., Tata McGraw Hill Publishers, 2010.
6. Fundamentals of Limit Analysis of Structures (A Course in Plastic Analysis of Structures), V.K. Manicka Selvam, Dhanpat Rai Publication.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181403	Engineering Survey-II	3-0-0	3

### **MODULE 1: Curve surveying**

Characteristics of different types of curves- Simple circular curve- Elements, Compound curve, Reverse curve, Transition curve- length, Ideal transition curve, Characteristics of transition curve, Computation and setting out of simple circular and transition curve;  
Vertical curves – Types, length, computation and setting out of vertical curves, sight distance.

### **MODULE 2: Triangulation**

Geodetic surveying- Principle, Classification of triangulation system, Triangulation figures, Strength of figures, Reconnaissance-selection of stations, Indivisibility and height, Signal and towers, Phase of signal, Base line measurements, Satellite station, measurement of horizontal angles.  
Trilateration-Use, advantages, Triangulation vs Trilateration, Triangulate ration

### **MODULE 3: Theory of errors and adjustments**

Errors and precision, definitions, Laws of accidental errors, Principle of least square, Laws of weights, Determination of probable error, Determination of most probable values- normal equations, method of correlates, Triangulation adjustment- station and figure adjustment, Adjustment of geodetic triangle- Spherical triangle, Spherical excess, Numerical problems.

### **MODULE 4: Modern Survey Equipment**

Electromagnetic Waves-important characteristics, distance measurement, modulation, Types of EDM, Target-component and characteristics. Total Station-Procedures for topographic survey.

### **MODULE 5: Photogrammetry**

Introduction, Types of aerial photograph, Definitions, Scale of a vertical photograph, computation of length and height from vertical photograph, Relief displacement, Scale of tilted photograph, Flight planning, Stereoscopic vision, Parallax in aerial photograph, measurement of parallax.

### **MODULE 6: Remote sensing**

Electromagnetic energy, electromagnetic spectrum, Interaction of electromagnetic energy with matter, Atmospheric window, Active and passive remote sensing, Remote sensing platforms, Ideal and real remote sensing system, Types of data products, Data acquisition and interpretation, Application of remote sensing, Remote sensing in India  
GPS- Introduction, principle of GPS.

### **Text / Reference Books:**

1. Surveying Vol. I, II: Punmia, Jain & Jain, Laxmi publications, 2016
2. Surveying Vol. I, II: S.K. Duggal, McGraw-Hill Education Pvt. Ltd, 2013
3. Surveying and Leveling – R. Subramanian, Oxford University Press, 2015
4. Surveying & Leveling – N N Basak, Mc Graw-Hill Education Pvt. Ltd., 2014
5. Remote Sensing & Geographic Information System – A. M. Chandra, S. K. Ghosh, Alpha Science International Ltd; 2nd Revised edition (28 July 2015)

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181404	Engineering Geology	3-0-0	3

**Course objectives:** To introduce basic geology and the importance of geological information in site investigation to civil engineering students.

### **MODULE 1: The Earth**

Origin, Age and Internal structure of the Earth; Materials of Earth; Earth as a closed system. Geomorphology - Weathering of rocks and its engineering considerations; Geological work of wind and running water.

### **MODULE 2: Study of Minerals**

Study of rock forming minerals, their physical properties & uses. Feldspar Group, Quartz group, Pyroxene group, Mica group and Clay minerals.

### **MODULE 3: Study of Rocks**

Igneous, Sedimentary and Metamorphic rocks their formation, textures, structures and composition; Engineering properties of rocks.

### **MODULE 4: Structural Features of Rocks**

Stratification, lamination, bedding, outcrop; dip and strike and their simple calculation; Folds, Faults, Joints, Unconformity.

### **MODULE 5: Stones and Aggregates**

#### **Building stones:**

Requirement of good building stones, Physical Properties of Building stones- porosity, water absorption, crushing strength, fire resistance, abrasion resistance, frost resistance, density; Geological characteristics- mineralogical composition, texture and structure, resistance to weathering; Important building stones

#### **Aggregates:**

Aggregates- coarse and fine aggregates; Rock Aggregates for road and concrete mixes, suitable rock types and desired properties, Engineering properties of rock aggregates.

### **MODULE 6: Geological Hazards**

Earthquakes- causes and effect of earthquake; Intensity and magnitude of earthquake waves; seismic zoning map of India and seismic micro zonation; Landslides – Terminology and classification; causes of landslides and its control.

### **MODULE 7: Geological Investigations**

Objectives of geological investigations; General principle of geological and geophysical exploration; Electrical Resistivity Method and Seismic Refraction Method. Geological investigations required for selection of sites for buildings, bridges, highways, dams, reservoirs, tunnels

## **MODULE 8: Rock Mechanics**

Engineering classification of Rocks-Intact and In-situ; Rock quarrying-rock drilling, rock boring, core recovery, modified core recovery, Rock Quality Designation (RQD).

### **Text / Reference Books:**

1. Engineering Geology- SK Duggal, HK Pandey & N Rawal; Mc Graw Hill Education
2. Engineering and General Geology -Parbin Singh, 8<sup>th</sup> Ed. S.K, Kataria and Sons, New Delhi
3. Engineering Geology-Subinoy Gangopadhay; Oxford University Press, New Delhi
4. Rock Mechanics for Engineers-VP Verma; Khanna Publishers, New Delhi

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181405	Construction Materials and Concrete Technology	3-0-0	3

## 1<sup>st</sup> part: CONSTRUCTION MATERIALS

### MODULE 1: Introduction to Engineering Material

Evolutionary Trends in Construction Materials, Traditional and Innovative Materials, Properties of Materials, Functional Requirements of Materials, BIS codes and specifications for various building materials.

Bamboo, Timber and timber based products, Bricks -Classification  
Paints, Sealants and Adhesives; Glass.

### MODULE 2: Cement, Aggregates, Steel

Cement- Different types and Grades of Cement, Hydration of cement, Physical and chemical properties, Gel Structure, Testing of Cement for Physical and chemical properties as per BIS specifications.

Aggregates-Testing of Aggregates for physical and mechanical properties Water.  
Steel-Reinforced Steel Bars, Structural Steel  
Roofing Sheets, Corrugated galvanized Iron sheet, Galvalume sheets for roofing

### MODULE 3: Modern Materials

Damp Proofing, Water Proofing, Thermal Insulation, Sound Insulation and Fire Protection materials, Solid and Hollow Concrete Block, Autoclaved Aerated concrete (AAC) Blocks, Fly-ash Bricks, Interlocking Paver Blocks, Aluminium Composite Panels, Galvalume Sheets.

## 2<sup>nd</sup> part: CONCRETE TECHNOLOGY

### MODULE 1: Fresh and hardened Concrete

Proportioning of concrete, Operations involved in concrete production, Workability-Measurement of workability. Problem of segregation and bleeding and laitance.

Strength of Concrete: Compressive strength and factors affecting it, Testing of hardened concrete-cube and cylindrical sample, Platen effect, flexure test, Stress-strain relation and modulus of elasticity, Shrinkage, Creep of concrete and its effect.

Durability of Concrete: Corrosion of reinforcing bars, sulphate attack, frost action, deterioration by fire, concrete in seawater, acid attack, and carbonation.

### MODULE 2: Concrete Mix Design

Principle and methods, Statistical Quality control. Concrete Rheology, Maturity concept, IS method for concrete Mix Design.

### MODULE 3: Special concretes and modern materials

Admixtures- Action of admixtures, Types, Advantages

Special concrete as Lightweight concrete. High Density Concrete, Sulphur impregnated concrete, Polymer concrete, Lime concrete, High strength concrete, Fibre Reinforced Concrete.

#### **MODULE 4: Non-destructive testing**

Destructive vs. Non-Destructive testing, Methods & Principles of NDT. Rebound hammer, UPV, core-cutting

#### **Text / Reference Books:**

1. “Engineering Materials”, Rangawalla. S.C Chartar Publishing House
2. “Building Materials”, Varghese, PHI Learning Pvt. Ltd.
3. “Alternative Building Materials and Technologies” by Jagadish, Reddy and Rao, New Age International (P) ltd.
4. Rai Mohan and Jai Singh M.P. “Advances in Building Materials and Construction-CBRI Roorkee”.
5. “Civil Engineering Materials” “Technical Teachers” Training Institute Chandigarh, Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Spence RJS and Cook DJ- ‘Building Materials in Developing Countries’ John Wiley and Sons.
7. Shetty M.S. “Concrete Technology, Theory and Practices”. S. Chand & Company Ltd., New Delhi.
8. Neville A.M., Properties of Concrete, Pitman Publishing Company.
9. Gambhir M.L. “Concrete Technology”- Tata McGraw Hill Publishing Company Ltd., New Delhi.
10. Gambhir M.L. “Concrete Manual”- Dhanpal Rai & Sons, Delhi.

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181406	Environmental Science	2-0-0	0

**MODULE 1: Environment and Ecology**

- i. Introduction
- ii. Environment and Ecology
- iii. Objectives of ecological study
- iv. Aspects of Ecology
  - a) Autecology
  - b) Synecology
- v. Ecosystem
  - a) Structural and functional attributes of an ecosystem
  - b) Food chain and food web
  - c) Energy flow
  - d) Biogeochemical cycles

**MODULE 2: Land: Use and Abuse**

- i. Land use: Impact of land – use on environmental quality
- ii. Land degradation
- iii. Control of land degradation
- iv. Waste land
- v. Wet lands

**MODULE 3: Water Pollution**

- a) Introduction
- b) Water quality standards
- c) Water pollution
- d) Control of water pollution
- e) Water pollution legislations
- f) Water quality management in Rivers

**MODULE 4: Air Pollution**

- i. Introduction
  - a) Air pollution system
  - b) Air pollutants
- ii. Air pollution laws
- iii. Control of air pollution
  - a) Source correction method
  - b) Pollution control equipment
  - c)

**MODULE 5: Noise Pollution**

- i. Introduction
- ii. Sources of noise pollution
- iii. Effects of noise
  - a) Physical effects
  - b) Physiological effects

- c) Psychological effects
- iv. controls of Noise pollution

**Text / Reference Books:**

1. Environmental engineering and management by Dr Suresh Dhameja
2. Environmental studies by Dr B.S. Chauhan
3. Environmental science and engineering by Henry and Hence
4. Environmental studies for undergraduate course by Dr Susmitha Baskar
5. Chemistry for environmental engineering and science by Clair Sawyer



<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181411</b>	<b>Hydraulics and Hydraulics Machines Lab</b>	<b>0-0-2</b>	<b>1</b>

### **LIST OF EXPERIMENTS**

1. Verification of Bernoulli's theorem
2. Determination of metacentric height of a floating body
3. Determination of water surface profile for a free vortex flow
4. Determination of water surface profile for a forced vortex flow
5. Determination of Coefficient of discharge for a Venturimeter
6. Determination of coefficient of discharge for an orificemeter
7. Calibration of a rectangular notch
8. Determination of friction factor for a pipe flow.
9. Study of performance characteristics of a centrifugal pump.
10. Study of performance characteristics of a Pelton wheel turbine.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181413	Engineering Survey Lab	0-0-4	2

**Practical 1: Horizontal and vertical angle measurement**

To measure horizontal angle with the method of repetition and vertical angle with Theodolite and determine the height of an object with Trigonometric levelling.

**Practical 2: Traversing and map preparation**

To carry out closed traversing with Theodolite, prepare map of the area along with contour map using concepts of Gale's Traverse Table.

**Practical 3: Curve setting: Simple circular curve**

To set a simple circular curve between two given straight roads by Rankine's method.

**Practical 4: Curve setting: Combined curve**

To set a combined curve (Simple circular and Transition curve) between two given straight roads.

**Practical 5: Open traversing with total station**

To carry out open traversing with Total Station.

**Practical 6: GPS survey**

To carry out a GPS survey.

<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181414</b>	<b>Engineering Geology Lab</b>	<b>0-0-2</b>	<b>1</b>

### **LIST OF EXPERIMENTS**

1. Identification of hand specimen of rocks and minerals with the help of their physical properties
2. Problems of dip and strike
3. Geological maps and sections
4. Completion of outcrops
5. Borehole correlation problems

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181415	Construction Materials and Concrete Technology Lab	0-0-2	1

**Laboratory work:**

1. Testing of cement.  
Standard consistency, setting time (initial and final), fineness, soundness and compressive strength test (3 days, 7 days and 28 days).
2. Testing of Aggregates.
  - (a) Fine aggregate.  
Sieve analysis for zoning and fineness modulus (FM), Bulking of sand, Absorption and moisture content, specific gravity.
  - (b) Coarse aggregate.  
Sieve analysis for grading, absorption and moisture content, specific gravity flakiness index, Elongation index, Impact value, Crushing value and Abrasion value.
3. Compressive strength test of concrete, workability test of fresh concrete.
4. Concrete Mix design by IS method.

