

# Department of Civil Engineering

## Minor Programme in Civil Engineering

Minors are coherent sequences of courses taken in addition to the courses required for the Bachelor of Engineering students chosen from a considerable variety of complementary courses under the categories of technical and complementary studies.

Department of Civil Engineering, JUIT, Wagnaghat proudly offers minor in Civil Engineering for all concerned students. This minor program covers the most current theories and practices used in Civil Engineering. The program provides a valuable adjunct credential to engineering students pursuing their major degree in various fields. Engineering students from any branch may choose from a considerable variety of complementary courses under the categories of technical and complementary studies offered by Civil Engineering Department JUIT, Wagnaghat. This minor program is rigorous enough to serve as a introductory credential for students subsequently electing to pursue advanced studies in Civil Engineering.

### *Conditions for Award of Additional Certificate of Minor in Civil Engineering*

1. Earning of minimum credits, as required for award of Major degree.
2. Earns 20 credits in addition to the credits as specified for the programme in the minor area.
3. Additional 20 credits in a minor discipline could be earned through MOOCs also and may include supporting courses from allied discipline limited to a maximum of 6 credits.
4. Successfully completing the Industrial Internship within the minimum period of 4 years.
5. Completing all the requirements of a degree in the minimum period of years.

Following is the course curriculum outline for proposed Minor programme in Civil Engineering, from which **subjects worth 20 credits (15 from mandatory course, 5 from remaining courses) may be chosen by the student:**

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN							
COURSE CURRICULUM FOR MINOR PROGRAMME(160 +20 CREDITS)							
MINOR IN CIVIL ENGINEERING (Mandatory courses- 15 credits)							
S. No.	Semester	Name of the Subjects	Course Hours			Credits	Total Hours
			L	T	P		
1	3	Surveying	3	0	0	3	3
2	4	Mechanics of Solids	3	0	0	3	3
3	6	Geotechnical Engineering	3	0	0	3	3
4	7	Design of Concrete Structures	3	0	0	3	3
5	8	Fluid Mechanics	3	0	0	3	3

Can choose **remaining 5 credits** from any of the following courses

S. No.	Semester	Name of the Subjects	Course Hours			Credits	Total Hours
			L	T	P		
1	3	Surveying Lab	0	0	2	1	2
2	5	Construction Technology and Management	3	0	0	3	3
3	6	Geotechnical Engineering Lab	0	0	2	1	2
4	7	Concrete Technology Lab	0	0	2	1	2
5	7	Water Supply Engineering	3	0	0	3	3
6	8	Transportation Engineering	3	0	0	3	3
7	8	Fluid Mechanics Lab	0	0	2	1	2

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

# Proficiency Programme in Civil Engineering

Civil Engineering students can choose to either broaden their background or attain in-depth coverage of a particular subject by enrolling in a Proficiency Programme. Proficiency courses are coherent sequences of courses that may be taken in place of regular elective slots required for the B. Tech degree, in the chosen field of proficiency.

## *Conditions for award of additional certificate of proficiency in Civil Engineering*

1. Qualify for the award of B. Tech. degree in the minimum period.
2. Have passed in minimum of >50% of B. Tech elective subjects taken from Civil Engineering Department.
3. Grade Point Average in the elective subjects of (2) is >7.0.
4. Major project has been done in Civil Engineering Department with at least 'A' grade
5. CGPA for 195 credits (pre 2018 batch) /160 credits (post 2018 batch) of B. Tech. level is >6.5.

At present Department of Civil Engineering JUIT, Waknaghat offers following proficiency programmes:

1. Proficiency in Computer Aided Design
2. Proficiency in Building Design and Construction
3. Proficiency in Geotechniques
4. Proficiency in Water Management
5. Proficiency in Transportation Engineering
6. Proficiency in Construction Technology and Management

The Proficiency programme offered in aforementioned areas are designed primarily for students of Civil Engineering Department, JUIT to experience the engineering approach to the solution of design problems. Students pursuing any of the proficiency course will be better prepared for careers in Civil Engineering. These proficiency courses will provide students with a technical and competitive edge over most traditional civil engineering undergraduates in the civil engineering job marketplace. As per 160 credit course curricula, a student must opt minimum 4 courses from chosen field of proficiency in place of regular elective courses to get additional certificate of proficiency in chosen field.

Following are the course curriculum outline for proposed 6 proficiency courses:

### **1. Proficiency in Computer Aided Design:**

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN COMPUTER AIDED DESIGN						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	p		
1	Computer Applications in Environmental Engineering	1	0	4	3	5
2	Building Drawing	1	0	4	3	5
3	Simulations in Geotechnical Engineering	1	0	4	3	5
4	Computational models in Transportation Engineering	1	0	4	3	5
5	Construction Management Computations	1	0	4	3	5
6	Modelling, Simulation and Computer Applications	3	0	0	3	3

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

## 2. Proficiency in Building Design and Construction

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN BUILDING DESIGN AND CONSTRUCTION						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	P		
1	Advanced Reinforced Concrete Design	3	0	0	3	3
2	Building Drawing	1	0	4	3	5
3	Design of Prestressed Concrete Structures	3	0	0	3	3
4	Construction Safety and Health	3	0	0	3	3
5	Advanced Structural Analysis	3	0	0	3	3
6	Construction Technology and Management	3	0	0	3	3

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

## 3. Proficiency in Geotechniques:

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN GEOTECHNIQUES						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	P		
1	Geosynthetics	3	0	0	3	3
2	Geoenvironment	3	0	0	3	3
3	Underground Technology	3	0	0	3	3
4	Advanced Foundation Engineering	3	0	0	3	3
5	Simulations in Geotechnical Engineering	1	0	4	3	5
6	Ground Improvement Techniques	3	0	0	3	3

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

## 4. Proficiency in Water Management:

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN WATER MANAGEMENT						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	P		
1	Open Channel Flow and Hydraulic Machine	3	0	0	3	3
2	Dam and Reservoir Design	3	0	0	3	3
3	Hydropower Engineering	3	0	0	3	3
4	Process Design in Environment Engineering	3	0	0	3	3
5	Surface Water Quality Management	3	0	0	3	3
6	Industrial Wastewater Treatment	3	0	0	3	3

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

### 5. Proficiency in Transportation Engineering:

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN TRANSPORTATION ENGINEERING						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	P		
1	Pavement Analysis and Design	3	0	0	3	3
2	Highway Construction, Maintenance and Management	3	0	0	3	3
3	Transportation Engineering	3	0	0	3	3
4	Traffic Engineering	3	0	0	3	3
5	Advanced Highway Material and Construction	3	0	0	3	3
6	Computational models in Transportation Engineering	1	0	4	3	5

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

### 6. Proficiency in Construction Technology and Management:

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, SOLAN						
COURSE CURRICULUM FOR PROFICIENCY PROGRAMME (160 CREDITS)						
PROFICIENCY IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT						
S. No.	Name of the Subjects	Course Hours			Credits	Total Hours
		L	T	P		
1	Construction Technology and Management	3	0	0	3	3
2	Construction Management Computations	1	0	4	3	5
3	Construction Planning and Control	3	0	0	3	3
4	Construction Techniques	3	0	0	3	3
5	Construction Financial Management	3	0	0	3	3
6	Heavy/Civil Construction Equipment, Methods, and Management	3	0	0	3	3

\* Elective courses from MOOC or NPTEL may be chosen by student (maximum 6 credits) in case course content matches with subjects mentioned above.

## Advanced Reinforced Concrete Design

COURSE CODE: 18B1WCE831

COURSE CREDITS 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Design of concrete structures

### *Course Objectives:*

1. To understand the design concepts of various structural elements using working stress method and detailing of reinforcement
2. To understand the design of beam and slab using Yield line theory.
3. Underground and elevated liquid retaining structures. To study the design of material storage structures
4. To understand the design concept of cantilever and counterfort types of retaining walls

### **Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Analysis and design of beams and slabs by working stress method	Familiarity
CO-2	Yield line Theory of slabs and Methods of Analysis	Assessment
CO-3	Design of underground and elevated water tanks	Assessment
CO-4	Design cantilever and counterfort retaining walls	Assessment
CO-5	Analysis and design of Foundation	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Analysis and design of beams and slabs by working stress method:</b> Introduction to working stress method of design. Assumptions in the theory of simple bending, Concept of transformed or equivalent sections, Analysis of singly reinforced section and doubly reinforced sections.	8
2	<b>Yield line Theory of slabs and Methods of Analysis:</b> Introduction to yield line theory, Properties of yield lines, Methods of analysis, one-way slabs, two-way slabs, yield line analysis of slabs	10
3	<b>Design of underground and elevated water tanks:</b> 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.	12

<b>4</b>	<b>Design cantilever and counterfort retaining walls:</b> Principles of Cantilever and counterfort type retaining walls, Detailed design of cantilever type of retaining walls	<b>9</b>
<b>5</b>	<b>Analysis and design of Foundations:</b> Types of foundations and its needs. Analysis and design of an isolated footing	<b>3</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers, and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

**Suggested Reference Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers, and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/106104019/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/106104019/1>
  - ii. <https://nptel.ac.in/courses/106104019/4>
  - iii. <https://nptel.ac.in/courses/106104019/26>
  - iv. <https://nptel.ac.in/courses/106104019/2Ev>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

<b>Course Outcomes (Advanced Reinforced Concrete Design)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	<b>1.75</b>
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	<b>2</b>
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	<b>1.75</b>
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.08</b>
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	<b>1.75</b>
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	

## Building Drawing

COURSE CODE:18B17CE771

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 1-0-4

**Pre-requisite:** Individuals with knowledge of engineering drawing, understanding of architectural terminology and compatible with using windows operating system.