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**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY  
GUWAHATI**

**Course Structure and Syllabus  
(From Academic Session 2018-19 onwards)**

**B.TECH  
CIVIL ENGINEERING  
5<sup>TH</sup> SEMESTER**



## ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

### Course Structure

(From Academic Session 2018-19 onwards)

#### B. Tech 5<sup>th</sup> Semester: Civil Engineering Semester V/ B. TECH/CE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
<b>Theory</b>								
1	CE181501	Open Channel Flow and Irrigation Engineering	3	1	0	4	30	70
2	CE181502	Structural Design-I	3	1	0	4	30	70
3	CE181503	Environmental Engineering-I	3	1	0	4	30	70
4	CE181504	Transportation Engineering-I	3	1	0	4	30	70
5	CE181505	Geotechnical Engineering-I	3	1	0	4	30	70
6	HS181506	Engineering Economics	3	0	0	3	30	70
<b>Practical</b>								
1	CE181514	Transportation Engineering Lab	0	0	2	1	15	35
2	CE181513	Environmental Engineering Lab	0	0	2	1	15	35
3	CE181515	Geotechnical Engineering Lab	0	0	2	1	15	35
4	SI181521	Internship-II (SAI-Academia)	0	0	0	1	-	100
<b>TOTAL</b>			18	5	6	<b>27</b>	<b>225</b>	<b>625</b>
Total Contact Hours per week : 29								
<b>Total Credits: 27</b>								

## Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181501	Open Channel Flow and Irrigation Engineering	3 -1- 0	4

### PART –I [OPEN CHANNEL FLOW]

#### MODULE 1: Basic Concepts in Open Channel Flow

Introduction, Differences in Open Channel and Pipe Flow, Types of Channel, Classification of Open Channel Flow. Computation of Hydraulic depth and Hydraulic Radius of different shapes of Channels.

#### MODULE 2: Energy Depth Relationships

Specific Energy, Specific Energy Diagram and its characteristics, Minimum Specific Energy at a Given Discharge, Maximum Discharge at a Given Specific Energy, Critical Depth, Computations – Direct expression, Trial & Error Method, Section factor curves. Specific Force and Specific Force Diagram. Conditions for Minimum Specific Force at a Given Discharge and Maximum Discharge at a Given Specific Force. Numerical Problems. Flow Transition over hump and due to width constriction under subcritical & super flow condition.

#### MODULE 3: Uniform Flow

Introduction, Chezy's Equation for average velocity, Manning's Formula, Kutter's Formula, Bazin's Formula. Computation of uniform flow, Computation of normal depth – Trial & Error Method, Graphical method, Das & Bar Formula, Section factor curves. Related Numerical Problems. Hydraulically Efficient Channel sections, Numerical Problems.

#### MODULE 4: Gradually Varied Flow (Steady)

Dynamic equation of GVF (Steady) – dynamic equation for wide rectangular channel using Chezy's eq. And Manning's formula. Classification & characteristics of water surface profile. Computation of GVF profile: Graphical Integration method, Direct step method, Introduction to Numerical methods.

#### MODULE 5: Rapid Varying Flow: Hydraulic Jump

Introduction, Practical uses of Jump, Types of Jump, Length of Jump, Velocity Profile and Pressure Distribution in Jump. Momentum Equation in Hydraulic Jump and finding of the relationship between the sequent depths in case of horizontal rectangular frictionless channel. Numerical problems

### PART –II [IRRIGATION ENGINEERING]

#### MODULE 1: Introduction

Definition – Irrigation. Advantages, Disadvantages and Ill- Effects of Irrigation. Necessity and Development of Irrigation in Assam. Types of Irrigation, Techniques of water distribution in farms

#### MODULE 2: Water Requirements of Crops

Duty, Delta and Base Period, Factors affecting Duty. Definitions – Rabi crops, Kharif crops, Cash crop, Crop ratio, Kor watering, Kor period, Kor depth, Crop rotation, Intensity of irrigation, Gross commanded Area, Cultural commanded area, Capacity factor, Full supply coefficient, Nominal Duty, Irrigation Efficiencies. Consumptive Use – Estimation of consumptive use, Net Irrigation Requirement,

Numerical Problems. Soil – Moisture Relationship, Different Water holding capacities at root zone. Numerical Problems.

### **MODULE 3: Canal Irrigation**

Alignment of canals – Ridge canal, Contour canal, Side – Slope canal. Distribution system in canal Irrigation. Canal Head Works – Layout with major components, Brief Descriptions of all Major components. Design of Irrigation canal in Alluvial soil -- Kennedy's Theory and Lacey's Theory for the Design of canals. Numerical Problems.

### **MODULE 4: Cross Drainage Works**

Definition- Cross- Drainage Works. Aqueduct, Super passage, Level Crossing, Inlet – outlet

### **MODULE 5: Lift Irrigation**

Introduction, Sources of ground water, ground water yield, Transmissibility, Specific yield, Storage coefficient, Thiem's equation Confined and unconfined aquifer, Dupit's equation for unconfined and unconfined aquifer, Interference among wells, Well loss & specific capacity. Numerical.

### **Textbooks/Reference Books:**

1. Open Channel Hydraulics --- V. T. Chow, V. T. Chow, The Blackburn press,2009.
2. Flow Through Open Channels --- K. G. Ranga Raju, McGraw Hill Education, 2001
3. Open Channel Flow --- M. M. Das PHI, 2009
4. Flow in Open Channels --- K. Subramanya, Tata McGraw Hill Education Private limited,2008
5. Flow Through Open Channels --- Rajesh Srivastava, Oxford University Press, 2008
6. Mechanics of Sediment Transport & Alluvial Stream Problems --- Garde & Ranga Raju
7. John Wiley & Sons (Asia) private limited, 1986.
8. Irrigation Engineering and Hydraulic Structures --- S. K. Garg, Khanna Publishers, 2006
9. Irrigation Water Power and Water Resource Engineering --- Arora, Standard publisher's distributors, 2015
10. Irrigation Engineering --- R. K. Sharma & T. K. Sharma, S Chand and Company, 2007
11. Irrigation and Water Resource Engineering --- G. L. Asawa, new Age Publication, 2008
12. Irrigation and Water Power Engineering --- B. C. Punmiya Laxmi Publications, 2016
13. Ground water Hydrology– H. M. Roghunath, New Delhi: New Age International (P) Ltd., Publishers, 2006



Course Code	Course Title	Hours per week L-T-P	Credit C
CE181502	Structural Design-I	3 -1- 0	4

### **MODULE 1: Introduction to Reinforced Concrete**

Concrete, Reinforced Cement Concrete, Discussion on Materials, Inspection, Testing and Quality of RC Structures, Characteristic Strength of Concrete and Steel, Concept of Limit state of Collapse and Serviceability Methods of design Objectives of design- RCC- Limit State method- Assumptions- Stress-Strain behavior of Steel and Concrete- Stress block parameters- Working stress method- comparison of Limit state and Working Stress design method.

### **MODULE 2: Design of Singly Reinforced Beams & Doubly Reinforced Beams**

Analysis of Cracked and Un-Cracked RC section, Concept of Moment of resistance.

Analysis of Singly Reinforced RC Section, Depth of Neutral Axis-Balanced-Under Reinforced-Over Reinforced Sections- Limiting Moment - Design parameters- Design examples.

Analysis of Doubly Reinforced RC Section- Limiting Moment - Design parameters- Design examples.

### **MODULE 3: Design for Shear, Bond and Torsion**

Design of Vertical Stirrups-Bent-up bars- Limitation, Development Length-Design for shear and bond. Discussion on Maximum shear strength of concrete.

### **MODULE 4: Design of Flanged Beams**

Analysis of flanged RC section- T- Beam and L-Beams, Singly and Doubly Reinforced-Effective flange width- Limiting Moment - Design examples.

### **MODULE 5: Design of Slabs**

Design of One and Two way slabs- Effect of edge conditions- Moment of Resistance-Torsion reinforcement at corners- Design examples, IS-code method of Slab design.

### **MODULE 6: Design of Columns**

Design principles of RC columns- Assumptions- Short Column and Long Column, Rectangular and Circular Columns- Helical reinforcement

### **MODULE 7: Design of Footings**

Analysis and design of Shallow Foundations, Design for Bending- One-way shear and Two-way shear, Design example of Isolated footing and Combined footing.

### **MODULE 8: Stair Case**

Analysis and Design of dog legged staircase, open newel staircase. Earthquake safety provision of Stair Case as per IS:4326-1993

### **Text/ Reference Books:**

1. IS:456 - 2000 - Plain and Reinforced concrete - Code of practice.
2. Design of Reinforced Concrete Structures (Limit State) – A.K.Jain, 1st Edition, Nemchand Brothers, Roorkee.
3. P.C. Verghese, Limit State Design of Reinforced Concrete, PHI.
4. *Reinforced Concrete Design*, S U Pillai & Devdas Menon. Tata McGraw Hill.
5. Design of Reinforced Concrete Structures, N. Subramanian, OUP India

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181503	Environmental Engineering-I	3-1-0	4

### **MODULE 1: Introduction**

Population Forecasting and Water Demand

### **MODULE 2: Sources of Water and Wastewater**

**Water:** Surface source and Groundwater source, Well: Definition, classification, Numerical

**Wastewater:** Point Source and Non-Point Source

### **MODULE 3: Physical, Chemical and Biological Characteristics of Water and Wastewater**

**Water:** Test. Turbidity, Odour, Temperature, Colour, Total dissolved solid

Chemical: pH, Alkalinity, Hardness, Chloride, Fluoride, Sulphate

Biological: MPN, E-Coli

#### **Wastewater:**

Odour, Temperature, Colour

Chemical: pH, Nitrogen, Chloride, Fluoride, Sulphate, Phoporous

Biological: DO, BOD, COD, TOC

### **MODULE 4: Unit Operations and Processes for Surface Water and Wastewater Treatment**

**Water Treatment Processes:** Theory and Application

Aeration, Solids Separation, Settling Operations, Coagulation, Filtration, Softening, Disinfection

**Wastewater Treatment Processes:** Theory and Application

Aeration, Solids Separation, Settling Operations, Coagulation, Filtration, Softening, Disinfection

### **MODULE 5: Water Conveyance System**

**Intake works:** River, reservoir and channel intakes, selection of intake.

Types of conduit, Pipe materials, Pipe testing

### **MODULE 6: Distribution System**

Layout, and design of distribution system, Maintenance of distribution system, Detection of leakage and wastage and their prevention, Gates and valves in distribution system

### **MODULE 7: Water Supply and Drainage of Building**

Introduction, Principles. Governing design of water supply in buildings, lay out, Design of water pipes-traps, Sanitary fitting, Plumbing System of Drainage- Single stack system, One pipe system, two pipe system

### **MODULE 8: Adverse Effects**

Adverse Effects on Human Health & Environment, Aquatic life, Animal life, Plant life, Water Pollution Measurement Techniques, Water Pollution Control Equipment & Instruments, Indian Standards for Water Pollution Control

#### **Textbooks / Reference Books:**

1. H. S Peavy, D. R. Rowe and George Tchobanoglous, *Environmental Engineering*, McGraw-Hill International Ed.
2. T. J McGhee, *Water Supply and Sewerage*, McGraw-Hill Inc.

3. Environmental Engineering Vol. I and II Santosh Kumar Garg
4. Environmental Engineering K. N. Duggal.
5. Environmental Engineering Vol. I and II, B.C. Punmia
6. M. L Davis and D. A Cornwell, *Introduction to Environmental Engineering*, McGraw-Hill, Inc.
7. Metcalf & Eddy, *Wastewater Engineering- Treatment and Reuse* (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill, 4<sup>th</sup> Edn.
8. C. N Sawyer, P. L McCarty and G. F. Parkin, *Chemistry for Environmental Engineers*, McGraw-Hill
9. APHA, *Standard Methods Examination of Water and Wastewater*, American Public Health Association, Washington DC
10. *Manual for Sewer and Sewerage*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India
11. *Manual for water supply and treatment*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181504	Transportation Engineering-I	3 -1- 0	4

### **MODULE 1: Transportation Infrastructure**

Classification of Indian Road Network; Characteristics of road transport; National Highway Development Programme: Golden Quadrilateral and North-south & East-West economic corridor; Introduction to DRRP and PMGSY; Highway alignment and engineering surveys.

### **MODULE 2: Road Geometry**

Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, gradients, sight distances, horizontal and vertical alignments as per IRC: 73 and IRC: 86

### **MODULE 3: Pavement Materials**

Characterization of different pavement materials including bitumen, aggregate, subgrade soil, modified bitumen, emulsion, cutback and bituminous mix; their desirable properties and quality control tests; Blending of Aggregates; Design of bituminous paving mixes using Marshall method of mix design; Selection of pavement materials as per IRC and MORTH; Road Construction Technologies

### **MODULE 4: Pavement Design**

Design factors for flexible and rigid pavements including Vehicle Damage Factor (VDF), Equivalent Single Axle Load (ESAL), Equivalent Axle Load Factor (EALF), Lane Distribution Factor (LDF) and Fourth Power Damage Law; Calculation of stresses in Rigid Pavements; Design of flexible pavement using IRC: 37; Design of rigid pavements using IRC: 58

### **MODULE 5: Pavement Rehabilitation**

Distresses in flexible and rigid pavement and their maintenance measures; functional and structural evaluation of flexible pavement, overlay design as per IRC-81

### **MODULE 6: Traffic Engineering**

Traffic studies on flow, speed, travel time - delay and O-D study, PCU, Peak Hour Factor (PHF), parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Grade separated intersections and channelization; Highway capacity and level of service of rural highways and urban roads; Traffic signs.

### **Textbooks / Reference Books :**

1. Principles of Transportation Engineering by P. Chakroborty and Animesh Das
2. Analysis of Pavement Structures by Animesh Das
3. Pavement Analysis and Design by Yang H. Huang
4. Traffic Engineering and Transport Planning by L.R. Kadiyali
5. Ministry of Road Transport and Highways: Specification for Road and Bridge works (5<sup>th</sup> Revision)

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181505	Geotechnical Engineering-I	3 -1- 0	4

### **MODULE 1: Composition, Index Properties Classification of Soils**

Soil structure and its behavior. Typical clay mineral structures of Kaolinite, Montmorillonite and Illite. Soil-water system. Soil as a three phase system. Index properties and Phase relationship. Particle-size analysis. Consistency of soils and Atterberg's limits. Activity of clays. Soil classification – according to grain size, according to plastic properties (IS classification). Numerical problems.

### **MODULE 2: Permeability of Soil**

Darcy's law – discharge velocity and seepage velocity, it's validity. Factors affecting permeability. Laboratory and field determination of permeability co-efficient. Permeability of stratified soil deposits. Numerical problem.

### **MODULE 3: Seepage Analysis**

Seepage pressure – quick condition. Derivation of Laplace equation of flow in 2-D. Properties and applications of flow net – determination of quantity of seepage, seepage pressure, uplift pressure and exit gradient. Construction of flow net. Phreatic line of an earth dam – Casagrande's method of determining phreatic line in a dam. Numerical problems.

### **MODULE 4: Stress and Stress distribution**

Stress path. Effective stress concept. Geostatic Stresses Boussinesq's theory and Westergaard theory. Pressure distribution diagrams – stress isobar. Newmark's influence chart. Contact pressure. Numerical Problems.

### **MODULE 5: One Dimensional Consolidation**

Introduction. The consolidation process. Consolidation of laterally confined soil – compression index, co- efficient of compressibility, co- efficient of volume change. Consolidation of undisturbed specimen. Determination of pre-consolidation pressure. Secondary Compression. Numerical problems.

### **MODULE 6: Compaction**

Introduction. Standard Proctor Test. Zero air voids line. Modified Proctor test. Field compaction methods and its control. Factors affecting compaction. Numerical problems.

### **MODULE 7: Shear Resistance of Soil**

Introduction- Friction and cohesion. Mohr's stress circle. Mohr- Coulomb Failure theory. Drainage conditions and measurement of shear strength – direct shear test, tri-axial test, unconfined compression test, vane shear test. Pore pressure parameters. Sensitivity and thixotropy of cohesive soils. Stress-strain-volume change characteristics of cohesion less and cohesive soils. Numerical problems

### **Textbooks / Reference Books:**

1. Soil Mechanics and Foundation Engineering- P. Purushothama Raj, Pearson Education in South Asia, Second Edition, (2018)
2. Geotechnical Engineering – Debasish Moitra, Universities Press; First Edition edition (2016)
3. Geotechnical Engineering – Shashi K Gulati & Manoj Dutta, McGraw Hill Education (16 May 2005)

4. Basic and Applied Soil Mechanics- Gopal Ranjan & A. S. Rao (1991), Wiley Eastern Ltd., New Delhi.
5. Soil Mechanics and Foundation: Dr. B. C. Punmia, Laxmi Publications; Sixteenth edition (2017), Language: English, ISBN-10: 8170087910, ISBN-13: 978-8170087915
6. Soil Engineering in Theory and Practice (Part I & Part II): Dr. Alam Singh, CBS; 2 edition (1 December 2009)
7. Foundation Analysis and Design: Joseph E. Bowles, McGraw-Hill

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181506	Engineering Economics	3-0-0	3

**Course Outcomes (COs):**

The students will be able to

1. Acquire knowledge about economics its nature, scope and importance.
2. Understand the economic laws, principles, and theories and their relevance in present day situation.
3. Develop the ability of critical thinking to meet the challenges at the national and global problems.
4. Apply knowledge in finding out socio-economic problems and appropriate measures to deal with them.
5. Equip students with vital knowledge to run government and non-government institutions and bodies.
6. Assemble knowledge which is vital for industry and research and evolve proper policy for economic development.

**MODULE 1: Introduction to Economics**

**(3 Lectures)**

Meaning and Definition of Economics, Nature and Scope of Economics, Concept of Micro and Macro Economics

**MODULE 2: Utility Analysis**

**(3 Lecture)**

Meaning of Utility, Utility Function, Consumers Equilibrium, Concept of Indifference Curve, properties of Indifference Curve, Equilibrium under Indifference Curve

**MODULE 3 : Demand and Supply Analysis**

**(4 Lectures)**

Law of Demand, Demand Function, Elasticity of Demand, Types of Elasticity of Demand, Measurement of Elasticity of Demand, Demand Forecasting, Law of Supply, Supply Function

**MODULE 4: Revenue, Production & Cost Analysis**

**(4 Lectures)**

Average, Marginal and Total Revenue, Revenue Function, Average, Marginal and Total Cost, Cost Function, Short and Long Run Cost Curves. Break Even Point, Managerial Uses of Cost Function, Cobb Douglas Production Function

**MODULE 5 : Market Structure**

**(4 Lectures)**

Concept of Market, Price-Output Determination under Perfect Competition, Monopoly Market and Monopolistic Competition

**MODULE 6 : Money, Banking and National Income**

**(8 Lectures)**

Definition of Money, Function of Money, Index Numbers, Construction of Index Numbers, value of Money, Causes of Inflation, Functions of Commercial and central bank, Central bank and its monetary policy, Money Market and Capital Market, Functions of Stock exchange, Concept of National Income, Measurement of National Income, Concept of Investment.

**MODULE 7: Introduction to Environmental Economics****(5 Lectures)**

Concept of Environmental Economics, Cost -Benefit Analysis, Social Cost, Externalities, Concept of Pareto Equilibrium, Externality, Market Failure

**MODULE 8: Public Finance****(3 Lectures)**

Introduction to Public Finance, Concept of Budget, Types of Budget, Budget Receipts, Concept of Goods and services Tax (GST)

**Textbooks/Reference Books:**

1. Managerial Economics by V. Agarwal: Pearson Pvt. Limited, New Delhi.
2. Engineering Economics by Dr. A. Ahmed & G. Begum: Chandra prakash, Guwahati
3. Principles of Engineering Economics with Application by Dr. Z. A. Khan, A. N. Siddiquee, B. Kumar, M. H. Abidi: Cambridge University Press.
4. Public Finance and Public Policy by Dr. R. K Choudhury: Kalayani publishers
5. Quantitative Methods for Economics by R. Veerachamy: New Age International Publication Ltd.
6. Micro and Macro Economics by Dr. M. L. Seth: Educational Publishers, Agra -3
7. A Koutsoyiannis: Modern Microeconomics
8. Environmental Economics by R. N. Bhattacharya: Oxford Publication



<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181514</b>	<b>Transportation Engineering Lab</b>	<b>0- 0-2</b>	<b>1</b>

**LIST OF EXPERIMENTS:**

1. Sieve analysis [as per IS 2386 (Part I)-1963] and blending of aggregates by Triangulation and Rothfuchs Method
2. Combined Flakiness and Elongation Index test [as per IS 2386 (Part I)-1963]
3. Specific Gravity test of coarse and fine aggregates [as per IS 2386 (Part III)-1963]
4. Aggregate Impact Value test [as per IS 2386 (Part IV)-1963]
5. Los Angeles Abrasion Value test [as per IS 2386 (Part IV)-1963]
6. Aggregate Crushing value Test [as per IS 2386 (Part IV)-1963]
7. California Bearing Ratio (CBR) test [as per IS 2386 (Part XVI)-1987]
8. Dynamic Cone Penetrometer test [as per ASTM D6951/D6951M-09]
9. Penetration test on bitumen [as per IS: 1203-1978]
10. Ductility test on bitumen [as per IS: 1208 - 1978]
11. Ring and Ball test for softening point determination [as per IS 1205-1978]
12. Flash and fire point determination using Pensky-Martens apparatus [as per IS: 1209 1978]
13. Striping value test of aggregates [as per IS: 6241-1971]
14. Saybolt Viscosity test on bitumen emulsion [as per ASTM D7496-11]
15. Marshal Stability test on bituminous mixes to determine optimum binder content [as per ASTM-D6927, ASTM- D5581]

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181513	Environmental Engineering Lab	0-0-2	1

### **LIST OF EXPERIMENTS:**

#### **Water:**

1. Determination of pH, Conductivity value of a given sample
2. Determination of Alkalinity of a given sample
3. Determination of Acidity of a given sample
4. Determination of Hardness of a given sample
5. Determination of Total Solids (TS, SS) of a given sample
6. Determination of Chloride Content of a given sample
7. Determination of Sulphate Content of a given sample
8. Determination of Ca, Mg Content of a given sample
9. Determination of Sulphate Content of a given sample
10. Determination of Plate Counts and MPN test; of a given sample

#### **Waste water:**

1. Determination of DO Content of a given sample
2. Determination of BOD of a given sample
3. Determination of COD of a given sample
4. Determination of Fluoride and metals using colorimetric methods
5. Introduction to advance instruments i.e. Atomic Adsorption Spectroscopy (AAS). Flame Photometer, UV spectrophotometer

#### **Textbooks/Reference Books:**

1. C. N Sawyer, P. L McCarty and G. F. Parkin, Chemistry for Environmental Engineers, McGraw-Hill
2. APHA, Standard Methods Examination of Water and Wastewater, American Public Health Association, Washington DC
3. Manual for Sewer and Sewerage, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India
4. Manual for water supply and treatment, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181515	Geotechnical Engineering Lab	0-0-2	1

**LIST OF EXPERIMENTS:**

1. Water content determination by-
  - i. Oven drying method
  - ii. Infrared Moisture meter method
2. Specific gravity by-
  - i. Density bottle
  - ii. Pycnometer
3. Grain size distribution
4. Determination of plastic limit. Determination of liquid limit by-
  - i. Casagrande apparatus
  - ii. Cone penetrometer
5. Standard Proctor test
6. Constant head and falling head Permeability test
7. Consolidation test
8. Direct Shear test
9. Unconfined compression test

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**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY  
GUWAHATI**

**Course Structure and Syllabus  
(From Academic Session 2018-19 onwards)**

**B.TECH  
CIVIL ENGINEERING  
6<sup>TH</sup> SEMESTER**



## ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

### Course Structure

(From Academic Session 2018-19 onwards)

#### B.Tech 6<sup>th</sup> Semester: Civil Engineering Semester VI / B.TECH/CE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
<b>Theory</b>								
1	CE181601	Transportation Engineering-II	3	1	0	4	30	70
2	CE181602	Engineering Hydrology	3	1	0	4	30	70
3	CE181603	Structural Design-II	3	1	0	4	30	70
4	CE181604	Environmental Engineering-II	3	0	0	3	30	70
5	CE181605	Geotechnical Engineering-II	3	1	0	4	30	70
6	HS181606	Accountancy	2	0	0	2	30	70
<b>TOTAL</b>			17	4	0	<b>21</b>	<b>180</b>	<b>420</b>
Total Contact Hours per week : 21								
<b>Total Credits: 21</b>								

**N.B. 4-6 weeks Mandatory Industry Internship need to be done in the 6<sup>th</sup> semester break and the report is to be submitted and evaluated in 7<sup>th</sup> semester**

## Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181601	Transportation Engineering-II	3-1-0	4

### Railway Engineering

#### MODULE 1:

(8 hours)

**Permanent Way:** Rail, sleeper, ballast – their ideal requirements, dimensions, classification and behaviours, wearing of rails, coning of wheels, creep – causes, effects & remedies, Railway surveys – traffic, reconnaissance, preliminary and final location surveys.

**Geometric Design:** Gauges, alignment, horizontal curves, super elevation, Gradients and grade compensation, Length of transition curve, cross – sections of permanent way, Geometric requirements for high speeds.

#### MODULE 2:

(8 hours)

**Construction of Railway Track:** Stages in construction, methods of plate laying, various fittings and fixtures, points and crossings, turn – outs and track junctions.

**Signaling and Interlocking:** Control of train movements types of signals in stations and yards, principles of interlocking.

**Resistances to Traction:** Various resistances, Hauling capacity and Tractive effort, various stresses in Railway Track.

### Airport Engineering

#### MODULE 3:

(8 hours)

**Aircraft Characteristics:** Aeroplane component parts.

**Airport Planning:** Regional planning, Airport selection, Zoning laws, Imaginary surfaces.

**Airport Layout:** Geometric components of an airport and their functions, Typical Airport layouts.

**Runway Design:** Runway orientation, Basic Runway Length, corrections for Elevation, Temperature and Gradient, Runway Geometrics.

#### MODULE 4:

(7 hours)

**Taxiway Design:** Geometric Design Standards, Turning radius, Exit Taxiways.

**Structural Design of Airport Pavements:** Design factors, Design methods for Flexible and Rigid Pavement, Design of an overlay, special characteristics and Requirements of Airport Drainage.

### Tunnel Engineering

#### MODULE 5:

(9 hours)

##### Tunnels:

Introduction about tunnels, advantages and disadvantages of tunnels compared to open cuts, Criteria for selection of size and shape of tunnels, construction of shaft. Factors affecting methods of tunnelling.

**Driving Tunnels in Soft Ground:** General characteristics of soft ground, Different method of driving tunnels in soft ground.

**Driving Tunnels in Hard Ground:** Meaning of the term ‘Faces of Attack’, Mucking, methods of removal of muck. Methods of Ventilation, Lighting and aspects of drainage.

**Textbooks/Reference Books:**

1. Railway Engineering by Satish Chandra and M.M Agarwal
2. A textbook of railway engineering by S.C. Saxena and S.P. Arora
3. Airport Planning and Design by S. K. Khanna, M.G Arora and S.S. Jain
4. Airport Engineering by Rangwala
5. Harbour, Dock and Tunnel Engineering by R. Srinivasan
6. Roads Railways Bridges and Tunnels Engineering by Ahuja & Birdi

<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181602</b>	<b>Engineering Hydrology</b>	<b>3-1-0</b>	<b>4</b>

**Course Objectives:**

1. To provide knowledge in the hydrological cycle, precipitation, evapotranspiration, infiltration and its measurements.
2. To estimate the runoff.
3. To understand hydrographs and IUH.
4. To know the types of aquifers
5. To understand the surface and subsurface in detail.
6. To understand the various methods of flood estimation and hence flood routing.

**MODULE 1: Introduction (2 hours)**

Hydrologic cycle – Schematic representation, System representation. Global Water Budget, History of Hydrology, Scope of Hydrology.