**Course Objectives:**

1. Learn the AutoCAD user interface.
2. Create sites, profiles, and cross-sections.
3. Use plan production tools to create plan and profile sheets.
4. Prepare detail drawings and Generate perspective view.
5. Creating a 3D building model with walls, curtain walls, windows, and doors
6. Adding floors, ceilings, and roofs to the building model.
7. Adding component features, such as furniture and equipment.
8. Setting up sheets for plotting with text, dimensions, details, tags, and schedules.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Create, edit, view, and analyze surfaces and sites, profiles, and cross-sections, Prepare detail drawings	Assessment
CO-2	Generate perspective view of simple building and use plan production tools to create plan and profile sheets.	Assessment
CO-3	Adding floors, ceilings, and roofs to the building model, component features, such as furniture and equipment.	Assessment
CO-4	Creating a 3D building model with walls, curtain walls, windows, and doors	Assessment

**Course Contents:**

Unit	Contents	Lectures
1	Product Overview, AutoCAD Civil 3D Workspaces, Start Tab, AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Toolspace	2
2	Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Breaklines and Boundaries, Surface Analysis Tools	2
3	Creating Alignment from Objects, Creating and Modifying Alignments, Labels and Tables, Create Profiles from Surface, Generate perspective view of simple building	2
4	Creating a Corridor, Creating Sections, Plan Production Tools, Prepare detail drawings for single and two storied residential building	2
5	Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools, Setting Up Levels and Grids	2

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6	Working with Doors and Windows, curtain walls, views, Adding Components, Modeling Floors, ceilings and roofs, Stairs, Railings, and Ramps	2
7	Creating Construction Documents, Adding Tags and Schedules and Creating Details in building	2
<b>Total lectures</b>		<b>14</b>

**List of Experiments:**

Sr. no.	Description	Hours
1	AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Toolspace, Draw symbols, conventions and Abbreviations	3
2	Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Breaklines and Boundaries	3
3	Surface Process, Breaklines and Boundaries	3
4	Generate perspective view of simple building	3
5	Plan Production Tools, Prepare detail drawings for single and two storied residential building	3
6	Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools	3
7	Doors and Windows, curtain walls	3
8	Floors, ceilings and roofs, Stairs, Railings, and Ramps	3
9	Adding Tags and Schedules and Creating Details in building	4
<b>Total</b>		<b>28</b>

**Suggested Textbook(s):**

- V. B. Sikka, “Civil engineering drawing”, Charotar Publication
- Gurcharan singh, Subash chander, “Civil engineering drawing”, published by Standard Publishers Distributors
- R. S. Malek G. S. Meo, “Civil engineering drawing”, Computech Publication Ltd New Asian

**Other useful resource(s):**

1. [nptel.ac.in/](http://nptel.ac.in/)
2. [www.Autodesk.com](http://www.Autodesk.com)
3. [www.drawingnow.com](http://www.drawingnow.com)
4. [www.learn-to-draw.com](http://www.learn-to-draw.com)

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**Evaluation Scheme:**

<b>1</b>	Mid Sem. Evaluation	20 Marks
<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO1	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.16</b>
CO2	3	2	3	3	3	2	2	2	3	2	2	3	<b>2.5</b>
CO3	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
CO4	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
<b>Average</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2.5</b>	<b>2</b>	<b>1.75</b>	<b>2.75</b>	

## Design of Prestressed Concrete Structures

COURSE CODE:18B1WCE735

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Mechanics of Solids and Design of Concrete Structures

### *Course Objectives:*

1. To impart knowledge on basic concepts about prestressing and how prestressed concrete is different from normal cement concrete.
2. To impart knowledge about Analysis of prestressed members for flexural. Different methods correlation
3. Losses in Prestress part I, Losses in Prestress part II and Losses in Prestress part III
4. To learn how to design prestressed concrete members.
5. Calculation of deflection and crack width.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing.	Familiarity
CO-2	Analysis of different types of Pre-stressed Concrete sections	Assessment
CO-3	Estimate losses of pre-stressing.	Assessment
CO-4	Design of pre-tensioned and post tensioned girders for flexure and shear	Assessment
CO-5	Design continuous pre-tensioned and post tensioned beams	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
<b>1</b>	<b>Introduction to Prestressed Concrete:</b> Basic concepts, Brief History and Development of building Materials. Types of Prestressing, different definitions, Advantages and Limitations, types of prestressing. Pre tensioning System and devices, stages, advantages and disadvantages, Devices manufacturing of railway sleepers. Post tensioning system and devices, stages, advantages and disadvantages, devices, Manufacturing of post tensioning bridge girders. Prestressing steel, forms, types of properties and codal provisions.	<b>8</b>

<b>2</b>	<b>Analysis of prestressed members for flexure:</b> Flexural strength – Simplified procedures as per codes. Analysis of member under axial load, at transfer, at service conditions, permissible stress, assumptions, variations of internal forces. Analysis of flexural members based of stress concept. Analysis of flexural members based of force concept. Analysis of flexural members based on load balancing concept. Numerical solving.	<b>10</b>
<b>3</b>	<b>Losses in prestress:</b> Losses in Prestress part I, why losses are to be considered, Elastic shortening. Losses in Prestress part II, Difference between losses in pre tensioning and post tensioning, friction loss, and anchorage slip. Losses in Prestress part III, Creep of concrete, steel relaxation, shrinkage of concrete, time dependent losses.	<b>6</b>
<b>4</b>	<b>Design of Prestressed Concrete members:</b> Design of sections for flexure part I, Design of sections for flexure part II and Design of sections for flexure part III.	<b>10</b>
<b>5</b>	<b>Calculation of deflection and crack width:</b> Calculation of deflection, total deflection, limits as per IS Code, span to depth ratio, Numerical solving. Calculation of crack width, Different methods, limits of crack widths.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

#### **Suggested Textbook(s):**

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi, 1998.
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co.Pvt. Ltd. 1997.
3. Rajagopalan, N, “Prestressed Concrete”, Alpha Science, 2002

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

1. S. Muthukrishnan, "Data streams: Algorithms and applications", Foundations and Trends in Theoretical Computer Science, Volume 1, issue 2,2005.
2. Bach, E., and J. Shallit. Algorithmic Number Theory. Vol. 1. Cambridge, MA: MIT Press, August 26, 1996. ISBN:9780262024051.

#### ***Other useful resource(s):***

1. Link to NPTEL course contents:<https://nptel.ac.in/courses/105106117/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/105106117/1>
  - ii. <https://nptel.ac.in/courses/105106117/2>
  - iii. <https://nptel.ac.in/courses/105106117/4>
  - iv. <https://nptel.ac.in/courses/105106117/6>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Design of Prestressed Concrete Structures)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.08
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	1.75
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	

## Construction Safety and Health

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Building material and Construction Technology.

### *Course Objectives:*

1. To understand the hazards and controls of various phases of construction.
2. To understand safety and health regulations as per BIS and consensus standards applicable to the construction industry.
3. To understand the requirements of safe workplaces, updates of regulations, techniques of planning for safety in the construction process.
4. To analyze the basic hazards related to construction activities.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Identify common hazards of construction	Familiarity
CO-2	Understand and interpret safety and health regulations (BIS) as they pertain to construction activities	Assessment
CO-3	Analyse and recommend appropriate control measures to eliminate or minimize hazards	Assessment
CO-4	Apply the knowledge for conducting hazard assessment and designing regulatory compliance pertaining to construction activity	Usage

### **Course Contents:**

Unit	Contents	Lectures
<b>1</b>	<b>Introduction to health, safety and Environment:</b> Need for Safety in Indian Construction Sites, Introduction to Industrial Safety, Introduction to Health Management, Introduction to Environment Management	<b>5</b>
<b>2</b>	<b>Enforcement of health and safety laws:</b> Introduction, Health and Safety Commission, IS Safety Codes, Powers of the Factory Inspectorate, Methods to Ensure Compliance, General Requirements & Legislation for Protective Clothing and Safety Equipment	<b>8</b>
<b>3</b>	<b>Hazards of construction and their prevention:</b> Physical Injury Hazards, Excavation, Scaffolding, Formwork, Structural Framework, Roof work, Cranes and Heavy Lifting, Tunnelling, Sewers and Confined Spaces, Demolition and Contaminated Sites, Work over Water, Health Hazards, Legislation, Chemical Hazards, Physical Hazards, Biological Hazards, Site Arrangements for Health, Safety and Welfare.	<b>15</b>

<b>4</b>	<b>Safety Policies:</b> Legislation, Health and Safety Policy Statements, Safety Organization, Safety Management Contracting, Subcontracting, Safety Groups and Group Safety Schemes	<b>8</b>
<b>5</b>	<b>Management systems for safe construction:</b> Pre-contract Activities, Survey and Investigation, Design and Specification, Design Aids for Safe Construction, Risk, Reliability, The Need for Information on Safety	<b>6</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Bhattacharjee, S.K. (2011) Safety Management in Construction, Khanna Publishers
2. Reese, C.D. & Eidson, J.V. (2006) Handbook of OSHA Construction Safety and Health, Taylor & Francis.
3. Holt, A.S.J. (2005) Principles of Construction Safety, Wiley-Blackwell Publishers
4. Few IS Codes & journal papers.

**Suggested Reference Book(s):**

1. Hinze, J.W. (1997) Construction Safety, Prentice Hall
2. MacCollum, D.V. (1995) Construction Safety Planning, John Wiley & Sons
3. Lingard, H. & Rowlinson, S. (2005) Occupational health and Safety in Construction Project Management, Spon Press.
4. MacCollum, D.V. (2007) Construction Safety Engineering Principles, McGraw Hill Publishers
5. Li, R.Y.M. & Poon, S.W. (2013) Construction Safety, Springer Publishers

**Other useful resource(s):**

1. <https://nptel.ac.in/courses/105/102/105102206/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Construction Safety and Health)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	3	2	2	2	3	2	1	1	<b>2.08</b>
CO-2	3	2	2	2	3	2	2	2	3	1	1	2	<b>2.08</b>
CO-3	3	2	3	2	3	3	2	3	3	1	2	1	<b>2.33</b>
CO-4	2	3	3	2	3	2	3	2	3	1	2	1	<b>2.25</b>
<b>Average</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>3</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>3</b>	<b>1.25</b>	<b>1.5</b>	<b>1.25</b>	

## Advanced Structural Analysis

COURSE CODE: 18B1WCE631

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Structure Analysis

### *Course Objectives:*

1. To impart the knowledge of matrix method to solve determinate and indeterminate structure.
2. To provide basic knowledge of moving loads and influence line.
3. To learn how different design software use matrix method.
4. To learn basics of finite element method.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will be able to solve basic determinate and indeterminate problems from matrix method by using hand calculation.	Assessment
CO-2	Student will be able to visualize the principle on which design software works	Assessment
CO-3	Student will be able to determine design loads for a given cross- section of structure.	Assessment
CO-4	Student will come to know why earlier methods used for solving indeterminate structure are discarded in this era.	Usage
CO-5	Student will learn basic concept on which Finite Element Method works.	Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Revision of basics of structure analysis	2
2	<b>Kani's Method:</b> Kani's method to analyze simple portal frames	5
3	<b>Flexibility Method:</b> Derivation of flexibility method, compatibility equation and its application on truss, beams and frames, Flexibility matrix Method	10
4	<b>Influence Line:</b> Influence line for indeterminate structures, Influence lines for Indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffening girders.	8
5	<b>Stiffness Method:</b> Degree of freedom, Derivation of Stiffness matrix, transformation matrix for 2d beam, truss and frame, matrix solution for beam, truss, and frame.	12
6	<b>Approximate Analysis of frames:</b> Approximate analysis of frames for vertical loads and horizontal loads on it.	5
<b>Total lectures</b>		<b>42</b>

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**Suggested Textbook(s):**

1. Devdas Menon: Advanced Structural Analysis, Narosa, 2009
2. Ashok Kumar Jain: Advanced Structural Analysis, 3rd Edition, Nem Chand & Bros, 2015

**Suggested Reference Book(s):**

1. Aslam Kassimali: Matrix Analysis of Structure, 2nd Edition, Cengage Learning, 2012.
2. C.K, Wang: Intermediate Structural Analysis, 7th Ed., Mc Graw Hill, 2008

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105106050/#>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Advanced Structural Analysis)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	3	3	1	2	2	1	3	3	1	1	2.0
CO-2	2	3	3	2	2	3	2	1	2	1	1	3	2.1
CO-3	3	2	2	2	1	3	1	1	2	2	2	3	2.0
CO-4	3	3	3	2	2	3	2	2	1	1	1	2	2.1
CO-5	3	3	3	2	0	2	1	1	2	1	2	3	1.9
<b>Average</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	<b>2.2</b>	<b>1.2</b>	<b>2.6</b>	<b>1.6</b>	<b>1.2</b>	<b>1.8</b>	<b>1.6</b>	<b>1.4</b>	<b>2.4</b>	

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## Construction Technology and Management

COURSE CODE:18B1WCE531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** Building Materials and Construction

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### *Course Objectives:*

1. To impart fundamental knowledge & skills in students by communicating the concept of construction technology management effectively.
2. To promote intellectual & social values in construction engineers
3. To engage students in research & innovation by providing sustainable solution to construction industry.
4. To develop human values & ethics in students & prepare them to be responsible citizens...