**MODULE 2: Weather and Precipitation (7 hours)**

Characteristics of the atmosphere, Atmospheric Water Vapor and its Indices –Vaporization, Condensation, Vapor Pressure, Density of moist air, Dew point temperature, Humidity. Mechanism of formation of Precipitation – Mechanism of cooling, Mechanism of condensation, Mechanism of droplet growth, Mechanism of accumulation of moisture. Forms and Types of Precipitation. Measurement of rainfall – Non-Recording and Recording Rain gauges, AWS, Radar measurement of rainfall, Selection of Rain gauge site, Rain gauge net – work, Adequacy of Rain Gauge Stations. Methods of computing average rainfall – Arithmetic mean method, Thiessen Polygon method, Isohyetal method. Interpolation and Adjustment of Missing Data – Station Year Method, Double mass curve. Related Numerical Problems. Hyetograph and mass curve of rainfall, Depth Area Duration Curve. Calculation of Return period from rainfall frequency curve.

**MODULE 3: Infiltration (3 hours)**

Introduction, Factors affecting infiltration, Infiltration capacity- Horton’s infiltration curve. Infiltration Indices, Numerical solutions, Measurement of infiltration – Flooding type Infiltrimeter

**MODULE 4: Evapotranspiration (4 hours)**

Introduction, Factors affecting evaporation, Measurement of Evaporation – Empirical Formulae (Meyer’s equation), Water Budget Method, Energy Budget Method, Mass Transfer Method, Aerodynamic method, Reservoir evaporation and methods for its reduction. Evapotranspiration – Estimation–Empirical equations–(Blaney Criddle equation, Thornthwaite equation), Using Lysimeter.

**MODULE 5: Runoff (8 hours)**

Introduction, Estimation of runoff – Empirical formulae, Infiltration method, Hydrograph analysis, Rational method.

**MODULE 6: Hydrograph (8 hours)**

Introduction, Components of hydrograph, Base Flow Separation, Computation of direct Surface Runoff. Unit Hydrograph – Definition, Derivation of UH with assumptions, Limitations and uses, UH of different durations, Synthetic UH, Instantaneous UH, all related numerical problems.



**MODULE 7: Estimation of Flood****(8 hours)**

Introduction, Methods of Estimation – Rational method, envelop curves, Empirical formulae, PMP chart, UH method, Flood Frequency Analysis – Gumbel's method, Log-Pearson Type – III Distribution, (All related numerical problems)

**MODULE 8: Flood Routing****(8 hours)**

Introduction – Reservoir routing and Channel routing, Hydrologic Routing – Basic Equations, Reservoir Routing by Modified Pul's Method, Channel Routing – Muskingum Equation and Muskingum method, Hydraulic Routing – Introduction by S.V. Equation

**Textbooks/Reference Books:**

1. Applied Hydrology - V. T. Chow, McGraw-Hill Science/Engineering/Math; 1 edition (February 1, 1988)
2. Engineering Hydrology - K. Subramanya, Tata McGraw-Hill Education
3. Hydrology - M. M. Das, PHI (1 December 2009)
4. Hydrology - H. M. Roghunath, New Delhi: New Age International (P) Ltd., Publishers, 2006
5. Applied Hydrology - K. N. Mutreja, Tata McGraw-Hill
6. Irrigation Engineering and Hydraulic Structures --- S. K. Garg, Khanna publishers, 2006
7. Irrigation Water Power and Water Resource Engineering --- Arora, Standard Publishers Distributors, 2015

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181603	Structural Design-II	3-1-0	4

### **MODULE 1: Introduction to Methods of Design**

Properties of Structural Steel, Corrosion, Fire Protection. Indian Standard Specifications and Sections. General Design Requirements & Design Process. Analysis Procedures & Design Philosophy. Introduction to Limit State Design. Partial safety Factor-Load-Load Combinations-Classification of Cross sections- Plastic, Compact, Slender Sections, Buckling Class of Sections. IS code provisions.

### **MODULE 2: Design of Connections and Fasteners**

Connections with Lap Joint and Butt Joint, Single Cover Butt Joint, Double Cover Butt Joint, Types of fasteners – Bolted connections, Riveted Connections, Welded Connections, Assumptions- Design examples – Design of Bolted Connections, Design strength of Bolt, Block Shear Failure, Design of Welded connections – Butt weld- Fillet weld – Design examples.

### **MODULE 3: Design of Tension Members**

Introduction, Plates and Angles as Tension members, Plates with holes as Tension Members, Calculation of Net Area, Yield and Rupture of plates under tension. Angles with holes under Tension. Angles connected through one leg and both legs.

### **MODULE 4: Design of Compression Members**

Buckling Class of Compression Members. Design Compressive strength- Design Example of Struts in Trusses, Design of Angles connected through one-leg and both legs, Design of Axially Loaded Columns. Design of Built-up columns, Laced and Battened Columns, Design of Lacing systems and Batten Systems

### **MODULE 5: Design of Beams**

Classifications of Beam sections, Plastic, Compact, Slender section, Behaviour of Steel Beams, Analysis and design of Laterally restrained and Un-Restrained Beams, Design strength in bending, Plastic Section Modulus - Design Examples. Design check for Shear in Beams

### **MODULE 6: Design of Beam-Column**

Behaviour of members under combined loading, Shear and Bending – Modes of Failures – beam - Column Connection, Design Examples.

### **MODULE 7: Design of Column Splices and Column Base**

Design of Column Splice-Design Examples- Design of Column Base- Slab Base- Gusseted Base- Design Examples

### **Textbooks/Reference Books:**

1. IS-800-2007. General Construction in Steel, Code of Practice
2. Steel Structures: Design and Practice , N. Subramanian, Oxford University Press.
3. Design of Steel Structures, N. Subramanian, Oxford University Press.
4. Design of Steel Structures – S. Duggal, McGraw Hill Education (India) Private Limited.
5. Design of Steel structures – S. S. Bhavikatti, I.K. International Publishing House Pvt. Ltd.
6. Design of Steel Structures - Anand S. Arya , J.L. Ajmani

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181604	Environmental Engineering-II	3-0-0	3

### **MODULE 1: Wastewater Treatment Processes: Theory and Application**

Screening, Comminuting, Grit Removal, Flow Measurement, Primary Sedimentation, Aeration, Solids Separation, Settling Operations, Coagulation, Filtration, Softening, Disinfection

### **MODULE 2: Secondary Treatment of Wastewater and Disposal**

Attached Growth Method, Suspended Growth method, Tertiary treatment of wastewater, Sludge Disposal standards and methods, Miscellaneous Treatment of Wastewater: Stabilization ponds, and Oxidation, ditches

### **MODULE 3: Air and Environment**

Types of Pollutants, their sources and impacts, Air pollution meteorology, Air control, air quality standards and limits.

### **MODULE 4: Solid Wastes**

Sources of Solid Wastes-Municipal. Hazardous, Characteristics, Generation, collection and transportation of solid wastes, Engineering systems for solid waste management (reuse/recycle, Energy recovery, treatment and disposal)

### **MODULE 5: Noise Pollution & Control**

Intensity, Duration – Types of Industrial Noise, Effects of Noise – Noise Measuring & Control – Permissible Noise Limits

#### **Textbooks:**

1. H. S Peavy, D. R Rowe and G. Tchobanoglous, *Environmental Engineering*, McGraw-Hill International Ed., 1985.
2. Metcalf & Eddy, *Wastewater Engineering- Treatment and Reuse* (Revised by G. Tchobanoglous, F. L. Burton and H. D. Stensel), Tata McGraw Hill, 4<sup>th</sup> Edn., 2004.
3. T. J McGhee, *Water Supply and Sewerage*, McGraw-Hill Inc., 1991.
4. Environmental Engineering Vol. I and II Santosh Kumar Garg.
5. Environmental Engineering K.N.Duggal.
6. Environmental Engineering Vol. I and II, B.C. Punmia.

#### **Reference Books:**

1. T. J McGhee, *Water Supply and Sewerage*, McGraw-Hill, Inc
2. J. M. Montgomery, *Water Treatment Principles and Design*, John Wiley & Sons
3. M. L Davis and D. A Cornwell, *Introduction to Environmental Engineering*, McGraw-Hill, Inc
4. S.J Arceivala and S. R. Asolekar, *Wastewater Treatment for Pollution Control and Reuse*, Tata McGraw Hill, 2006.
5. *Manual for Sewer and Sewerage*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India
6. *Manual for water supply and treatment*, Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Development, Govt. of India

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181605	Geotechnical Engineering-II	3-1-0	4

**MODULE 1: Earth Pressure Theories**

**(7 hours)**

Type of earth retaining structures. Lateral earth pressure. Active and passive earth pressure, earth pressure at rest. Theory application to all types of soils with different surcharge and saturation (Rankine's theory). Coulomb's wedge theory. Rebhann's graphical method and Culmann's graphical method for active earth pressure. Numerical problems

**MODULE 2: Stability of Slopes**

**(4 hours)**

Infinite and finite slopes. Stability analysis of infinite and finite slopes. The Swedish slip circle method. Friction circle method. Use of Taylor's stability chart. Numerical solutions

**MODULE 3: Ground Investigation and Geotechnical Characterization**

**(6 hours)**

Depth of exploration. Number and disposition of pits and boring. Ground water levels. Methods of sub-surface exploration. Soil samples and samplers. Standard penetration test and different corrections over it. Seismic refraction method and electrical resistivity method

**MODULE 4: Bearing Capacity**

**(10 hours)**

Bearing capacity criteria. Modes of Shear failure. Terzaghi's bearing capacity theory. Skempton's, Meyerhof's and Brinch Hansen's bearing capacity theory. B.I.S. Code provision. Settlement analysis in sands and clays. Permissible settlements for different structures. Allowable bearing pressure. Bearing capacity from field tests- based on Standard Penetration Test, based on Cone Penetration Test, Based on Plate Load Test. Numerical Problems

**MODULE 5: Deep Foundation**

**(6 hours)**

Types of piles. Method of installation. Point resistance and skin friction. Load carrying capacity of piles - dynamic formulae, static formulae, pile load test. Group action in piles – efficiency, Under-reamed pile. Negative skin friction. Pullout resistance of piles. Numerical problems

**MODULE 6: Well Foundation**

**(2 hours)**

Types of wells and Caissons. Necessity, different components. Depth and bearing capacity calculations. Forces acting. Well sinking. Control of shifts and tilts

**Textbooks/Reference Books:**

1. Soil Mechanics and Foundation Engineering- P. Purushothama Raj, Pearson Education in South Asia, Second Edition, (2018)
2. Geotechnical Engineering – Debasish Moitra, Universities Press; First Edition edition (2016)
3. Geotechnical Engineering – Shashi K Gulati & Manoj Dutta, McGraw Hill Education (16 May 2005)
4. Basic and Applied Soil Mechanics- Gopal Ranjan & A.S. Rao (1991), Wiley Eastern Ltd., New Delhi
5. Soil Mechanics and Foundation: Dr. B. C. Punmia, Laxmi Publications; Sixteenth edition (2017), Language: English, ISBN-10: 8170087910, ISBN-13: 978-8170087915
6. Soil Engineering in Theory and Practice (Part I & Part II): Dr. Alam Singh, CBS; 2 edition (1 December 2009)
7. Foundation Analysis and Design: Joseph E. Bowles, McGraw-Hill, 1977

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181606	Accountancy	2-0-0	2

**MODULE 1:**

Concept and classification of Accounts, Transaction, Double Entry system of Book Keeping, Golden rules of Debit and Credit, Journal- Definition, advantages, Procedure of Journalising, Ledger, advantages, rules regarding Posting, Balancing of Ledger accounts, Trial Balance- Definition, objectives, procedure of preparation.

**MODULE 2:**

Name of Subsidiary Books, Cash Book-definition, advantages, objectives, types of Cash Book, preparation of different types of cash books, Bank Reconciliation Statement, Regions of disagreement between Cash Book with Pass Book balance, preparation of Bank Reconciliation Statement

**MODULE 3:**

Final Account: Preparation of Trading Account, Profit and Loss Account with adjustments.

**MODULE 4:**

Concept of Capital Expenditure and revenue Expenditure, Baddebts, Provision for Bad and Doubtful debts, Provision for discount on Debtors, Outstanding expenses, Prepaid expenses, Accrued Income

**MODULE5:**

Introduction to Depreciation Accounting- Meaning, causes, factors, methods of charging depreciation etc.

**Textbooks/Reference Books:**

1. Theory and Practice of accountance- KR Das, KM Sinha, KS Pal Choudhury, Dr. A Rahman, PK Pujary
2. Book- Keeping & Accountancy- C Mohan Juneja, J R C Chawla, KK Sakseena
3. Double Entry Book- Keeping & Accountancy- JR Batliboi

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# **ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY GUWAHATI**

**Course Structure and Syllabus  
(From Academic Session 2018-19 onwards)**

**B.TECH  
CIVIL ENGINEERING  
7<sup>TH</sup> SEMESTER**



# ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Guwahati

Course Structure

(From Academic Session 2018-19 onwards)

**B.Tech 7<sup>th</sup> Semester: Civil Engineering**  
Semester VII/ B.TECH/CE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P		C	CE
<b>Theory</b>								
1	CE181701	Quantity Surveying	3	0	0	3	30	70
2	CE1817PE1*	Program Elective-1	3	0	0	3	30	70
3	CE1817PE2*	Program Elective-2	3	0	0	3	30	70
4	CE1817OE1*	Open Elective-1	3	0	0	3	30	70
5	HS181704	Principles of Management	3	0	0	3	30	70
<b>Practical</b>								
1	CE181722	Project-1	0	0	6	3	50	50
2	SI181721	Internship-III (SAI-Industry)	0	0	0	2	-	200
<b>TOTAL</b>			<b>15</b>	<b>0</b>	<b>6</b>	<b>20</b>	<b>200</b>	<b>600</b>
<b>Total Contact Hours per week : 21</b>								
<b>Total Credit: 20</b>								

<b>Programme Elective – 1</b>		
Sl.No.	Subject Code	Subject
1	CE1817PE11	Advanced Structural Analysis
2	CE1817PE12	Water Resources Engineering
3	CE1817PE13	Ground Improvement Technique
4	CE1817PE1*	Any other subject offered from time to time with the approval of the University

<b>Programme Elective – 2</b>		
Sl.No.	Subject Code	Subject
1	CE1817PE21	Earthquake Engineering
2	CE1817PE22	River Engineering
3	CE1817PE23	Machine Foundation
4	CE1817PE2*	Any other subject offered from time to time with the approval of the University

<b>Open Elective – 1</b>		
Sl.No.	Subject Code	Subject
1	CE1817OE11	Optimization Techniques
2	CE1817OE12	Environmental Impact Assessment

## Detail Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181701	Quantity Surveying	3-0-0	3

### MODULE 1: Introduction

Principle of estimating, Purpose and type of estimating, Main items of work and their units of measurement, Standard methods of measurements.

### MODULE 2: Specifications of Work

Aims of specification, Types, Method of preparation, General specification of different classes of buildings, Detail specification of some important items.

### MODULE 3: Rate Analysis & Schedule of Rates

Purpose, Factors affecting Rate Analysis, Labour & Material requirement for important items of work, Analysis of rates for various Items of buildings.

Local schedule of Rates, Rates of important items of work from different Government schedule of rates.

### MODULE 4: Building Estimate

Estimate of Single Storied Building (sloped roof, Trusses, R.C.C., P.C.C., openings, flooring, finishing), Preparation of B.O.Q.

Estimate of septic tank: septic tank, water supply and sanitary installation.

### MODULE 5: Road Estimate

Estimate of earthwork, Estimate of pitching of slopes, Estimate for a New Road, Culvert.

### MODULE 6: Valuation- Introduction & Methods

Cost, Price & Value, Different forms of value, Purpose of valuation, Different methods of valuation. Rental method of valuation - Different forms of Rent, Sinking Fund, Year's Purchase, Annuity. Method of depreciation - Various methods of Depreciation, numerical problems.

### MODULE 7: Land & Building Method

Various methods of valuation of buildings, belting method of land valuation, Numerical problems of valuation of land and building.

### Textbooks/Reference Books:

1. "Estimating and Costing in Civil Engineering" by Prof. B. N. Dutta, UBS Publishers Distributors Pvt. Ltd.
2. "Estimating, Costing and Specification in Civil Engineering" by Mr. M. Chakraborty.
3. "A Textbook of Estimating and Costing (Civil)" by D. D. Kohli and R. C. Kohli S. Chand & Company Ltd.
4. "Estimation Costing and Valuation" by Rangwala, Charotar Publishing House Pvt. Ltd.
5. "Estimating and Costing" by G.S. Birdie, Dhanpat Rai Publishing Company Pvt. Ltd.



Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE11	Advanced Structural Analysis	3-0-0	3

### **MODULE 1: Analysis of Indeterminate Structures**

**Review of basic concepts in structural analysis:** structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy; applications of principle of virtual work and displacement- based and force- based energy principles; deriving stiffness and flexibility coefficients

**Indeterminate structures:** Brief review of Slope-deflection method, Moment distribution method

### **MODULE 2: Introduction to Matrix Analysis of Structures**

Matrix; vector; basic matrix operations; rank; Review of solution of linear simultaneous equations; Eigen values and Eigen vectors.

Introduction to Local and Global/ Structure coordinate systems; displacement and force transformation matrices; Element and Structure stiffness matrices; equivalent joint loads; stiffness and flexibility approaches

### **MODULE 3: The Direct Stiffness Method**

Introduction to computer application; Numerical modeling of structure for analysis; Nodal Data, Member / Element data; Member property data; Material data for structure;

Defining structure in Global coordinate system; Formation of Member stiffness matrices in Local coordinate; Assembly of Structure stiffness matrix in Global coordinate; Understanding application of Boundary conditions; Formulation of Load vectors; Matrix solution for Global displacements

### **MODULE 4: Direct Stiffness Method for Analysis of Plane Truss, Plane Frame**

Structural Analysis of Plane truss by Direct stiffness method (four DOF per element)

Structural Analysis of Plane frames by Direct stiffness method (six DOF per element)

### **MODULE 5: Unsymmetrical Bending and Shear Centre**

Principal moment of inertia, Stress in beams due to unsymmetrical bending, Shear Centre, Methods of Locating Shear Centre

#### **Textbooks/ Reference Books:**

1. Matrix method of Structural Analysis- S SBhavikatti, VIKASH PUBLISHING HOUSE PVT LTD
2. Advanced Structural Analysis- Devdas Menon, Narosa Publishing House, 2009.
3. Matrix Methods of Structural Analysis- P. N. Godbole R.S. Sonparote, S.U. Dhote, Publisher: PHI
4. Matrix Analysis Framed Structures - Weaver, William, Gere, James M. Publisher: CBS
5. Structural Analysis: T S Thandavamoorthy, Oxford University Press.
6. Basic Structural Analysis- C S Reddy, McGraw Hill Education (India) Private Ltd., New Delhi.
7. Structural Analysis-II- S SBhavikatti, Vikash Publishing House Pvt Ltd

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE12	Water Resources Engineering	3-0-0	3

### **MODULE 1: Introduction**

Fields of water resources engineering; problems of water resources engineering, economics in water resources engineering, Social aspects of water resources engineering, planning of water resources projects, the future of water resources engineering. Water resource in North East and its use

### **MODULE 2: Engineering Economy in Water Resources Planning**

Social importance, steps in an Engineering economy study, discount rate, sunk cost, intangible values, economic life, physical life and period of analysis of a project, cash flow diagram, discounting factors – single payment factors and uniform annual series factors, discounting methods, present worth method, rate of return method, annual cost method, benefit cost ratio method

### **MODULE 3: Cost Allocation**

Definition, separable cost, joint cost, common cost, method of cost allocation–remaining benefits method and alternative justifiable expenditure method

### **MODULE 4: Planning for Water Resources Development**

Levels of planning, phases of planning objectives, data required for planning, projections for planning, project formulation, project evaluation, environmental considerations in planning multipurpose project planning, requirement of uses in multipurpose projects, drawbacks in project planning

### **MODULE 5: Reservoir**

Purpose, physical characteristics of reservoir, storage capacity determination from the site, reservoir site selection, reservoir capacity determination, reservoir sedimentation, trap efficiency, distribution of sediment in a reservoir, useful life of reservoir, reservoir operation and operation rule curves, reservoir yield, economic height of a dam, reservoir working table

### **MODULE 6: River Bank Erosion**

Causes, anti-erosion measures, design of anti-erosion structures

### **Textbooks/ Reference Books:**

1. Water Resources Engineering-by R.K. Linsley& J.B. Franzini, McGraw-Hill International Book Company
2. Water Power Engineering- by M.M. Dandekar & K.N. Sharma, Vikash Publishing House Pvt. Ltd., Noida, UP
3. Irrigation and Water Resources Engineering –by G.L. Asawa, New Age International (P) Limited Publishers
4. Hydrology and Water Resources Engineering –by S.K. Garg, Khanna Publishers, Delhi
5. Economics of Water Resources Planning –by L. Douglas James and Robert R. Lee, McGraw-Hill Book Company
6. Irrigation and Water Resources Engineering –by B.C. Punmia, Pande& B.B. Lal, Standard Publishers Distributors, Delhi
7. IS 8408:1994 Planning and Design of Groynes in alluvial river Guidelines.
8. IS 10751:1994 Planning & Design of Guide Banks for alluvial rivers Guidelines
9. River Behaviour Management and Training (Vol. I& II), Central Board of Irrigation and Power, 1994

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE13	Ground Improvement Technique	3-0-0	3

#### **MODULE 1: Surface Compaction**

Introduction, Review of compaction theory, Field procedures of compaction, Equipment for Surface Compaction, Quality Control

#### **MODULE 2: In-situ Deep Compaction in Granular Soils**

Introduction, In-situ densification methods in granular soils, Terra-Probe, Vibroflotation techniques, Ground Suitability for Vibroflotation, Advantages, Mueller Resonance Compaction, Dynamic Compaction, Depth of Improvement

#### **MODULE 3: Dewatering Methods**

Methods of Dewatering Systems, Design Steps for Dewatering Systems, Distance of Well Points from Sources of Seepage, Effective Well Radius, Discharge Computations, Design of Filters

#### **MODULE 4: Precompression and Vertical Drains**

Review of Compressibility of Soils and Consolidation, Principle of Precompression, Methods of Preloading, Monitoring of Compression, General Principle of Vertical Drains, Design of Vertical Drains, Types and Construction of Vertical Drains

#### **MODULE 5: Stone Columns**

Stone Columns, Improvement in Soil Bearing Capacity due to Stone Columns

#### **MODULE 6: Grouting and Injection**

Introduction, Groutability, suspension grout, solution grout, grouting equipments and methods, Applications

#### **MODULE 7: Cementing and Chemical Stabilization**

Cement Stabilization, Bituminous Stabilization, Chemical Stabilization

#### **MODULE 8: Introduction to Reinforcement of Soil**

Concept of soil reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – simple design – applications of reinforced earth. Role of Geotextiles in filtration, drainage, separation, road works and containment.

#### **Textbooks/ Reference Books:**

1. Ground Improvement Techniques by Dr. P Purushothama Raj
2. Koerner, R.M. “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill, 1994
3. Mittal.S, “An Introduction to Ground Improvement Engineering”, Medtech Publisher, 2013
4. Bergado et. al. – Soft Ground Improvement
5. Gopal Ranjan and A. S. R. Rao – Basic and Applied Soil Mechanics

#### **Recommended IS Codes:**

1. IS9759: 1981 “Guidelines for Dewatering During Construction”, Bureau of Indian Standards, New Delhi, Reaffirmed 1999
2. IS15284(Part1): 2003 “Design and Construction for Ground Improvement – Guidelines” (Stone Column), Bureau of Indian Standards, New Delhi, 2003

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE21	Earthquake Engineering	3-0-0	3

### **MODULE 1: Introduction to Seismology**

Understanding Earthquakes, Earth's Interior and Plate Tectonics, Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters; Modification of Earthquake due to Local soil effect; Amplification

### **MODULE 2: Structural Systems for Seismic Resistance**

Structural systems – Building configuration, influence of structural classification on building responses - Basic Principles of seismic design. Soft Storey and Weak Storey concept

### **MODULE 3: Introduction to Structural Dynamics**

Equations of Motion for SDOF and MDOF Systems; Un-damped Free Vibration of SDOF and MDOF Systems; Mode Shapes and Frequencies of MDOF System; Concept of Response Spectra, Rayleigh Damping Matrix; Eigen Solutions and Modal Analysis of Structures for seismic loads

### **MODULE 4: Method of Seismic Analysis**

IS: 1893-1984 /2002/ 2016 - Seismic Coefficient method and Modal analysis method - Applications to multi-storied building frames – water tanks – chimneys. Concept of Equivalent Lateral Force for Earthquake; Response Spectrum Analysis, Modal Combination Rules; Response Spectrum Method of Analysis of Structures and Codal Provisions

### **MODULE 5: Earthquake Geotechnical Engineering**

Fundamentals of Seismic Soil-Structure Interaction; Local Site effects, Soil-structure interaction, Dynamics Properties of Soil, Dynamic Earth Pressure, Introduction to Soil Liquefaction and Liquefaction potential analysis method, Introduction to Ground Improvement Techniques

### **MODULE 6: Earthquake Resistant Construction**

Earthquake Resistant Design Philosophy; Concept of ductility in structures; ductile detailing requirements; Codal Provisions for ductile detailing (specific reference to IS: 13920-2016). Specific reference to IS: 4326 for Earthquake resistant construction of buildings.

Introduction to Earthquake-resistant features in non-engineered constructions and masonry structures; Introduction to IS: 13927 and IS: 13928-1993 through Assignment, Introduction to Retrofitting, various Retrofitting options for Buildings, Base isolation concept, Isolation systems

### **Textbooks/ Reference Books:**

1. I.S. 1893 - 2002 / 2016 - Criteria for Earthquake Resistance design of Structures
2. I.S. 1893 - 1984 - Criteria for Earthquake Resistance design of Structures
3. A.K. Chopra- 'Dynamics of Structures' Prentice Hall India
4. Pankaj Agarwal and Manish Shrikhande - 'Earthquake Resistant Design of Structures', PHI, 2008
5. Clough R.W. and Penzien J.- 'Dynamics of Structures', McGraw-Hill, Newmark N.M. and Rosenblueth E. - 'Fundamentals of Earthquake Engg.', Prentice Hall, 1971
6. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988
7. Ellis L. Krinitzsky, J.M. Gould and Peter H. Edinger, 'Fundamentals of Earthquake Resistant Construction', John Wiley, 1993
8. S. L. Kramer, 'Geotechnical Earthquake Engineering'
9. I.S. Codes 4326, 13920-2016, IS: 13927 and IS: 13928-1993

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE22	River Engineering	3-0-0	3

### **MODULE 1: Introduction**

River course- upper, middle and deltaic reaches; Himalayan and Peninsular rivers, principal river systems of India.