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the roles and responsibilities of a project manager, importance of contract document and tender for construction work.	Familiarity
CO-2	Prepare schedule of activities in a construction project finding critical path, cost controlling, resource allocation and updating of the network.	Assessment
CO-3	Identify the equipment used in construction.	Assessment
CO-4	Cost optimization of the construction equipment's, economic life, and replacement of the construction equipment's	Usage
CO-5	Understand safety practices in construction industry	Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Introduction to different types of contracts, owner – contractor relationship, the terms and conditions of a contract.	3
2	<b>PERT and CPM Analysis:</b> Relevance of construction schedules-Bar charts, the programme evaluation review technique method, calculations for critical path scheduling, activity float and schedules	8

<b>3</b>	<b>Construction Equipment's:</b> Introduction to various operations in construction, execution and management.	<b>3</b>
<b>4</b>	<b>Earth excavating, compacting, finishing and hauling machinery:</b> Standard and special construction equipments, heavy earthmoving equipments, shovels and cranes, crushing plant, batching plant, bitumen plant.	<b>6</b>
<b>5</b>	<b>Cost control:</b> Selection of construction equipment cost of owning and operating, capacity and utilization, breakdown analysis, economic life, replacement of equipment and sinking fund.	<b>6</b>
<b>6</b>	<b>Resource allocation and Updating:</b> Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numerical algorithms.	<b>10</b>
<b>7</b>	<b>Safety measures in construction design:</b> Form works, their design, fabrication and uses. Uses and design of scaffoldings. Steel constructions; fabrication and erection techniques	<b>6</b>
<b>Total lectures</b>		<b>42</b>

#### **Suggested Textbook(s):**

1. Punmia and Khandelwal K.K. - Project Planning and Control - Laxmi Publ. Delhi.
2. P. S. Gahlot and B.M. Dhir - Construction Planning and management- New Age international Publ. Delhi
3. Srinath, L.S. - PERT and CPM Principles and Applications -East West Press

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

1. Amit and B.L. Gupta – Construction Management and Machinery – Standard publishers Delhi.
2. Moder. J., C. Phillips and Davis - Project Management with CPM, PERT and Precedence Diagramming - Van Nostrand Reinhold Co.
3. Willis. E.M. - Scheduling Construction projects - John Wiley and Sons.

#### **Evaluation Scheme:**

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignments (10) - 10 Presentation(1) -10 Attendance/Quiz - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

<b>Course Outcomes (Construction Technology and Management)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	<b>2</b>
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	<b>2</b>
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	<b>1.75</b>
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.0</b>
CO-5	2	2	3	3	3	2	2	1	3	2	2	2	<b>2.25</b>
Average	<b>2</b>	<b>2.4</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>1.4</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.2</b>	<b>1.6</b>	<b>2</b>	

## Geosynthetics

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELETIVE

L-T-P: 3-0-0

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**Pre-requisite:** Soil Mechanics and Foundation Engineering

### *Course Objectives:*

1. To understand the concept of geosynthetics reinforcement in Geotechnical Engineering
2. Introduction to different types of geosynthetics
3. To evaluate the different properties of geosynthetics and its testing
4. To analyse the functions of geosynthetics and its suitability
5. To design different structures using geosynthetics according to various applications

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Identify the type of geosynthetics and their relevance in geotechnical field	Familiarity
CO-2	Understand the mechanism of formation of different geosynthetics	Assessment
CO-3	Analyse and compute different properties of geosynthetics	Assessment
CO-4	Apply the knowledge for designing the structures using Geosynthetic materials	Assessment

### **Course Contents:**

Unit	Contents	Lectures
<b>1</b>	<b>An Overview of Geosynthetic:</b> Geosynthetics in Geotechnical Engineering, Historical development, reinforced Earth mechanism, Types of geosynthetics: geotextiles, geogrids, geonet, geomembranes, geocomposites, Recent use in India	<b>6</b>
<b>2</b>	<b>Manufacturing of Geosynthetics:</b> Polymerization, Different type of geosynthetics based on manufacturing woven, monofilament, multifilament, slit filament, non-woven, Different bonding process: Mechanically bonded, Chemically bonded, Thermally bonded	<b>6</b>
<b>3</b>	Geosynthetics properties and testing: Physical Properties: Mass per unit area, Thickness, Specific gravity, Hydraulic properties: Apparent open size, Permittivity, Transmissivity, Mechanical Properties: Uniaxial Tensile Strength, Burst and Puncture Strength, Soil Geosynthetic friction tests, Durability: Abrasion resistance, Ultraviolet resistance	<b>10</b>
<b>4</b>	Geosynthetics functions: Reinforcement, Separation, Filtration, Drainage, Barrier Functions, Confinement	<b>10</b>

<b>5</b>	Geosynthetics Designing and Application: Use of geosynthetics in roads, use of reinforced soil in Retaining walls, Improvement of bearing capacity, Geosynthetics in environmental control and landfills, Ground Improvement by Geodrains, Use of Geosynthetics in lining of canals	<b>10</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

- 1) Designing with Geosynthetics by Robert M. Koerner, Prentice Hall, New Jersey, UAS, 1989
- 2) Engineering with Geosynthetics by G.VenkatappaRao and G.V.S SuryanarayanaRaju – Tata McGraw Hill, New Delhi, 1990

**Suggested Reference Book(s):**

- 1) Handbook on Geosynthetics and their applications, Sanjay Kumar Shukla, Thomas Telford, 2002 Web Resources
- 2) Construction and Geotechnical Methods in Foundation Engineering by Robert M. Koerner – McGraw Hill, New York, 1985
- 3) Fundamentals of Geosynthetic Engineering by Sanjay Kumar Shukla, Jian-Hua Yin, CRC Press

**Other useful resource(s):**

- <http://nptel.ac.in/courses/105106052> Geosynthetics and Reinforced Soil Structures (Video): (NPTEL Course)
- <http://nptel.ac.in/courses/105101143>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Geosynthetics)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	3	2	2	2	3	2	1	1	<b>2.08</b>
CO-2	3	2	2	2	3	2	2	2	3	1	1	2	<b>2.08</b>
CO-3	3	2	3	2	3	3	2	3	3	1	2	1	<b>2.33</b>
CO-4	2	3	3	2	3	2	3	2	3	1	2	1	<b>2.25</b>
<b>Average</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>3</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>3</b>	<b>1.25</b>	<b>1.5</b>	<b>1.25</b>	

## Geoenviorment

COURSE CODE:  
COURSE CREDITS: 3  
CORE/ELECTIVE: ELECTIVE  
L-T-P: 3-0-0

**Pre-requisite:** Geotechnical Engineering and Environmental Engineering

### *Course Objectives:*

1. To impart the knowledge of fundamentals of Geoenvironmental engineering.
2. To develops the understanding of multiphase behaviour of soil and soil-water contaminant interaction studies.
3. To understand and design waste containment systems such as vertical barriers and MSW landfill.
4. To understand contaminant site remediation and advance characterization techniques.

### *Course Outcomes:*

S. No.	Course Outcomes	Level of Attainment
CO1	Understand the sources, types of ground contamination and inter- relate the concepts of geotechnical engineering and environmental engineering in process of contamination.	Assessment
CO2	Relate and comprehend the role of soil – water interaction with concepts from soil physics and chemistry.	Assessment
CO3	Solve problems related to contaminant transport through saturated and unsaturated soil using governing equations.	Assessment
CO4	Design vertical barriers, liner systems and application of different grouting methods	Usage
CO5	Design landfill system along with leachate collection system, gas generation estimation, gas collection and monitoring system, final cover and its stability.	Usage

### **COURSE CONTENT:**

S No.	Content	Lectures
1.	<b>Fundamentals of Geoenvironmental Engineering:</b> Scope of geoenvironmental engineering - multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process – sources and type of ground contamination – impact of ground contamination on geoenvironment - case histories on geoenvironmental problems	5
2.	<b>Soil-Water-Contaminant Interaction:</b> Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles. Concepts of unsaturated soil – importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants	14

3.	<b>Waste Containment System:</b> Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment – different role of soil in waste. containment – vertical barriers, different types of grouting methods, different components of landfill such as liner system, leachate collection system, gas emission rate and gas collection system, cover system and its stability issues – property evaluation for checking soil suitability for waste containment – design of waste containment facilities.	<b>18</b>
4.	<b>Contaminant Site Remediation:</b> Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation	<b>3</b>
5.	<b>Advanced Soil Characterization:</b> Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling	<b>2</b>
TOTAL LECTURES		<b>42</b>

#### **Suggested Textbook(s):**

1. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
2. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.

#### **Reference book:**

1. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Sarsby R., "Environmental Geotechnics" Thomas Telford Ltd., London, 2000.
3. Yong, R. N., " Geoenvironmental Engineering, Contaminated Soils, pollutant Fate and Mitigation" CRC press, New York, 2001

#### **Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Environmental Geotechnics)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	2	2	2	2	3	x	x	1	1	1	3	2
CO-2	3	3	2	2	2	3	x	x	2	1	1	3	2.2
CO-3	3	3	3	2	2	2	x	x	2	2	1	3	2.3
CO-4	3	3	3	3	3	2	x	x	2	2	3	3	2.7
CO-5	3	3	3	3	3	2	x	x	2	2	3	3	2.7
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>3</b>	

## Underground Technology

COURSE CODE:18B1WCE638  
COURSE CREDITS: 3  
CORE/ELECTIVE: ELECTIVE  
L-T-P: 3-0-0

**Pre-requisite:** Geotechnical Engineering and Foundation Engineering

### *Course Objectives:*

1. To impart the knowledge of recognizing the diversity and complexity of underground excavations and associated works such as foundation construction.
2. To provide guidance for support selection of underground openings which is dependent upon the ground conditions, excavation size and shape and excavation method employed.
3. To inculcate the understanding of ground improvement and develop knowledge of different ground improvement techniques.
4. To understand, analyze and design flexible retaining structures.
5. To provide knowledge of tunneling and various aspects of tunnel engineering.