### **MODULE 2: Types of Rivers**

Perennial, flashy and virgin rivers, incised and boulder rivers, rivers in the flood plains, deltaic rivers, braided rivers, tidal rivers, aggrading and degrading types of rivers

### **MODULE 3: River Behavior**

Behavior of rivers in straight reaches and bends; river meandering- causes and general features, factors affecting meandering, meandering parameters; cut-off, development and effects of cut-off, causes of braiding and delta formation

### **MODULE 4: Flood Estimation**

Rational, empirical and unit hydrograph methods; flood frequency analysis, probability and return period flood, Gumbel and Log Pearson distributions, design flood and probable maximum flood

### **MODULE 5: Origin and Formation of Sediments**

Nature of sediment problems; stream erosion and deposition, wind erosion and deposition, wind erosion and deposition

### **MODULE 6: Sediment Transport**

Sediment- bed load, suspended load and wash load; incipient motion of sediments, mode of sediment transport- rolling, sliding, saltation and suspension; introduction to theories of sediment transport including Shield's theory

### **MODULE 7: Regimes of Flow**

Definition, description of regimes of flow, plane bed, ripples, dunes, transition and anti-dune regime; prediction of regimes of flow

### **MODULE 8: River Training**

Definition, objectives classification- high water, low water and mean water river training; types of river training works-marginal embankments, spurs, guide banks, porcupines, bank pitching and revetments, cut-off, pitched island, sills and bottom panelling, bandalling; river training works in Assam

### **Textbooks/Reference Books:**

1. Chang H.H., "Fluvial Processes in River Engineering", Publisher: John Wiley & Sons
2. Garde R. J. and Ranga Raju K.G., "Mechanics of Sediment Transport and Alluvial Stream", Publisher: Wiley Eastern Ltd., New Delhi
3. Subramanya S. K., "Engineering Hydrology", Publisher: McGraw Hill Companies
4. Das M.M. & Saikia M.D., "Hydrology", Publisher: Prentice Hall of India Pvt. Ltd

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817PE23	Machine Foundation	3-0-0	3

### **MODULE 1: General Principles of Machine Foundation Design**

Type of machines and foundations, general requirements of machine foundation, soil and machine data required for design, permissible amplitude, design criteria, relevant IS codes.

### **MODULE2: Theory of Vibrations**

Vibration of elementary systems, vertical, sliding, torsional and rocking modes of vibrations, degrees of freedom, coupled motion, undamped and damped free vibrations, overdamped, under damped and critically damped system, logarithmic decrement, undamped and damped forced vibration, constant force and rotating mass oscillators, mass-spring-dashpot model, equation of motion, dynamic magnification factor, principle of vibration measuring instruments.

### **MODULE 3: Dynamic Properties Soils**

Elastic constants, stiffness and damping of soils and their determination, block vibration test, cyclic plate load test.

### **MODULE 4: Design of Reciprocating Machine Foundations**

Methods of analysis, linear elastic weightless spring method, elastic half-space method, design procedures for block and frame foundations, codal provisions.

### **MODULE 5: Vibration Isolation and Absorber**

Force and motion isolation, vibration isolation techniques, transmissibility ratio, mechanical isolation, foundation isolation, isolation by location, isolation by barriers, undamped dynamic vibration absorber.

### **Textbooks/ Reference Books:**

1. Swami Saran, "Soil Dynamics and Machine Foundations", Galgotia Publications Pvt. Ltd., New Delhi.
2. Shamsher Prakesh and Vijay Kumar Puri, "Foundations for Machines: Analysis and Design", A Wiley-Interscience Publication, John Wiley and Sons.
3. P. Srinivasulu and C. V. Vaidyanathan, "Hand Book of Machine Foundations", McGraw-Hill Education.
4. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall International Series, Pearson Education India
5. F. E. Richart, Jr., J. R. Hall, Jr. and R. D. Woods, "Vibrations of Soils and Foundations", Prentice-Hall International Series
6. IS 2974-1: "Code of Practice for Design and Construction of Machine Foundations", Part 1: Foundation for Reciprocating Type Machines, Bureau of Indian Standards

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817OE11	Optimization Techniques	3-0-0	3

### **MODULE 1: Introduction and Basic Concepts**

Historical Development; Engineering applications of Optimization; Art of Modeling Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems

Classification of optimization problems

Optimization techniques – classical and advanced techniques

### **MODULE 2: Optimization using Calculus**

Stationary points; Functions of single and two variables; Global Optimum

Optimization of function of one variable and multiple variables;

Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values

### **MODULE 3: Linear Programming**

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations

Graphical method for two variable optimization problem; Examples

Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems

Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, **Linear Programming Applications.**

### **MODULE 4: Dynamic Programming**

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality

Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP), **Dynamic Programming Applications.**

### **MODULE 5: Advanced Topics in Optimization**

Piecewise linear approximation of a nonlinear function

Multi objective optimization

Direct and indirect search methods, GA

Evolutionary algorithms for optimization and search

Applications in civil engineering

**Textbooks/Reference Books:**

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International P)Ltd., New Delhi, 2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi, 1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi, 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.



Course Code	Course Title	Hours per week L-T-P	Credit C
CE1817OE12	Environmental Impact Assessment	3-0-0	3

### **MODULE 1: Introduction for EIA**

Framework, screening, scoping and baseline studies; techniques for assessment of impacts on physical resources, ecological resources, human use values and quality of life values. Impact assessment methodologies-various methods, their applicability. Strategic environmental assessment. Cumulative impact assessment. Risk and uncertainty in EIA.

### **MODULE 2: Environment Attributes**

Prediction and Methods of Assessment of Impacts on Various Aspects of Environment; Application of various models for the Prediction of impact on Air Environment, Water Environment, Noise Environment and Land Environment. Public participation in environmental decision making process

### **MODULE 3: Environmental Protection acts, Rules and Standards**

EIA guidelines, Environmental Policies-National and international; international treaties. Carbon management, Kyoto Protocol and Clean Development Mechanism (CDM), Carbon neutrality. Environmental Legislations-acts, rules, regulations and notifications. Environmental standards.

### **MODULE 4: Environmental Audit**

Objectives, types, features, planning of audits; organization of auditing programme, pre-visit data collection. Audit protocol; onsite audit; data sampling - inspections - evaluation and presentation, audit report - action plan - management of audits; waste management contractor audits. Introduction to ISO 14001 series, OHSAS 18001; case studies

### **MODULE 5: Environmental Management**

Preventive policy of environment, waste minimization, conservation of water and energy, use of renewable, sources, pollution audit, pollution control strategy, disposal of treated effluents, solid waste disposal concept of green cities, green belt development.

### **MODULE 6: Case Studies**

Environmental Impact Analysis on --- Hydroelectric power projects, Mining Projects, Nuclear Power Plants.

### **Textbooks/Reference Books:**

1. MoEF, GoI, Environment Impact Assessment, Impact Assessment Division, January 2001 (Manual)
2. Water (Prevention and Control of Pollution) Act 1974. Air (Prevention and Control of Pollution) Act 1981
3. Environmental Impact Assessment (2nd Ed.) -LW Canter, McGraw Hill Inc. Singapore, 1996
4. Environmental Impact Assessment-Cutting edge for the 21st century - A Gilpin, CUP, London, 1994
5. Environmental Impact Assessment-Theory & Practice - P Wathern, and U Hynman, Sydeny, 1988
6. Renewable Energy Environment and Development- M Dayal, Konark Pub. Pvt. Ltd., 1998

7. Planning and Implementation of ISO14001, Environmental Management System- G Gyani and A Lunia, Raj Publishiong House, Jaipur, 2000. 7. ISO 14001
8. An Introduction to Environmental Audit - RD Tripathi, Alpha Publications, 2009.
9. “The ISO: 14000 Handbook” – J Caseio (Ed), Published - CEEM Information Services. 2000
10. A Guide to the Implementation of the ISO: 14000 Series on Environmental Management - I Ritchie, and W Hayes, Prentice Hall, New Jersey, 1998. 11. OHSAS & SA Guidelines

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181704	Principles of Management	3-0-0	3

**MODULE 1: Introduction** (6 Lecture)

Definition and meaning of management, Characteristics of management, importance of management, functions of management-planning, organising, directing, staffing, coordination and controlling etc., principles of management, Difference between administration and management

**MODULE 2: Financial Management** (6 Lecture)

Definition and management of financial planning, importance and characteristics of sound financial plan, concepts of capital- fixed capital and working capital, source of finance, fund flow statement.

**MODULE 3: Marginal Costing** (6 Lecture)

Definition and meaning of marginal costing, advantages, marginal cost equation, contribution, profit-volume ratio, break even analysis, margin of safety.

**MODULE 4: Cost Accounting** (6 Lecture)

Cost Accounting- Concept and benefit, elements of cost, preparation of cost sheet with adjustment of raw materials, work-in-progress and finished goods.

**MODULE 5: Capitalisation**

Definition and meaning of capitalisation, over and under capitalisation.

**MODULE 6: Motivation** (6 Lecture)

Introductory observation, definition of motivation, motivational technique, features of sound motivational system.

**MODULE 7: Leadership** (6 Lecture)

Concept of leadership, principles of leadership, functions of leadership, qualities of leadership, different styles of leadership

**Textbooks/Reference Books:**

1. Principle of Business Management: RK Sharma, Shashi K.Gupta
2. Business Organisation and Management: SS Sarkar, RK Sharma, Shashi K.Gupta
3. Industrial Organisation and Management: SK Basu, KC Sahu, B Rajvive
4. Principles of Management by Dr. A. K. Bora: Chandra Prakash, Guwahati.
5. Management Accounting: RK Sharma, Shashi K Gupta
6. Cost Accounting: SP Jain, K I Narang
7. Cost Accounting, RSN Pillai, V Bhagawati
8. Principles of Management: RN Gupta
9. Principles of Management: RSN Pillai, S. Kala
10. Principles of Management: Dipak Kumar Bhattacharjee

<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>CE181722</b>	<b>Project-1</b>	<b>0-0-6</b>	<b>3</b>
<b>GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME</b>			

<b>Course Code</b>	<b>Course Title</b>	<b>Hours per week L-T-P</b>	<b>Credit C</b>
<b>SI181721</b>	<b>Internship-III (SAI - Industry)</b>	<b>0-0-0</b>	<b>2</b>
<b>GUIDELINES WILL BE ISSUED BY THE UNIVERSITY FROM TIME TO TIME</b>			

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**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY  
GUWAHATI**

**Course Structure and Syllabus  
(From Academic Session 2018-19 onwards)**

**B.TECH  
CIVIL ENGINEERING  
8<sup>th</sup> SEMESTER**



**ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY**  
**Guwahati**  
**Course Structure**

(From Academic Session 2018-19 onwards)

**B. Tech 8<sup>th</sup> Semester: Civil Engineering**

**Semester VIII/ B. TECH/CE**

Sl. No	Sub-Code	Subject	Hours per Week			Credit C	Marks	
			L	T	P		CE	ESE
<b>Theory</b>								
1	CE181801	Construction Engineering and Management	3	0	0	3	30	70
2	CE1818PE3*	Program Elective-3	3	0	0	3	30	70
3	CE1818PE4*	Program Elective-4	3	0	0	3	30	70
4	CE1818OE2*	Open Elective-2	3	0	0	3	30	70
5	CE1818OE3*	Open Elective-3	3	0	0	3	30	70
<b>Practical</b>								
1	CE181822	Project-2	0	0	8	4	100	50
<b>TOTAL</b>			<b>15</b>	<b>0</b>	<b>8</b>	<b>19</b>	<b>250</b>	<b>400</b>
<b>Total Contact Hours per week : 23</b>								
<b>Total Credits: 19</b>								

PROGRAMME ELECTIVE – 3 SUBJECTS		
Sl. No	Subject Code	Subject
1	CE1818PE31	Advanced Structural Design
2	CE1818PE32	Design of Hydraulic Structures
3	CE1818PE33	Geotechnical In-situ Testing
4	CE1818PE3*	Any other subject offered from time to time with the approval of the University

<b>PROGRAMME ELECTIVE – 4 SUBJECTS</b>		
<b>Sl. No</b>	<b>Subject Code</b>	<b>Subject</b>
1	CE1818PE41	Design of Substructures
2	CE1818PE42	Pavement Design and Construction
3	CE1818PE43	Bridge Engineering
4	CE1818PE44	Water Power Engineering
5	CE1818PE4*	Any other subject offered from time to time with the approval of the University

<b>OPEN ELECTIVE – 2 SUBJECTS</b>		
<b>Sl. No</b>	<b>Subject Code</b>	<b>Subject</b>
1	CE1818OE21	Disaster Risk Management
2	CE1818OE22	Solid and Hazardous Waste Management
3	CE1818OE2*	Any other subject offered from time to time with the approval of the University

<b>OPEN ELECTIVE – 3 SUBJECTS</b>		
<b>Sl. No</b>	<b>Subject Code</b>	<b>Subject</b>
1	CE1818OE31	Finite Element Method
2	CE1818OE32	Remote Sensing and Geographical Information System
3	CE1818OE3*	Any other subject offered from time to time with the approval of the University

## Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
CE181801	Construction Engineering and Management	3-0-0	3

### MODULE 1: Introduction to Construction Methods and Equipment

Introduction The construction industry, the construction process, Classification of construction equipment, need of construction equipment, Factors behind the selection of construction equipment, cost of owning and operating equipment, investment and operating costs, depreciation costs.

- Earthmoving equipment: tractors and attachments, dozers and rippers, scrapers, shovel, dragline, trenching machine, clamshell, hoe, track, dumper, roller, compactor.
- Drilling and blasting equipment; pumping equipment, stone crushing equipment, concrete manufacture, transport, placing and compacting equipment.
- Equipment for moving materials- builder's hoist, forklift, crane, belt conveyor, cableway, ropeway.
- Demolition: Advanced techniques and sequence for demolition and dismantling of old structures.
- Substructure construction: underwater construction of diaphragm wall and basement, sheet pile construction, shoring for deep cutting, well points, dewatering equipment for open excavation, piling, tunneling, ground improvement techniques.