### *Course Outcomes:*

S. No.	Course Outcomes	Level of Attainment
CO-1	Determine the conditions and structures required for underground structure.	Familiarity
CO-2	Stabilize excavation for underground construction using sheet piles, anchored bulkheads, management of ground water conditions and apply dewatering methods.	Assessment
CO-3	Design and understand the construction methodology of deep foundation, analyze side - support systems for underground excavations.	Assessment
CO-4	Solve problems related to required ground conditions, side – support system, lining and design tunnels with its various components.	Usage
CO-5	Understand the construction methodologies for side - support system required for underground excavation, coffer dams, caissons, wells, basement and tunnel construction.	Usage

### **Course Contents:**

Unit	Contents	Lectures Required
1	<b>Introduction:</b> Introduction to various underground structures, Underground construction methodology & equipment.	5
2	<b>Underground construction:</b> Excavations, soil support methods, diaphragm walls, reinforced earth.	5
3	<b>Ground Water management:</b> Management of groundwater, dewatering methods Cofferdams, Caisson & wells.	6
4	<b>Permanent Support and Temporary Support system:</b> Methods of Basement construction, bracing system.	8

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5	<b>Ground Improvement:</b> Grouting, In – situ Densification: Preloading, Compaction Grouting, Dynamic Compaction, Blast densification, Vibro–Compaction and Vibro–Replacement, Vibro – flotation Compaction piles, Reinforcement of embankments and foundations.	6
6	<b>Tunnels:</b> Introduction, Tunnel stabilization and lining, Cut and Cover Tunnels, Bored Tunnels, Immersed Tube Tunnels, Water Conveyance Tunnels, Micro-tunnels.	6
7	<b>Underground Conduits:</b> Ditch Conduits, Positive Projecting Conduits, Negative Projecting Conduits, Imperfect Ditch Conduits, Tunnelled Conduits.	6
<b>Total lectures</b>		<b>4</b> <b>2</b>

**Suggested Textbook(s):**

1. Geotechnical Engineering by Gulati and Dutta (TMH)
2. Tunnel Engineering Handbook edited by Bickel, Kuesel and King

**Suggested Reference Book(s):**

1. Foundation Engineering Handbook, edited by Winterkorn & Fang.
2. Construction technology by Roy Chudley & Roger Green
3. Advance Construction Technology by Roy Chudley & Roger Green
4. Railway Bridges and Tunnels by Vazirani and Chandola

**Other useful resource(s):**

1. Link to NPTEL course content: <https://nptel.ac.in/courses/105103093/24>
2. Links related to topics of course:
  - <https://nptel.ac.in/courses/105108069/5>
  - <https://freevideolectures.com/course/3269/advanced-foundation-engineering/25>
  - <https://nptel.ac.in/courses/105106055/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Underground Technology)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	2	3	3	1	2	2	0	3	3	1	1	<b>2.0</b>
CO-2	2	3	3	2	2	3	2	1	2	1	1	3	<b>2.1</b>
CO-3	3	2	2	2	1	3	1	1	2	2	2	3	<b>2.0</b>
CO-4	3	3	3	2	2	3	2	2	1	1	1	2	<b>2.1</b>
CO-5	3	3	3	2	0	2	1	1	2	1	2	3	<b>1.9</b>
CO-6	2	2	2	2	1	3	3	0	3	2	2	3	<b>2.1</b>
<b>Average</b>	<b>2.67</b>	<b>2.5</b>	<b>2.67</b>	<b>2.17</b>	<b>1.17</b>	<b>2.67</b>	<b>1.83</b>	<b>0.83</b>	<b>2.17</b>	<b>1.67</b>	<b>1.5</b>	<b>2.5</b>	

## Advanced Foundation Engineering

COURSE CODE:18B1WCE733

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Foundation Engineering

### *Course Objectives:*

1. To impart the knowledge of foundation design involving advance analysis and design techniques.
2. This course serves as an addition to the foundation engineering concepts, taking it beyond the traditional foundation design into machine and reinforced earth concept.
3. To impart understanding of the mechanics between the soil and foundation system.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Ability to learn the basic requirements of consultancy like preliminary survey, report writing and how the site for the construction is investigated, the testing techniques before the design and the equipment required for the sampling and testing.	Familiarity and Usage
CO-2	Acquisition of complete knowledge of various foundation design procedures, elastic analysis of foundations and the application of types of foundations.	Usage
CO-3	Development of a thorough understanding of deep foundations which will involve the design and analysis of laterally loaded piles and well foundations.	Usage
CO-4	Understanding of foundation design in expansive soils and stabilization of the slopes and cuts using materials like geotextiles, geogrids and geonet.	Usage
CO-5	Ability to design and analyze the foundation system for a machine and to apply the dynamics for analysis of motion of machine foundations.	Assessment and Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Revision of foundation engineering, introduction to soil exploration, interpretation of soil exploration data.	3
2	<b>Mat Foundations:</b> Bearing Capacity of mat foundations, Mat Settlement, Design of rigid and flexible mats.	5
3	<b>Pile Foundations:</b> Design of piles and pile groups, Design of pile caps, laterally loaded piles, Settlement of pile and pile groups, sheet piles	8

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4	<b>Well and Caisson Foundation:</b> Bearing capacity, Settlement, Lateral Stability analysis.	4
5	<b>Foundations on Expansive Soils:</b> Introduction to expansive soils, swell measurement, foundation consideration, construction on expansive soils.	5
6	<b>Reinforced Earth and Flexible earth retaining systems:</b> Design Principals, Methods of constructions and applications, Design of substructure for retaining walls and dams, Design of sheet piles, anchored bulkheads.	6
7	<b>Machine Foundations:</b> Soil dynamics, Analysis of machine foundation, dynamic soil constants and their determination, Indian standards on design and construction of foundation for reciprocating and impact type of machines.	6
8	<b>Soil-structure interaction:</b> Idealized soil, foundation and interface behavior, Elastic models of soil behavior; Beams and plates on elastic foundation.	5
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. V.N.S. Murthy: Advanced Foundation Engineering, CBS Publishers and Distributors, 2010
2. Braja M. Das: Principles of Foundation Engineering, PWS Publishing Company, 2017
3. Joseph Bowles: Foundation Analysis and Design, McGraw Hill Book Company, 2017

**Suggested Reference Book(s):**

1. Literature on Advanced foundations Bureau of Indian Standard codes on foundations.

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

<b>Course Outcomes (Advanced Foundation Engineering)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	3	3	3	2	1	3	2	3	2	1	2	<b>2.36</b>
CO-2	3	3	1	2	3	2	2	3	3	2	2	2	<b>2.33</b>
CO-3	3	1	2	3	3	2	3	3	2	2	1	2	<b>2.25</b>
CO-4	3	2	2	3	3	2	1	2	3	3	2	2	<b>2.33</b>
CO-5	3	3	3	1	3	1	2	2	3	2	3	2	<b>2.33</b>
<b>Average</b>	<b>3</b>	<b>2.4</b>	<b>2.2</b>	<b>2.4</b>	<b>2.8</b>	<b>1.6</b>	<b>2.2</b>	<b>2.4</b>	<b>2.8</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	

## Simulations in Geotechnical Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 1-0-4

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**Pre-requisite:** Geotechnical Engineering and Software lab in Civil engineering

### *Course Objectives:*

1. To introduce constitutive soil models
2. To learn finite element analysis in geotechnical engineering application using PLAXIS 2D.
3. To learn finite element analysis in geotechnical engineering application using GEO 5.
4. To learn finite element analysis in geotechnical engineering application using ABAQUS.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO1	Students will be familiar with different soil models used in constitutive modelling	Assessment
CO2	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures using Plaxis.	Usage
CO3	Students will be able to evaluate strength reduction method, calculation of deformation, elemental forces, stress contours using Plaxis.	Usage
CO3	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures.	Usage
CO4	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures using ABAQUS.	Usage

### **LIST OF EXPERIMENTS AND LECTURES:**

S. No	Description	Hours (P+L)
1	Introduction of different constitutive soil models in Plaxis	2+1
2	FEM Analysis through modeling of shallow foundations in PLAXIS	2+1
3	Axisymmetric FEM Analysis through modeling of pile foundation using PLAXIS	2+1
4	Slope stability analysis using Strength reduction method (SRM) in PLAXIS	4+2
5	Determination of deformation and element forces through modeling of nail or geosynthetics reinforced embankment or cut in PLAXIS	4+2
6	Analysis of retaining wall.	2+1
7	Analysis of anchored structure through modelling	2+1
8	Slope stability analysis	2+1

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9	Axisymmetric modelling of deep foundation in layered soils using ABAQUS	4+2
10	Slope stability analysis for calculation of factor of safety using ABAQUS	2+1
11	Study of embankment deformation under static load using ABAQUS	2+1
<b>Total Labs</b>		<b>28+14</b>

#### Suggested Textbook(s):

1. Plaxis Introductory: Student Pack and Tutorial Manual 2010 CRC Press, Inc. Boca Raton, FL, USA ©2011 ISBN:9076016100 9789076016108
2. Engineering Manual (Part 1) Geotechnical Software suite Geo 5
3. Engineering Manual ABAQUS examples problem guide Simulia™, Dassault Systèmes®

#### Suggested/Resources:

1. Applied Soil Mechanics with ABAQUS Applications 1st Edition by Sam Helwan
2. Applications of Computational Mechanics in Geotechnical Engineering by Luís Ribeiro e Sousa, M.M. Fernandes, Euripedes Vargas Jr., Robero Azevedo Publisher: Taylor & Francis, Year: 2007 ISBN: 041543789X, 9780415437899
3. Geotechnical Modelling by David Muir Wood (1st Edition) Publisher CRC Press ISBN 9780419237303 - CAT# RU29142

#### Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
Total		100 marks

#### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Simulations in Geotechnical Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO1	3	2	3	2	1	2	2	1	3	3	1	3	2.17
CO2	3	2	3	3	3	2	x	x	3	2	x	3	2.67
CO3	2	2	2	2	1	2	3	2	2	2	2	3	2.08
CO4	2	2	3	2	1	2	2	1	2	1	2	2	1.83
CO5	2	1	2	2	3	2	2	1	3	2	3	2	2.08
<b>Average</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	<b>2.25</b>	<b>1.25</b>	<b>2.6</b>	<b>2</b>	<b>2</b>	<b>2.6</b>	

## Ground Improvement Techniques

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Geotechnical Engineering

### *Course Objectives:*

1. Analyze the expansive soil properties and apply the same for the design of structures on expansive soils.
2. Apply mechanical modification, using deep compaction Techniques, Blasting, Vibro compaction, Dynamic and Compaction Piles.
3. Design dewatering system and using dewatering methods for ground improvement.
4. Adapt physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology.
5. Analyze the Stability analysis and Design of Reinforced earth retaining wall.