Mechanical construction technology for multistory buildings.

### MODULE 2: Project Life Cycle

Characteristics of Project life cycle, Phases of project life cycle, Brief description about the different phases project life cycle, Project management processes.

### MODULE 3: Construction Planning and Scheduling

Introduction to Building Information Modeling (BIM), Application of PERT and CPM techniques for construction scheduling.

**MODULE 4: Introduction to Project cost management-** Direct and Indirect cost estimate

**MODULE 5: Introduction to Project Procurement Management**

**MODULE 6: Safety and Quality Assurance in Construction**

### Textbooks/ Reference Books:

1. CPM in Construction Management – By ConO'Brien, J. J., Plotnick, F. L. 7th. Edition. McGraw Hill. 2010.
2. Project Management- By Frederick Gould and Nancy Joyce



Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE31	Advanced Structural Design	3-0-0	3

#### **MODULE 1: Prestressed Concrete**

Concept of Prestressing materials for Prestressed concrete, I.S. specifications; Analysis of Prestress-resultant stress at section, Thrust line, load balancing concept, stress in tendons. Design of simple section.

#### **MODULE 2: Retaining Walls**

Principles and analysis of Cantilever and Counterfort type retaining wall, Detailed design of different type of retaining walls for Active, Passive Earth Pressure and Surcharge.

#### **MODULE 3: Flat Slabs, Grid Slab or Waffle Slabs**

Analysis and Design of Flat Slabs, Grid slab or waffle slabs

#### **MODULE 4: Water Tank**

Design principles of underground and elevated water tanks, Detailed design of Rectangular and Circular elevated water tanks as per IS 3370, Design of Ring Beam and staging for elevated water tanks, Detailed Design of Intz Tanks, Pressed steel Tanks

#### **MODULE 5: Design of Plate Girder, Gantry Girder**

General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing- Transverse stiffeners - Design Examples.

#### **MODULE 6: Design of Industrial Steel Structure**

General- Components of Industrial buildings and introductions, Structural Configuration, Wind zones, Evaluation of Wind Loads on Roofs and Waals, Permeability of Buildings, Exposure, External and Internal pressure co-efficient, Design examples.

Concept of Pre-engineered Building

#### **Textbooks/ Reference Books:**

1. IS-800-2007 - General Construction in Steel, Code of Practice
2. IS 804- Specifications for Rectangular Pressed Steel Tanks
3. IS:456 - 2000 - Plain and Reinforced concrete - Code of practice
4. IS:4326-1993 - Earthquake Resistant Design and Construction of Buildings - Code of Practice
5. IS: 875(Part3)-1987 - Wind Loads on Buildings and Structures
6. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
7. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs(Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE32	Design of Hydraulic Structures	3-0-0	3

### **MODULE 1: Gravity Dam**

Introduction, Classification of Dam, Principles of Gravity Dam, Forces acting on Gravity Dam, Modes of Failure and Criteria for Structural Stability of Gravity Dams, Stability Analysis of Gravity Dams – 2D Gravity Method, Elementary and Practical Profile of a Gravity Dam, Design Considerations, Checking Stability Analysis of a Gravity Dam for Different Conditions (Numerical Problems)- Reservoir Empty Condition, Reservoir Full with Tail Water and without Tail Water Condition.

### **MODULE 2: Earthen Dam**

Introduction, Types of earthen dam, Causes of Failures of Earthen Dam, Seepage Analysis – Seepage Discharge Through Isotropic & Non-isotropic Soils, Determination of Phreatic Line for Homogeneous Soil with or without Horizontal filter. - Numerical Problems. Stability of Slopes:  $u/s$  Slope due to Sudden Drawdown,  $d/s$  Slope under Steady Seepage and foundation from the considerations horizontal shear at base

### **MODULE 3: Spillways**

Locations, Different Types, Ogee Spillway - Comprehensive Profile for Ogee Spillway as per USBR, Discharge Formula, Factors affecting Discharge Coefficient for Ogee Spillway. (Numericals). Side Channel Spillway- Dynamic equation for Spatially Varied Flow, Hind's solution for the design of Side Channel Spillway. Introduction to design concept of Siphon spillway.

### **MODULE 4: Energy Dissipator**

Introduction, Energy dissipator for different tail water conditions. Various Stilling Basins -Type-II, Type-III, Type -IV. Selection and Design of Stilling Basins (Numericals)

### **MODULE 5: Theories of Seepage & Design of Weirs and Barrages on permeable Foundations**

Causes of failure by piping and by direct uplift, Bligh's creep theory for seepage flow, Khosla's theory and concept of Flow net. Determination of uplift pressure below composite weir profile adopting Schwarz Christoffel transformation by Khosla's method of design. Principle for weirs on permeable foundation. Factors Governing the design of the weir and a barrage. Design of weirs and barrages using Khosla's theory of independent variables.

### **References:**

1. Design of Small Dam -U.S.B.R.
2. Irrigation & Hydraulic Structures - S. R. Sahasrabudhe
3. Irrigation and Water Power Engineering-P.N. Modi
4. Irrigation and Hydraulic Structure-S.K. Garg
5. Flow in Open Channel-Subramanya
6. C.B.I Publication No. 12.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE33	Geotechnical In-situ Testing	3-0-0	3

Introduction: Necessity and Importance of soil exploration, Method of sub surface exploration, Test pits, Trenches, Caissons, Tunnels and drifts, Wash boring, Percussion drilling, Rotary drilling, Factors affecting the selection of a suitable method of boring. Extent of boring, Factors controlling spacing and depth of bore holes, Spacing and depth of various Civil engineering structures.

Indirect method of exploration- Seismic refraction method, electrical resistivity, resistivity sounding and profiling. Qualitative and quantitative interpretation of test results, comparison of resistivity and seismic surveys limitations and shortcomings

Sampling- Sources of disturbances and their influence. Types of samplers, Principle of design of samplers, Preservation and shipment of samples.

Ground water Observation: Different method of ground water observation: Time lag in observation, sampling of ground water.

Boring and sampling records, Preparation of bore-log

Penetration test: Standard penetration tests, Dynamic cone penetration test with and without bentonite slurry, Static cone penetration tests. Various corrections in the test results. Interpretation of test results for design and determination of modulus of deformation. Correlation among various test results.

Plate load tests under constant load, cyclic load, Determination of deformation modulus, sub-grade modulus, coefficient of elastic uniform compression. Limitations of plate load tests.

Pile load test – Methods by constant load, cyclic load, pull-out test, lateral pile load test

In-situ dynamic tests- Shear modulus test, vertical and horizontal block vibration test. Determination of different dynamic soil constants

Introduction to cross hole logging, SASW, MASW techniques.

#### **Textbooks/ Reference Books:**

1. M. Hvorsler, Subsurface exploration and sampling of soil for Civil Engg. Purpose
2. B. M Das, Principles of Foundation Engineering, Thomson Brooks/Cole
3. G.Ranjan and A S R Rao, Basic and Applied Soil Mechanics, New Age international Publishers.
4. H. F. Winterkorn and H Y Fang, Foundation Engineering Hand Book, Galgotia Book source
5. Simon and Cayton, Site Investigation.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE41	Design of Substructures	3-0-0	3

**Course Objective:** Students should be able to-

- Gain familiarity with different types of foundation.
- Design of shallow foundations and deep foundations.
- Analyse the stability of well foundation.

**Course Outcome:** On completion of this course students will be able to –

- select appropriate foundations type based on available soil conditions.
- determine the load carrying capacity of various types of foundation.
- design reinforced concrete shallow foundations, pile foundations and well foundations.

### **MODULE 1: Geotechnical and Structural Design of Shallow Foundations**

Loads for design, determination of safe bearing capacity & allowable bearing pressure of footings in clay & sand, dimensioning of single isolated footing, considerations for dimensioning of groups of footings for equal settlements – the standard current practices. Structural design of isolated footings, strip footings, combined footings.

### **MODULE 2: Raft in Clay & Sand**

Types and their suitability, determination of safe bearing capacity & allowable bearing pressure. Structural design of raft by conventional (rigid) method as per IS: code of practice.

### **MODULE 3: Pile Foundation**

Determination of allowable load on single & pile group in clay & sand, fixation of length, diameter, number and spacing of piles, introduction to micro piles. Analysis of Laterally loaded piles by Reese & Matlock approach. Structural design of pile, pile group and pile cap.

### **MODULE 4: Sheet Piles**

Design of cantilever and anchored sheet piles, shoring piles.

### **MODULE 5: Elements of Bridge Sub Structure**

Forces on bridge sub – structure (IRC & IRS specification), well foundation with components only.

### **Textbooks/ Reference Books:**

1. Bowles.J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York, 1986.
2. Swamy Saran,” Analysis and Design of substructures”, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
3. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.  
Varghese.P.C, “Design of Reinforced Concrete Foundations” – PHI learning private limited, New Delhi – 2009.

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE42	Pavement Design and Construction	3-0-0	3

### **MODULE 1: Analysis of Pavement Stresses**

#### **Pavement Structure and Functional Attributes**

Pavement structure and functional attributes, factor affecting pavement design, types of wheel load for highways and airports, development of design method for highway and airport pavements

#### **Stresses in Pavements**

Stresses in flexible pavements: 1-layer, 2-layer, 3-layer theories, EWLF, ESWL

Stresses in Rigid pavement: load, friction and temperature stresses, combined stresses

### **MODULE 2: Structural Design of Pavements Flexible Pavement Design**

Airport pavement: Corps of Engineer's method, FAA method CDOT method, Asphalt institute method

Highway Pavement: Empirical method based on soil strength criteria: CBR method as specified by IRC, AASHTO method, Asphalt institute method, IRC-37: 2018 method

#### **Rigid Pavement Design**

Airport pavements: PCA methods, corps of Engineer's method, FAA method, Joints and reinforcement requirement

Highway pavement: IRC-58: 2015 method

### **MODULE 3: Construction of Pavement**

#### **Bituminous Road construction**

Asphalt Mix Production: Batch Plant, Drum Plant

Asphalt Mix Transportation and laydown, Asphalt Mix compaction, Quality Control of HMA

#### **Concrete Road Construction**

Preparation of base form work, placing of reinforcement and concrete, compaction, finishing, curing, joints, Quality Control

### **MODULE 4: Pavement Maintenance and Rehabilitation**

Flexible and rigid pavement Distresses-Identification, Causes and Treatments, Condition and Evaluation surveys, Present Serviceability Index, PCI curve, roughness measurement, IRI, structural strength, Benkelman beam deflections, design of overlays, routine maintenance, preventive maintenance and periodic maintenance, introduction to PMS

### **MODULE 5: Modern Pavement Technologies**

Self-Compacting Concrete roads, Cast in situ concrete block pavements, ICBP-Interlocking Concrete Paver block pavements (IRC-SP: 63), Stone Matrix Asphalt (SMA), Mastic Asphalt, Warm Mix Asphalt, Cold Mix Asphalt, Wet Mix Macadam

**Recycling of Asphalt Pavements:** Benefits, Pavement Selection Strategy, Cold Milling, HMA recycling, Hot in Place Recycling, Cold in Place recycling, Full depth reclamation

#### **Textbooks/ Reference Books:**

1. Pavement Analysis & Design: Yang H. Huang
2. Analysis of Pavement Structures: Animesh Das
3. Principles of Transportation Engineering: Partha Chakroborty & Animesh Das
4. Bituminous Road Construction in India: Prithvi Singh Kandhal

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE43	Bridge Engineering	3-0-0	3

### **MODULE 1: General Consideration of Bridges**

Introduction, historical review, Engineering and aesthetic requirements in bridge design, Introduction to bridge codes, economic evaluation of a bridge project, site investigation and planning, types of bridges, selection of suitable types of bridges.

### **MODULE 2: Bridge Hydrology**

Water way, Scour depth, factors affecting scour and its evaluation, afflux.

### **MODULE 3: Geotechnical Investigation for Bridges**

Bridge foundations - open, pile, well and caisson, piers, abutments and approach structures.

### **MODULE 4: Loading Standards**

Introduction to IS and IRC codes, highway bridge loading standards, Impact factor, Analysis of IRC loadings, Railway bridge loading standards.

### **MODULE 5: Design of Super-Structure**

Analysis and design of reinforced concrete slab bridge decks, box culverts, Tee beam and slab bridge deck, and balanced cantilever bridges.

### **MODULE 6: Bridge Bearings**

Types of bearings, design of different type of bearings

### **MODULE 7: Design of Sub-Structure**

Piers and abutments- types of piers, factors acting on piers, general features on abutments, stability analysis of abutments.

Bridge foundation- types of foundations, pile foundations, well foundations, caisson foundation.

### **Textbooks/ Reference Books:**

1. Essentials of Bridge Engineering- D.J. Victor, CBS PUBLISHERS AND DISTRIBUTORS PVT LTD
2. Design of bridges- N Krishna Raju, OXFORD & IBH PUBLISHING CO. PVT LTD
3. Principles and Practices of Bridge Engineering- S P Bindra, DHANPAT RAI PUBLICATIONS
4. Elements of Bridge Engineering- A K Pant

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818PE44	Water Power Engineering	3-0-0	3

### **MODULE 1: Introduction**

Water availability on earth, available water and technologically utilizable water, fields of water resources engineering, responsibilities of water resources engineers (estimation of water demands, estimation of water availability, identification of water user, investigation of water quality, investigation of geology, environmental & social acceptability, economic feasibility), planning of water resources projects, hydropower development and potential in India and North East, comparison between hydropower & thermal power.

### **MODULE 2: Reservoir**

Definition, purpose, types, physical characteristics of reservoir, zones of storage in a reservoir, storage capacity determination from the site, reservoir site selection, life storage capacity by mass curve method, reservoir sedimentation, trap efficiency, distribution of sediment in a reservoir, useful life of reservoir, reservoir operation, reservoir sedimentation control, reservoir yield, economic height of a dam, reservoir working table, reservoir operation rule curves, planning data requirement, environmental considerations in planning, project target reliability, compatibility of hydro-power water use.

### **MODULE 3: Types of Hydropower Plants**

High, medium and low head plants; runoff river plants, storage plants, diversion canal plants, pumped storage plants, tidal power plants; base load and peak load plants; concentrated fall and divided fall developments, components of hydropower schemes, general layout of hydropower plan with all its components, notable hydropower projects in North East, preparation of detailed project report.

### **MODULE 4: Estimation of Available Power**

Work, Energy and Power, Water energy, Flow and power duration curves, firm power, secondary power, dump power, load distribution –load factor, capacity factor and plant use factor. Power potential study: Nonsequential or flow-duration curve, Sequential stream flow routing (SSR) and Economic analysis.

### **MODULE 5: Dams**

General, Classification of dams, Selection of site and choice of dams, Gravity dam – forces acting, stability analysis, Embankment dam, Arch dam and Buttress dam.

### **MODULE 6: Water Conveyance**

Intakes – types, trash rack, control gates; canals, fore bay, tunnels, pipes.

**Penstock:** Design criteria, economic diameter, anchor blocks, water hammer analysis

**Surge Tanks:** Functions, types, design criteria.

**Turbines:** Types, functions, characteristics, working principles, Pelton wheel, Francis turbine, Kaplan turbine, Turbine characteristics – specific speed, characteristic curves, selection of type and numbers of turbines; scroll case, draft tubes, governing of turbines.

**Power House:** Components, general layout – surface and underground power houses.

## **MODULE 7: Introduction to System Analysis**

Definition of system, system modeling, broad system classification, system analysis, optimization model, types of optimization, basic elements of a model, application of optimization in water resources, simulation, types of simulation, necessity of simulation, advantages of simulation, limitations of simulation, components of a simulation model, difficulties in simulation, art of modeling (problem definition, model construction, model solution, model validity, implementation).

### **Textbooks/ Reference Books:**

1. Hydropower Structures – R.S. Varshney – N. C. Jain, Roorkee
2. Irrigation and Water Power Engineering – M. M. Das & M. D. Saikia – PHI Learning Pvt. Ltd., New Delhi.
3. Water Power Engineering – M. M. Dandekar & K. N. Sharma – Vikash Publishing House Pvt. Ltd., Noida, UP.
4. Irrigation Water Resources and Water Power Engineering – P. N. Modi – Standard Book House, Delhi – 110 006.
5. IS :11625-1986 – Criteria for Hydraulic Design of Penstocks.
6. IS :11639 (Part I)-1986 – Criteria for Structural Design of Penstocks (Surface Penstocks).
7. IS :11639 (Part II)-1995 – Criteria for Structural Design of Penstocks (Buried/Embedded Penstocks).
8. IS :11639 (Part III)-1996 – Criteria for Structural Design of Penstocks (Special Penstocks).
9. IS: 5330-1984 – Criteria for Design of Anchor Blocks for Penstocks with Expansion Joints.
10. VVK Rao (2006) Hydropower in The Northeast: Potential and Harnessing Analysis, Background Paper No.6.
11. Water Resources Engineering-by R.K. Linsley & J.B. Franzini, McGraw-Hill International Book Company
12. Irrigation and Water Resources Engineering –by G.L. Asawa, New Age International (P) Limited Publishers
13. Hydrology and Water Resources Engineering –by S.K. Garg, Khanna Publishers, Delhi
14. Irrigation and Water Resources Engineering –by B.C. Punmia, Pande & B.B. Lal, Standard Publishers Distributors, Delhi
15. River Behaviour Management and Training (Vol. I& II), Central Board of Irrigation and Power, 1994
16. Water Resources Systems Modelling Techniques and Analysis–by S. Vedula and P.P. Mujumdar, Tata McGraw-Hill Publishing Company Limited, New Delhi
17. Water Resources Systems Planning and Management An Introduction to Methods, Models and Applications- by Daniel P. Loucks and E.V. Beek, United Nations Educational Scientific and Cultural Organization
18. Water Resources Systems Planning and Analysis- by D.P. Loucks, J.R. Stedinger and D.A. Haith, Prentice Hall



Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818OE21	Disaster Risk Management	3-0-0	3

### MODULE 1: Introduction

Understanding Disaster Management (DM), Definition of Disaster, necessity of studying DM, Basic terms- Hazard, Vulnerability and Risk and understanding their inter-relationship, Types of vulnerability, Emergency & Disaster situation. Types of disaster – Causes and speed of onset.

### MODULE 2: Disaster Management Cycle

**Phase I: - Mitigation:** - Introduction- definition of components of DM cycle, Disaster Mitigation- structural, Nonstructural, Do's and Don'ts to avoid disaster Hazard identification & vulnerability analysis and various mitigation strategies. Role of Civil Engineers in mainstreaming DM to development projects.

**Phase II: - Preparedness:** Different measures- DRR, DM plan or Emergency Operation Plan (EOP) - Developing & writing the DM plan or EOP.

**Phase III & IV: - Response & Recovery:** Terminology, Aims of disaster response, Disaster Response Activities, Modern methods of disaster response. Disaster recovery- definition- The recovery plan.

### MODULE 3: Disaster Education and Public Awareness

Necessity & Stake holders roles and responsibilities-, Safety of Schools and Hospitals, work places and home.

### MODULE 4: Role of Technology in DM and Risk Management

Risk and Emergency management system - Application of GIS & Remote Sensing technology. Introduction to Incident Command System (ICD)

### MODULE 5: Introduction to Probable disasters in N.E. Region of India

- i. Earthquake disaster Causes, vulnerability, mitigation, preparedness
- ii. Flood disaster: Causes, vulnerability, mitigation, preparedness
- iii. Wind/Cyclone/Extreme-Weather/Landslide disaster: Causes, vulnerability, mitigation, preparedness

### Textbooks/ Reference Books:

1. Disaster Management Act 2005
2. Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012).
3. <https://ndma.gov.in/images/guidelines/national-dm-policy2009.pdf>
4. <https://ndma.gov.in/en/ndma-guidelines.html>
5. <https://ndma.gov.in/images/guidelines/earthquakes.pdf>
6. <https://ndma.gov.in/images/cbt/presentations/Mr.%20Sreedhar%2013.10.11.pdf>
7. <https://ndma.gov.in/en/disaster-management-cycle.html>
8. <https://ndma.gov.in/en/ongoing-programmes/school-safety-project.html>
9. <https://ncrmp.gov.in/>
10. <https://ndma.gov.in/images/cbt/booklets/Booklet1.pdf>
11. <https://ndma.gov.in/images/cbt/booklets/Booklet2.pdf>
12. <https://ndma.gov.in/images/cbt/booklets/Booklet3.pdf>
13. <https://ndma.gov.in/images/cbt/booklets/Booklet4.pdf>
14. <https://ndma.gov.in/images/cbt/booklets/Handbook.pdf>
15. Geneva: Sphere Project. <http://www.sphereproject.org/handbook/>
16. Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manil
17. <https://ndma.gov.in/en/media-public-awareness/media-kit.html>

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818OE22	Solid and Hazardous Waste Management	3-0-0	3

**Course Objective:** Students should be able-

- To provide comprehensive overview of solid, biomedical and hazardous waste management.
- To provide knowledge on solid waste management design aspects.
- To learn about the different methods of solid waste management.

**Course Outcome:** Upon successful completion of this course, students will be able to –

- Know solid waste remedial measures and their importance.
- Undertake projects related to solid waste management.

### MODULE 1: Solid Waste

Sources and engineering classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization.

### MODULE 2: Treatment Methods

Various methods of refuse processing, recovery, recycle and reuse, composting –aerobic and anaerobic, incineration, pyrolysis and energy recovery, Disposal methods –Impacts of open dumping, site selection, sanitary land filling –design criteria and design examples, leachate and gas collection systems, leachate treatment.

### MODULE 3: Biomedical Waste Management

Sources, treatment and disposal Hazardous Waste Management-Introduction, Sources, Classification, Physico-chemical, Chemical and Biological Treatment of hazardous waste, regulations.

Module IV Thermal treatment -Incineration and pyrolysis. Soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.

### Textbooks/ Reference Books:

1. Tchobanoglous G., Theissen H., and Eliassen R.(1991), “Solid Waste Engineering -Principles and Management Issues”,McGraw Hill, New York.
2. Pavoni J.L(1973)., “Handbook of Solid Waste Disposal”.’
3. Peavy, Rowe and Tchobanoglous (1985), “Environmental Engineering”, McGraw Hill Co. 4<sup>th</sup> Edition
4. Mantell C.L., (1975), “Solid Waste Management”, John Wiley.
5. CPHEEO, Manualon Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
6. WHO Manual on Solid Waste Management.
7. Vesiland A. (2002), “Solid Waste Engineering”, Thompson Books.
8. Hazardous waste (management and handling) rules, 20019. Biomedical (Handling and Management) Rules 2008

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818OE31	Finite Element Method	3-0-0	3

**MODULE 1:**

Introduction to Finite Element Analysis, Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis.

**MODULE 2:**

Finite Element Formulation Techniques, Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.

**MODULE 3:**

Introduction to Element Properties, Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional Numerical Integration: Two and Three Dimensional

**MODULE 4:**

Analysis of Frame Structures Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame.

**MODULE 5:**

FEM for Two and Three Dimensional Solids Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Non linearity and Static Condensation, Axisymmetric Element

**MODULE 6:**

FEM for Plates and Shells, Introduction to Plate Bending Problems

**MODULE 7:**

Introduction to Additional Applications of FEM, Finite Elements for Elastic Stability, Finite Elements in Civil Engineering, Dynamic Analysis.

**Textbooks/ Reference Books:**

1. S. Krishnamoorthy, Finite Element Analysis, Tata Mc Graw-Hill
2. P. N. Godbole , Introduction to Finite Element Methods, I K International Publishing House Pvt. Ltd
3. David V. Hutton, Fundamentals of Finite Element Analysis, Mc GrawHill
4. Maity, Computer Analysis of Framed Structures, I. K. International Pvt. Ltd. New Delhi
5. Erik G. Thompson, Introduction to the Finite Element Method: Theory, Programming and Applications, John Wiley
6. H. C. Martin and G. F. Carey, Introduction to Finite Element Analysis-Theory and Application, New York, McGraw-Hill
7. Irving H. Shames, CliveL. Dym, Energy and Finite Element Methods in Structural Mechanics; New Age International

8. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India, New Delhi, India
9. M. Mukhopadhyay, Matrix, Finite Element, Computer and Structural Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India
10. Zienkiewicz and Y. K. Cheung, The Finite Element Method in Structural and Soild Mechanics, Mc Graw Hill, London
11. Ceruzzi, A History of Modern Computing, The MIT Press, Cambridge, MA, 1998.
12. D. Cook, Concepts and Applications of Finite Element Analysis, Wiley
13. S. Rao, Finite Element Analysis, Elsevier Butterworth-Heinemann
14. W. Weaver Jr. and J. M. Gere, Matrix Analysis of Framed Structure, CBS Publishers

Course Code	Course Title	Hours per week L-T-P	Credit C
CE1818OE32	Remote Sensing and Geographical Information System	3-0-0	3

#### **MODULE 1: Introduction to Remote Sensing**

Principles, Electromagnetic Radiation, Laws of radiation, Interaction mechanisms, Ideal and practical remote sensing system, Atmospheric window, Spectral signature, Resolution

#### **MODULE 2: Platform and Sensors for Remote Sensing**

Terrestrial and Aerial platforms, satellites and orbits, space platforms – Landsat, spot. IRS. Characteristics of various sensor photo theodolite, aerial camera, MSS, RBV, TM, HRV and LISS system Radiometers.

#### **MODULE 3: Characteristics and use of various Data Product**

B& W, colored and Infrared photographs, B&W satellite imageries, F.C.C., high-density tapes, CCT, Image classification

#### **MODULE 4: Interpretation and analysis of R.S. Data**

Visual interpretation – interpretation element and key. Digital image processing – advantage over visual techniques. Components of image processing system

#### **MODULE 5: Application of Remote Sensing in Resource Management**

Fundamental analysis of Landforms, Geomorphology, Land use land cover, Application to highway planning and engineering.

#### **MODULE 6: Geographical Information System**

Basic concept, Principles, Data types, Analysis and decision making, components usefulness and application area.

#### **MODULE 7: Global Positioning System**

Working principles, Capabilities and uses

#### **Textbooks/ Reference Books:**

1. 'Remote Sensing and Image Interpretation', T.M. Lillesand and R.W. Kiefer, John Wiley & Sons, Singapore, 2002.
2. 'Introduction to Remote Sensing', J.B. Cambell, Taylor & Francis, UK, 2002.
3. 'Remote Sensing - Principles and Interpretation', F.F. Sabins Jr, W.H. Freeman & Co., New York, 1986.
4. Course material of 3<sup>rd</sup> Basic Course on RS & GIS, NESAC 2018
5. 'Remote Sensing - Models and Methods for Image Processing', R.A. Schowengerdt, Elsevier India Pvt. Ltd., New Delhi, 2006.
6. 'Remote Sensing and GIS', Basudeb Bhatta, Oxford University Press, New Delhi 02.
7. 'Introduction to Remote Sensing - Principles and Concepts' by Paul J Gibson, Routledge - Taylor & Francis, 2000.
8. 'Introduction to Remote Sensing - Digital Image Processing and Applications' by Paul J Gibson and Clare H Power, Routledge - Taylor & Francis, 2000.

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