### *Course Outcomes:*

S. No.	Course Outcomes	Level of Attainment
CO1	Analyze the field problems related to problematic soils and solve the problems using the ground Improvement techniques	Assessment
CO2	Summarize and practice ground improvement using Mechanical modification techniques	Assessment
CO3	Design drainage for seepage control, Assess dewatering field problems.	Usage
CO4	Application of physical and chemical ground improvement techniques using thermal modification, like grouting, shotcreting and guniting technology	Usage
CO5	Demonstrate the ground improvement techniques such as ground anchors, rock bolting and soil nailing, Design of reinforced earth retaining structures.	Usage

### **COURSE CONTENT:**

S No.	Content	Lectures
1.	<b>Introduction:</b> Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement.	4
2.	<b>Mechanical stabilization:</b> Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods Dynamic compaction, Vibrofloatation	12
3.	<b>Hydraulic modification :</b> Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, vacuum consolidation, Electro-kinetic dewatering, design and construction methods.	12

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4.	<b>Modification by admixtures and Grouting:</b> Cement stabilization and cement columns, Lime stabilization and lime columns, Stabilization using bitumen and emulsions, Stabilization using industrial wastes Construction techniques and applications, Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.	<b>8</b>
5.	<b>In situ soil treatment methods :</b> Soil nailing, rock anchoring, micro-piles, design methods, construction techniques, Case studies of ground improvement projects	<b>6</b>
<b>TOTAL LECTURES</b>		<b>42</b>

**Suggested Textbook(s):**

1. Nicholson, P.G. (2015). Soil Improvement and Ground Modification methods, Elsevier Publishers.
2. Hausmann, M. R. (1990) – Engineering Principles of Ground Modifications, McGraw Hill publications
3. Purushothama Raj (1995) – Ground Improvement Techniques, Laxmi Publications, India

**Reference book:**

1. M. P. Moseley and K. Krisch (2006) – Ground Improvement, 2nd Edition, Taylor and Francis.
2. Manfred R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co., 1990.
3. M C. R. Davies, F.Schlusser Ground improvement geosystems

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105/108/105108075/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Ground Improvement Techniques)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	3	x	x	1	1	1	3	2
CO-2	3	3	2	2	2	3	x	x	2	1	1	3	2.2
CO-3	3	3	3	2	2	2	x	x	2	2	1	3	2.3
CO-4	3	3	3	3	3	2	x	x	2	2	3	3	2.7
CO-5	3	3	3	3	3	2	x	x	2	2	3	3	2.7
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>3</b>	

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## Open Channel Flow and Hydraulic Machine

COURSE CODE:18B1WCE639

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:**Fluid mechanics

### *Course Objectives:*

The civil engineers design various hydraulic Structures such as Dams, canals, weirs, transitions etc. to control water and further utilize it for mankind. So, knowledge of flow characteristics of water moving on the surface of earth through natural and artificial water channels are essential. The main objective of this course is to familiarize students with the knowledge of open channel and their behaviors, the causes and principles of such behaviors, and applications open channels, applications and principles of turbines using the principles of science, mathematics and engineering.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of flow characteristics of open channel flow.	Assessment
CO-2	Learn the different flow regimes in open channels and their characteristics Predict if hydraulic jumps are to occur during flow, and calculate the fraction of energy dissipated during hydraulic jumps	Assessment
CO-3	Methods of discharge measurement, various phenomenon of flow in open channel	Assessment
CO-4	Different types of turbines, and its applications, working principles, efficiencies and problems associated with turbines	Assessment
CO-5	Knowledge of pumps, its applications, working principles, efficiencies and problems associated with pumps	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction to Open Channel Flow:</b> Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.	4
2	<b>Uniform Flow:</b> Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel. Computation of Uniform flow, Normal depth	7

3	<b>Non-Uniform Flow:</b> Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions, Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer	9
4	<b>Hydraulic Jump:</b> Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.	5
5	<b>Hydraulic Turbines:</b> Efficiencies & Classification, Pelton wheel turbine: Design, Velocity triangle, Radial flow Reaction turbines: working principles and Design of, Francis and Kaplan Turbine, Velocity Triangles, Draft tube: Types and theory, specific speed, Operating characteristics. Turbines, Selection of Turbines.	9
6	<b>Pumps:</b> Classification, Centrifugal pump Components and working, Velocity triangles, Head Losses and Efficiencies, Minimum starting speed, priming of centrifugal pump, specific speed, Cavitation, selection of pumps, Reciprocating pump, types, Components and working, slip, Indicator diagram, Air vessel.	8
<b>Total lectures</b>		<b>42</b>

#### Suggested Textbook(s):

1. Modi, P.N. and Seth, S.M., Hydraulic and Fluid Machines, Standard book house New Delhi, 1995.
2. K. Subramanya, Flow in Open Channels, Tata Mc. Graw Hill, 2009
3. K.G. Rangaraju, Flow through Open Channels, Tata Mc. Graw Hill, 2013

#### Suggested Reference Book(s):

1. M.H Chaudhury: Open Channel Flow, Prentice Hall of India, 2008
2. V.T Chow: Open Channel Hydraulics, Mc Graw Hill, 2009.
3. Terry W. Sturm, Open Channel Hydraulics, Tata Mc. Graw Hill, 2009.
4. Richard H. French, Open Channel Hydraulics, Mc Graw Hill, 1985

#### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105103096/>  
<https://nptel.ac.in/courses/112104117/33>  
<https://nptel.ac.in/courses/105103021/1>
2. Link to topics related to course:  
<https://nptel.ac.in/courses/105103096/1-24>  
<https://nptel.ac.in/courses/105103021/40-43>

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (5) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Open Channel Flow and Hydraulic Machine)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	3	x	x	1	1	1	3	2
CO-2	3	3	2	2	2	3	x	x	2	1	1	3	2.2
CO-3	3	3	3	2	2	2	x	x	2	2	1	3	2.3
CO-4	3	3	3	3	3	2	x	x	2	2	3	3	2.7
CO-5	3	3	3	3	3	2	x	x	2	2	3	3	2.7
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>3</b>	

## Dams and Reservoir Design

COURSE CODE: 18B1WCE736

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Water Resource Engineering, Geotechnical Engineering

### *Course Objectives:*

1. To introduce the students to the basic knowledge of dams and their appurtenances.
2. To develop an understanding regarding selection of a suitable dam for a particular site.
3. Impart knowledge about the construction, design and maintenance of various dams.
4. Train the students to analyze various dams to check their stability and safety.
5. To apply the principles of water resource and irrigation engineering and excel the students in the computation of the reservoir capacity which is indispensable for deciding the inundation area and demand pattern for any dam.
6. To enable the students to apply their knowledge of mechanics to calculate the critical stresses and various forces (static and dynamic) to ensure the proper design and stability of the dam.
7. To introduce the students to the various modern techniques and various challenges of dam construction by exposing them to real field conditions incorporating modern pedagogical methods of learning.
8. To train the students to use software tools for the modeling and analysis of various dams.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Select the suitable site for construction of different dams and suggest the type of dam required as per the topographical, functional, economical and ecological considerations.	Familiarity
CO-2	Know about the various components of a dam, their functions and types.	Familiarity
CO-3	Calculate the reservoir capacity based on demand (outflow) and supply (inflow) patterns.	Assessment / Usage
CO-4	Calculate the forces and stresses coming on gravity and earthen dams due to static and dynamic forces prevalent in nature	Assessment
CO-5	Analyze the dam for its safety against various forms of failure and suggest the preventive measures.	Assessment/ Usage

### **Course Contents:**

Unit	Contents	Lectures required
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<b>1</b>	<b>Introduction and project planning:</b> Dams and their historical emergence, requirement and types of dams, dam appurtenances. Planning of project, Purpose of development, Project study, Ecological and environmental considerations, Flood studies, Economic consideration, Physical factor governing selection of type, legal, economic, aesthetic considerations, and foundation and construction materials. Investigation, Source of information, Surface exploration, sampling, Field and laboratory tests.	<b>12</b>
<b>2</b>	<b>Reservoir studies:</b> Types of reservoir, inflow and outflow study into the reservoir, capacity determination by various techniques	<b>6</b>
<b>3</b>	<b>Concrete gravity dam:</b> Introduction, Origin and development, Forces acting on dam, Requirements for stability, Dams on pervious foundations	<b>9</b>
<b>4</b>	<b>Earth-fill dams:</b> Origin, Selection of type, Design principles, Foundation design, Embankments, Embankment details.	<b>9</b>
<b>5</b>	<b>Rockfill dams:</b> Origin and usage, Definition and types, Foundation design, Embankment design, Membrane design.	<b>6</b>
<b>Total lectures</b>		<b>42</b>

#### **Suggested Textbook(s):**

1. S.K. Garg: Irrigation Engineering and Hydraulic Structures, 19th Edition, Khanna Publishers, 2005.
2. W.P.Creager, J.D.Justin and J.Hinds: Engineering for dams, Wiley, 2007.

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

1. Trevor Turpin: Dams, First edition, Reaktion Books Publication, 2008.
2. S.K. Ukarande: Irrigation and Hydraulic structures, Third Edition, Ane Books Pvt. Limited, 2017.
3. I.H. Siddhiqui: Dams and Reservoirs: Planning and Engineering, First Edition, OUP Pakistan, 2008

#### **Evaluation Scheme:**

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Dams and Reservoir Design)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>	
CO-1	3	2	3	1	3	1	2	2	2	2	2	2	<b>2.09</b>	
CO-2	3	1	3	2	2	3	2	3	2	2	2	1	2	<b>2.17</b>
CO-3	3	2	3	2	3	2	1	3	1	2	2	1	2	<b>2.08</b>
CO-4	3	3	3	2	3	3	2	3	3	3	3	2	2	<b>2.67</b>
CO-5	3	2	2	3	3	3	2	2	3	3	3	2	2	<b>2.50</b>
<b>Average</b>	<b>3</b>	<b>2</b>	<b>2.8</b>	<b>2</b>	<b>2.8</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>2.4</b>	<b>1.6</b>	<b>2</b>		

## Hydropower Engineering

COURSE CODE:18B1WCE833

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Fluid Mechanics

### *Course Objectives:*

Power is required for the overall growth of a nation. The hydro power generation is one of the most important sources of electrical energy. This course is planned for the students interested in the waterpower engineering. In this course the students will get learn about the various components of hydro power plants various energy sources, working of different types of turbines and pumps. Learn asymptotic notations for performance analysis of algorithms.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of Various types of HP plants, turbines and its selection criteria.	Assessment
CO-2	Principles and design of various types of hydraulic structures required in HP Scheme.	Assessment
CO-3	Understanding of Economics of Power Generation.	Assessment
CO-4	They will develop Understanding of special features of mini, micro hydel plants.	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> purpose served by HP projects, Functional requirements in multiple purpose projects, compatibility, steps involved in planning of water resource project, financial analysis of a project, site investigations, Hydrological investigations, assessment of Hydropower potential, water availability, installed capacity determination.	8
2	<b>Principles of hydropower development:</b> Application, advantage and disadvantages of schemes, classification of hydropower schemes and their layouts, Principal components of Hydro-electric scheme	8
3	<b>Hydraulic turbines:</b> Classification and selection of turbines, governing of turbines	7
4	<b>Design of civil works:</b> Diversion structures, water conductor systems, desilting tanks, cross drainage structures, forebay, Surge tanks and hydraulic transients, Penstocks and pressure shafts, Intakes, penstock, powerhouse, and tailrace.	5

5	<b>Economics of Power Generation:</b> Terms and definitions, cost analysis, combined operation of different power plants, Operation of power plants for peaking and base load, principles of power plant design, location of power plant, economics in plant selection, factor affecting economics of generation and distribution of power Tariff for electrical energy.	8
6	Mini, micro, hydel plants: Special features of mini, micro hydel plants, civil works of medium and high for mini, micro, hydel plants, different types of turbines	7
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Rajput RK Textbook of Power Plant Engineering, Laxmi Publications Pvt. Ltd., 2007.
2. Modi, P.N. and Seth, S.M., Hydraulic and Fluid Machines, Standard book house New Delhi, 1995.
3. Dandekar, M. M. and Sharma, K. N.: waterpower Engineering, Vikas Publishing House, 2005.

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105105110/35-37>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Hydropower Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	3	3	3	1	1	2	3	2.25
CO-2	3	3	3	3	2	3	3	3	2	1	3	3	2.67
CO-3	3	3	3	3	2	2	2	2	2	2	3	3	2.5
CO-4	3	3	3	3	3	2	2	2	2	3	2	3	2.58
<b>Average</b>	<b>3</b>	<b>2.75</b>	<b>2.75</b>	<b>2.75</b>	<b>2.25</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>1.75</b>	<b>1.75</b>	<b>2.5</b>	<b>3</b>	

Approved in Academic Council held on 28 July 2021

## Process Design in Environmental Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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*Pre-requisite: No*

### Course Objectives:

1. To familiarize the students with the chemical and biological kinetics as applied to Environmental Engineering.
2. To understand the process analysis and selection, reactor modelling and operations as applied to water and wastewater systems.
3. To learn the principles of membrane processes for water purification, desalination and wastewater treatment including general and specific membrane problems such as fouling, scaling and cleaning, pre-treatment options, membrane elements and systems.
4. To understand the various advanced wastewater treatment processes.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	To familiarize the students with the alternatives of conventional treatment systems i.e., low-cost treatment systems including their detailed design and practical applications.	Assessment
CO2	To familiarize the students with the application of chemical and biological kinetics to conventional treatment systems.	Assessment
CO3	To understand the process analysis and selection of suitable reactors, reactor modelling and their applications for water and wastewater systems	Assessment
CO4	Describe principles of membrane processes for water purification, desalination and wastewater treatment including general and specific membrane problems such as fouling, scaling and cleaning, pre-treatment options, membrane elements and systems.	Assessment
CO5	To understand other various advanced wastewater treatment processes like Electro coagulation, UV Filtration etc.	Usage

### Course Contents:

S No.	Description	Lectures
1	Introduction to Process Analysis: Reactor analysis; Mass balance analysis; Modeling and analysis of ideal flow and non ideal flow reactor; Reactions, reaction rates and reaction rate co-efficient; Modeling treatment process kinetics	10
2	Introduction to Mass Transfer: Introduction; Gas-liquid mass transfer; Liquid-solid mass transfer	2

3	Fundamentals of Biological Treatment: Introduction; Microbial metabolism; Bacterial growth and energetic; Microbial growth kinetics; Modeling suspended growth treatment process; Aerobic biological oxidation; Biological nitrification; Biological denitrification; Anaerobic fermentation and oxidation process analysis	10
4	Advanced Wastewater Treatment Process: Introduction; Technologies used for advanced wastewater treatment; Depth filter; Surface filter; Membrane filtration process: design and analysis; Adsorption; Ion exchange; Advanced oxidation process	6
5	Disinfection process; Treatment, reuse of wastewater, Decentralized wastewater treatment system	4
6	Low-cost treatment systems (Oxidation Pond, RBC, Design of stabilization pond: aerobic, facultative, anaerobic, Design of aerated lagoon, Design of combined treatment system)	10

#### Suggested Textbook(s):

1. Metcalf, E., & Eddy, E. (2003). Wastewater engineering: treatment and reuse. McGraw Hill. Inc., New York.
2. Arceivala, S. J., & Asolekar, S. R. (2006). Wastewater treatment for pollution control and reuse, Tata McGraw-Hill Education.

#### Suggested/Resources:

1. Coker, A. Kayode. Modeling of chemical kinetics and reactor design. Gulf Professional Publishing, 2001.
2. Grady Jr, CP Leslie, Glen T. Daigger, Nancy G. Love, and Carlos DM Filipe. Biological wastewater treatment. CRC press, 2011.
3. Mara, Duncan. Domestic wastewater treatment in developing countries. Routledge, 2013.
4. Jakobsen, Hugo A. Chemical reactor modeling. Verlag nicht ermittelbar, 2014.

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Simulations in Geotechnical Engineering)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	3	1	1	1	0	2	0	0	0	0	1	<b>1.00</b>
CO2	3	3	1	3	1	0	2	0	0	0	0	1	<b>1.17</b>
CO3	3	3	1	3	1	0	3	0	0	0	0	1	<b>1.25</b>
CO4	3	1	2	1	2	0	2	0	0	0	0	0	<b>0.92</b>
CO5	3	1	3	1	3	0	2	0	0	0	0	0	<b>1.08</b>
<b>Average</b>	<b>3.00</b>	<b>2.20</b>	<b>1.60</b>	<b>1.80</b>	<b>1.60</b>	<b>0.00</b>	<b>2.20</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.60</b>	

## Surface Water Quality Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:** None

### *Course Objectives:*

1. Introduction to the principles of surface water quality, inputs and mass loading and comparison of water sources.
2. Rivers, estuaries, Streams, Bays and Harbours, Lakes. Indicator Bacteria, Pathogens and Viruses.
3. Dissolved Oxygen, Principal Components, Methodology, DO Models and Engineering Control for DO, Eutrophication, Basic Mechanism, Significance of N/P ratio, Models and Techniques.
4. Toxic Substances and Temperature.
5. Solubility of oxygen in water exposed to water saturated air at atmospheric pressure, Streeter Phelps derivation, limitations and modifications.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Introduction to the principles of surface water quality, inputs and mass loading and comparison of water sources.	Familiarity
CO-2	Rivers, estuaries, Streams, Bays and Harbours, Lakes. Indicator Bacteria, Pathogens and Viruses.	Assessment
CO-3	Dissolved Oxygen, Principal Components, Methodology, DO Models and Engineering Control for DO, Eutrophication, Basic Mechanism, Significance of N/P ratio, Models and Techniques.	Assessment
CO-4	Toxic Substances and Temperature.	Usage
CO-5	Solubility of oxygen in water exposed to water saturated air at atmospheric pressure, Streeter Phelps derivation, limitations and modifications.	Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Nature of problems existing, waste load allocation principles, nature of input loadings, point source mass loading rates, tributary mass loading rates, intermittent mass loading rates, comparison between the tributary and intermittent rates.	7
2	<b>Rivers and Streams:</b> River hydrology and flow, discharge of residual material into rivers, time variable analysis and engineering controls, and derivation of steady state stream equations.	8
3	<b>Estuaries, Bays, Harbors, Lakes and Dissolved Oxygen:</b> Physical aspects of estuaries, lakes, tides and tidal currents, distribution of water quality in estuaries, estimation of tidal dispersion coefficient, derivation of estuary equation,	10

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	modeling of real estuaries, numerical dispersion of steady state finite segment models and time variable aspects of estuaries. Lake wide water quality response to inputs, fine segment steady state flow of lake, Physical and hydrologic characteristics, Principal components of DO analysis, sources and sinks of DO-Kinetic relationship, DO analysis-streams and lakes, tidal rivers and estuaries DO models and engineering controls for DO.	
<b>4</b>	<b>Eutrophication and Indicator pathogens, bacteria's and viruses:</b> Basic mechanism of eutrophication, external sources of nutrients, significance of N/P ratio, simplified lake phytoplankton models, phytoplankton and nutrient interactions, phytoplankton and DO relationships, simplified river and stream eutrophication analysis, inputs of organisms, decay rate and fate of organisms and environmental control.	<b>8</b>
<b>5</b>	<b>Toxic Substances and Temperatures:</b> chemical water quality criteria and standards, principal physico-chemical components of toxic substance analysis, completely mixed lakes, rivers and streams, estuaries, multidimensional water bodies, estimation of net chemical loss rate, control of toxic substances, significance of water temperatures, excess heat inputs, heat balance, simplified heat balance equation, temperature models and reduction of excess heat inputs.	<b>9</b>
<b>Total lectures</b>		<b>42</b>

#### **Suggested Textbook(s):**

1. Thomann, R.V. and Muller, J.A., 'Principles of Surface Water Quality Modeling and Control', Harper and Row Publishers, New York, 1987.
2. Chapra, S.C., "Surface water quality modeling", Wave land Press Inc, 2008.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., New York, 1985.
4. Tebbutt, T.H.Y., "Principles of Water Quality Control", Trade Paperwork, 1998.
5. Garg S.K: Environmental Engineering – Sewage Disposal and Air Pollution Engineering (Volume -II), Khanna Publishers, India, 2015.

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

1. Government of India, "Guidelines for Water Quality Management", CPCB, Ministry of Urban Development, New Delhi, 2016.
2. Scientific Engineering Response and Analytical Services (SERAS), "Standard Operating Procedures for Surface Water Sampling", 2015.
3. Government of India, "General Standards for Discharge of Environmental Pollutants Part-A-Effluents and Part-B- Wastewater generation Standards, 2016.

#### **Other useful resource(s):**

1. <https://www.intechopen.com/books/water-quality>
2. <https://nptel.ac.in/courses/105/106/105106145/>
3. <https://nptel.ac.in/courses/105/105/105105042/>
4. <https://nptel.ac.in/courses/105/105/105105110/>
5. <https://link.springer.com/content/pdf/10.1007%2Fs11269-015-0982-2.pdf>
6. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/water-quality-management>
7. <http://www.oecd.org/env/outreach/38120922.pdf>
8. <https://www.hindawi.com/journals/tswj/2013/231768/>

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9. <http://mpcb.gov.in/envtdata/QAQC-%20An%20Overview-%20VAM.pdf>
10. [https://unstats.un.org/unsd/environment/envpdf/pap\\_wasess5a2india.pdf](https://unstats.un.org/unsd/environment/envpdf/pap_wasess5a2india.pdf)
11. <https://www.indiawaterportal.org/topics/springs>
12. <https://www.youtube.com/watch?v=u-CT7KW6tHg>
13. <https://www.youtube.com/watch?v=EAm8-7OzvU>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Surface Water Quality Management)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2.0	3.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	3.0	3.0	3.0	2.16
CO-2	2.0	2.0	3.0	3.0	2.0	2.0	1.0	2.0	2.0	3.0	2.0	2.0	2.16
CO-3	3.0	3.0	3.0	3.0	3.0	3.0	1.0	1.0	2.0	3.0	2.0	3.0	2.5
CO-4	3.0	3.0	3.0	3.0	3.0	2.0	3.0	3.0	2.0	3.0	2.0	3.0	2.75
CO-5	3.0	3.0	2.0	3.0	2.0	1.0	3.0	3.0	2.0	3.0	3.0	2.0	2.5
Average	2.68	2.80	2.60	2.80	2.40	1.80	2.00	2.20	1.80	3.00	2.40	2.60	

**I**

## Industrial Wastewater Treatment

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

**Pre-requisite:** None

### *Course Objectives:*

1. Learn to understand the basic fundamentals for treatment of industrial wastewater systems and the associated management strategies for its implementation.
2. Learn about the operations of the industrial wastewater treatment plant and the fundamental scientific principles involved in the treatment process.
3. Learn to design the unit operations and unit processes for treatment of industrial wastewaters.
4. Learn to design the physico-chemical and biological treatment systems for treatment of industrial wastewaters.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	To study the fundamentals of utilization of water by different industries and the different pollutants generated in the industrial wastes	Familiarity
CO-2	To understand the fundamentals of prevention and the control of the pollutants generated in the industrial wastes.	Assessment
CO-3	To study the fundamentals of the treatment of industrial wastes generated including physico-chemical process and biological processes	Assessment
CO-4	To understand the advanced techniques for treatment of industrial wastewater	Assessment
CO-5	To involve case studies for the different manufacturing units and their respective treatment processes for different industries	Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	Classification of Different Industrial Wastes (like soluble organics, suspended solids, acid/alkali, thermal discharge, inorganics, coloring substances, nutrients, heavy metal etc.) Industrial Waste Survey (possibility of minimization, variation of flow and characteristics, possibility of water conservation and reuse, strength to undergo) diff wastes like process, cooling, sanitary and in plant wastes.	10

2	Techniques for ascertaining character (grab sample, composite sample etc.), Neutralization (equalization basin, limestone bed, limestone tower) Equalizations Basin (objective, function, design principles), Floatation technique (gravity and DAF methods).	12
3	Heavy metals (discussion and removal techniques), Cementation/Recovery techniques, chemical oxidation (chlorine, ozone, hydrogen peroxide)	7
4	Biological Treatment of Organic Matter (ASP, TF, SBR, Lagoon, Anaerobic System), fundamentals of anaerobic process	13
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Eckenfelder, W.W. Jr., Industrial Water Pollution Control, 3rd Edition, McGraw Hill International Edition, Singapore, 2000.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, 2nd Edition, Tata McGraw Publishing Co. Ltd., New Delhi, 1998.

**Suggested Reference Book(s):**

1. H. Peavy, D. Rowe, G. Tchobanoglous "Environmental Engineering", 1<sup>st</sup> Edition, McGraw Higher Education Publications, India, 2017.
2. Metcalf and Eddy Inc: Wastewater Engineering: Treatment and Resource Recovery, 4<sup>th</sup> Edition, McGraw Hill Publications. India, 2014

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105106119/36>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Minor Project	25	Entire Semester	Students will present a case study on manufacturing and treatment of wastes generated from surrounding different industries

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Industrial Wastewater Treatment)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	2	3	1	2	2	3	1	1	2	<b>1.92</b>
CO-2	3	2	3	3	1	2	2	2	2	1	2	2	<b>2.08</b>
CO-3	3	2	3	3	1	1	3	2	2	3	1	2	<b>2.17</b>
CO-4	2	3	3	2	2	2	1	1	1	3	2	2	<b>2.00</b>
CO-5	3	2	2	1	2	2	1	2	3	3	2	2	<b>2.08</b>
Average	<b>2.6</b>	<b>2.2</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>1.8</b>	<b>2.2</b>	<b>2.2</b>	<b>1.6</b>	<b>2</b>	

## Payement Analysis and Design

COURSE CODE:18B1WCE632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### *Course Objectives:*

1. To develop skills in conducting analysis of pavements by calculating the response due to vehicular loading
2. To perform design of rigid and flexible pavements based on traffic and environmental factors.
3. To develop skills in engineering economics (especially life-cycle cost calculations for alternative designs)
4. To develop basic understanding of the principles of pavement management

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will have the opportunity to develop several designs of pavement structures throughout the semester.	Familiarity
CO-2	Through discussion of the topic of pavement management, the students gain an appreciation for the constantly changing nature of engineering decision-making and the impacts of various decisions on an infrastructure network.	Assessment
CO-3	Students will analyze traffic and geotechnical data from real-life projects and theoretical examples.	Assessment
CO-4	The students are required to complete a semester design problem and present their findings to the instructor and other students.	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	Advanced Pavement materials : Waste materials: types, uses in flexible pavement, effect and benefit of utilization of waste material, advance pavement material, Design of bituminous mixes by Marshal method, modified Hubbard –field method, Hveem method, etc.	8
2	Flexible pavement design: Basis of pavement design, Development of various design methods for Highway and Airport Pavements. Layered system concept, Classical methods, Mechanistic-Empirical Method and various damage models, pavement failure study: factors responsible for pavement failure, stress-strain behavior, Current practices in India and across the world.	8

<b>3</b>	Rigid pavement design: Analysis and design parameters, design of slab, spacing of joints, dowel bars, tie bars and joint details, pavement failure study: factors responsible for pavement failure, stress-strain behavior.	<b>6</b>
<b>4</b>	Overlays: Types of overlays, Overlay design, Pavement Evaluation	<b>6</b>
<b>5</b>	Design Software: FPAVE, MX Roads, etc.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

- 1 Yoder, E.J. and Witczak, M.W., “Principles of Pavement Design 2nd Ed”, John Wiley & Sons, Inc. (1975)
- 2 O’Flaherty, A. Coleman, “Highways : The Location, Design, Construction and Maintenance of Road Pavements”, 4th Ed., Elsevier (2006)
- 3 Fwa, T.F., “The Handbook of Highway Engineering”, CRC Press Taylor &Francies Group, 2006.
- 4 Khanna, S.K. and Justo, C.E.G., “Highway Engineering Nem Chand Jain & Bros, 2005.
- 5 Papagiannakis, A.T. and Masad, E.A., “Pavement Design and Materials, John Wiley & Sons Inc, 2008.

**Evaluation Scheme:**

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Pavement Analysis and Design)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	3	2	2	2	3	2	2	2	2	<b>2.17</b>
CO-2	2	3	2	3	3	1	2	2	2	2	2	2	<b>2.17</b>
CO-3	2	2	2	2	3	1	2	1	2	2	2	2	<b>1.92</b>
CO-4	2	3	2	3	2	2	2	1	2	3	2	2	<b>2.17</b>
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.5</b>	<b>1.5</b>	<b>2</b>	<b>1.75</b>	<b>2</b>	<b>2.25</b>	<b>2</b>	<b>2</b>	

## Highway Construction, Maintenance and Management

COURSE CODE:18B1WCE636

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### *Course Objectives:*

1. To enhance / develop the skills of professionals working in construction and allied sectors to upgrade their skills in Construction Contracts Management and help them to grow in their career.
2. To perform different method of construction for rigid and flexible pavements based on traffic and environmental factors.
3. To understand the different method of pavement repairing and maintenance
4. To develop basic understanding of the principles of pavement management

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will come to know about the types, working and importance of pavement in different condition (i.e., level or hilly terrain).	Familiarity
CO-2	Through discussion of the topic of highway construction, the students gain an appreciation for the methods and different steps involved in pavement construction.	Assessment
CO-3	Students will analyze different factors which affect the performance of pavement (i.e., environmental or traffic factor) from real-life projects and theoretical examples.	Assessment
CO-4	Students will become familiar with the different methods of pavement maintenance.	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Highway Construction:</b> Introduction, history of road construction, equipments for the road construction, stages of construction, limitations in pavement construction due to weather. <b>Earthwork:</b> Clearing and grubbing, excavation, embankment construction, replacement of soils, soil stabilization and their types.	8
2	<b>Flexible and Rigid pavement construction:</b> Flexible Pavement: different layers system and their specifications, defects in flexible pavement and their remedies, different types of pavements (i.e., dense bitumen macadam, water bound macadam etc.) and their specifications, different tests for bitumen.Rigid pavement: layer system and specifications, concrete surfacing, provision of different type of joints in rigid pavement, current practices for rigid pavement construction.	8

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<b>3</b>	<b>Highway maintenance:</b> General, distress in pavements (Cracking, patching, rutting, potholes, stripping and swelling), evaluation of pavement, structural evaluation, pavement maintenance.	<b>6</b>
<b>4</b>	<b>Introduction to transport economics:</b> Recycling of pavements: Introduction, selection of road for recycling, methods and equipments for recycling.	<b>6</b>
<b>5</b>	<b>Hill Roads:</b> Alignment, geometrics, design and construction for hill roads, drainage design, maintenance problems in hill roads, slope stability in hill roads, different factors responsible for pavement failure.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

- 1 Hass, R., Hudson, W.R. and Zaniewski, J. "Modern Pavement Management" Krieger, 1994.
- 2 Fwa, T.F., "The Handbook of Highway Engineering", CRC Press, Taylor & Francis Group, 2006.
- 3 Shain, M.Y., "Pavement Management for Airports, Roads and Parking Lots", Kluwer Academic Publishers Group, 2004.
- 4 Khanna, S.K. and Justo, C.E.G., "Highway Engineering" Nem Chand & Bros, Roorkee (U.A.) 8<sup>th</sup> Ed, 2005.
- 5 Hudson, W.R., Haas, R. and Uddin, W., "Infrastructure Management", McGraw Hill, 1997.

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Highway Construction, Maintenance and Management)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	3	2	2	2	2	1	2	2	3	3	2	2.17
CO-2	3	3	3	2	3	3	1	3	2	3	2	2	2.5
CO-3	2	2	2	2	3	2	1	2	2	2	2	2	2
CO-4	3	3	3	3	2	2	1	2	2	2	3	2	2.33
<b>Average</b>	<b>2.5</b>	<b>2.75</b>	<b>2.5</b>	<b>2.25</b>	<b>2.5</b>	<b>2.25</b>	<b>1</b>	<b>2.25</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	

## Transportation Engineering

COURSE CODE:18B1WCE634

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Highway Engineering

### *Course Objectives:*

1. To learn the fundamentals of railways, airways, water ways & other minor modes of transportation modes.
2. To provide the students with an in-depth knowledge and understanding of the principles governing the geometric design of railways
3. To develop an understanding of the concepts related to airport planning & design.
4. To provide fundamental concepts of harbor engineering and other modes of transportation

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	To know about the basics and scope of various components of railway and airport engineering.	Familiarity
CO-2	To be able to design the basic elements of railway and airport.	Assessment and Usage
CO-3	To enable the students to apply existing technology to the design, construction, and maintenance of railway physical facilities.	Assessment
CO-4	To learn about the aircraft characteristics, planning and components of airport.	Familiarity and Usage
CO-5	To study about the types and components of docks and harbours.	Familiarity

### **Course Contents:**

Unit	Contents	Lectures required
<b>1</b>	History of railways in India, alignment and project reports, permanent way and track materials, geometric design, railway points and crossings and junction, track laying, track drainage, station yards, maintenance of track.	<b>14</b>
<b>2</b>	Development of air transport in India, airport planning, airport design standards, terminal lay out & classification, Design of airport pavements, drainage, marking & lighting, heliports, air traffic control, air cargo, accidents in the air, maintenance of airports .	<b>13</b>

3	Historical development in India, tides, winds & waves, docks, harbours, break waters, jetties, landing stages & wharves, dry docks, transit sheds, cargo handling, inland water transport. Maintenance.	9
4	Pipelines, elevators, belt conveyors, aerial rope ways, & under sea transportation.	6
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Railway engineering, Subhash.C.Saxena&Satyapal Arora, Dhanpat rai &sons,
2. Railway, Airport and Harbour Engineering, K.P. Subramanian, Scitech Publication
3. Railways, bridges & tunnels, Vazirani. V.N, Chandola.S.P, Khanna publications, New Delhi

**Suggested Reference Book(s):**

1. Airport planning & design, Khanna.S.K, Neem chand publications, Roorkee,
2. Docks & harbors, Levison Francis, Clarendon press,

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

Course Outcomes (Transportation Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

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## Traffic Engineering

COURSE CODE: 18B1WCE635

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Highway Engineering

### *Course Objectives:*

1. To have an overall knowledge of the traffic performance on roads through systematic traffic studies
2. To develop a strong knowledge base of traffic regulation, control and its management in any transportation area.
3. To provide knowledge of traffic control devices and its design techniques in transportation interaction

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will be able to understand the importance of traffic engineering in the field of transportation.	Familiarity
CO-2	The student will be able to understand the various traffic components, traffic characteristics, traffic studies & analysis	Familiarity and Usage
CO-3	The student will be able to understand the fundamental principles of traffic flow, roadway capacity, level of service.	Familiarity and Usage
CO-4	The student will be able to understand highway safety operations, traffic regulations and control, road markings.	Familiarity and Usage
CO-5	The student will be able to design traffic signals, rotary intersections and prepare traffic management plans.	Assessment and Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	Importance of traffic engineering, scope of traffic engineering, traffic characteristics-road user characteristics, vehicular characteristics, Max dimensions and weights of vehicles allowed in India, Effects of traffic characteristics on various design elements of the road.	4
2	Traffic Engineering Studies and Analysis- Traffic Volume studies, spot speed studies, speed & delay studies, origin & destination studies, parking studies, their objectives, methods & data presentation, accident studies- Accident surveys. Causes of road accidents and preventive measures.	8
3	Capacity and Level of Service: Fundamental diagram of traffic flow, Relationship between speed, volume and density, Level of service, PCU, Design service volume, Capacity of non-urban roads, IRC recommendations, Brief review of capacity of urban roads.	8
4	Traffic Regulation and control Devices- Traffic control devices: signs, signals, markings and islands. Types of signs, Types of signals. Design of signals, Intersections at grade and grade separated intersections, Design of a rotary, Types of grade separated intersections.	12

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5	Design of Parking Lighting and Terminal Facilities: Parking surveys. On street parking, off street parking.	5
6	Traffic Regulation: Need and scope of traffic regulations. Regulation of speed, vehicles and drivers, General traffic regulations, Motor vehicle Act, Scope of traffic management, traffic planning and management.	5
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Principles of Transportation Engineering by Chakroborty&Das, Prentice Hall, India.
2. Highway Engg by S.K.Khanna& C.E.G. Justo, Nem Chand Bros.,Roorkee.(2017)
3. Traffic Engg and Transport Planning by L.R.Kadiyali, Khanna Publishers,Delhi.
4. Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd.

**Suggested Reference Book(s):**

1. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, F.W, McGraw- Hill Book Co., New York.
2. Traffic Flow Theory. By Drew, D.R., McGraw- Hill Book Co., New York.
3. Basic Statistics - Simpson and Kafks; Oxford and IBH Calcutta, 1969.
4. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K.V.Sultanchand

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Traffic Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

## Advanced Highway Material and Construction

COURSE CODE: 18B1WCE832

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### *Course Objectives:*

1. To understand the scope, application potential, evaluation, and performance expectation of the new highway materials.
2. To get familiar with the innovative application concepts of the conventional or the modern materials.
3. Usage of modern materials in highway construction and their innovative application
4. Introduction to new technology used in highway construction.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will come to know about the scope, application potential, evaluation, and performance expectation of the new highway materials	Familiarity
CO-2	The students will gain an appreciation for the innovative application concepts of the conventional or the modern materials	Assessment
CO-3	Students will analyze how to use and the benefits of modern materials in highway construction	Assessment
CO-4	Students will become familiar with the new technology used in highway construction	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Aggregates:</b> Classification, physical and strength characteristics, proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates.	6
2	<b>Soil:</b> Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization	8
3	<b>Bitumen:</b> Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of bitumen, Tests on bitumen, Emulsions – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen.	6
4	<b>Mixes:</b> Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications	6

<b>5</b>	<b>Cement Concrete:</b> Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes	<b>8</b>
<b>6</b>	<b>Road Construction:</b> Bituminous road construction procedures and specifications, Quality control requirements. Concrete Road construction: Construction methods, Quality control requirements, Joints in cement concrete pavements, reinforced cement concrete road construction.	<b>8</b>
<b>Total Lecture</b>		<b>42</b>

### Suggested Textbook(s):

- 1 Krebs, Robert D. And Walker, R. D., "Highway Materials", McGraw Hill Book Co., New York, 1971.
- 2 Her Majesty's Stationery Office, "Soil Mechanics for Road Engineers", Ministry of Transport, Road Research Laboratory, UK, 1966.
- 3 Her Majesty's Stationery Office, "Bituminous Materials in Road Construction", Ministry of Transport, Road Research Laboratory, UK, 1966.
- 4 Her Majesty's Stationery Office, "Concrete Roads Design and Construction", Ministry of Transport, Road Research Laboratory, UK, 1966.
- 5 Read, J. And Whiteoak, D., "The Shell Bitumen Handbook", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London, 2003.

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Advanced Highway Material and Construction)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	3	2	2	2	2	1	2	2	3	3	2	2.17
CO-2	3	3	3	2	3	3	1	3	2	3	2	2	2.5
CO-3	2	2	2	2	3	2	1	2	2	2	2	2	2
CO-4	3	3	3	3	2	2	1	2	2	2	3	2	2.33
<b>Average</b>	<b>2.5</b>	<b>2.75</b>	<b>2.5</b>	<b>2.25</b>	<b>2.5</b>	<b>2.25</b>	<b>1</b>	<b>2.25</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	

## Computational Models in Transportation Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 1-0-4

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**Pre-requisite:** Highway Engineering

### *Course Objectives:*

1. To provide a platform to undergraduate students for practical implementation of flexible pavement design.
2. To study the structural evaluation using Falling Weight Deflectometer.
3. To understand the role of optimization techniques in transportation engineering.

### **Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will know the principles and procedures of Design of Flexible Pavements used in highways	Familiarity and Usage
CO-2	Students will know the principles and procedures of Structural Evaluation using FWD used in highways	Familiarity and Usage
CO-3	Student will know the various optimization techniques for linear and non-linear problems	Familiarity and Usage
CO-4	Students will be able to solve Transportation problem via various numerical and computational methods	Familiarity and Usage

### **Course Contents:**

S. No.	Description	Hours (P+L)
1	Introduction to IITPAVE software, components and its use in Flexible Design Pavement (IRC: 37-2018)	4+2
2	To determine the effective subgrade Modulus/CBR using IITPAVE software	2+1
3	To determine the tensile strain and vertical subgrade strain using IITPAVE software.	2+1
4	Introduction to KGPBACK software, components and its use in structural evaluation using Falling Weight Deflectometer (IRC: 115-2014)	4+2
5	To determine the back-calculated elastic modulus of various pavement layers using KGPBACK software	2+1
6	Introduction to MXROAD and its components	2+1
7	Horizontal and Vertical Alignment Design using MXROAD	4+2
8	Introduction to HDM-4 and its components	2+1

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9	Pavement Management System using economic decision-making process in HDM-4, and application areas	4+2
10	Introduction to Hawkeye Processing Toolkit Software (ARRB) and its applications	2+1
<b>Total Labs + Lectures</b>		<b>28+14</b>

**Suggested Textbook(s):**

1. Highway Engineering Lab Manual by 'A.K.Justo & S.K.Khanna' Nemchand Publ.
2. Highway Engineering by S. K. Khanna & C.E.G.Justo.(2017)
3. IRC codes and Manuals
4. Linear Programming, Massachusetts: Addison-Wesley. 1962

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Principles and practices of Highway engg, L.R.Kadyali & N.B.Lal, , Khanna Publishers, Delhi (2006)

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

Course outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
Average	3	3	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

## Construction Technology and Management

COURSE CODE:18B1WCE531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Building Materials and Construction

### *Course Objectives:*

1. To impart fundamental knowledge & skills in students by communicating the concept of construction technology management effectively.
2. To promote intellectual & social values in construction engineers
3. To engage students in research & innovation by providing sustainable solution to construction industry.
4. To develop human values & ethics in students & prepare them to be responsible citizens...

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the roles and responsibilities of a project manager, importance of contract document and tender for construction work.	Familiarity
CO-2	Prepare schedule of activities in a construction project finding critical path, cost controlling, resource allocation and updating of the network.	Assessment
CO-3	Identify the equipment used in construction.	Assessment
CO-4	Cost optimization of the construction equipment's, economic life and replacement of the construction equipment's	Usage
CO-5	Understand safety practices in construction industry	Usage

### **Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Introduction to different types of contracts, owner – contractor relationship, the terms and conditions of a contract.	3
2	<b>PERT and CPM Analysis:</b> Relevance of construction schedules-Bar charts, the programme evaluation review technique method, calculations for critical path scheduling, activity float and schedules	8
3	<b>Construction Equipment's:</b> Introduction to various operations in construction, execution and management.	3
4	<b>Earth excavating, compacting, finishing and hauling machinery:</b> Standard and special construction equipments, heavy earthmoving equipments, shovels and cranes, crushing plant, batching plant, bitumen plant.	6
5	<b>Cost control:</b> Selection of construction equipment cost of owning and operating, capacity and utilization, breakdown analysis, economic life, replacement of equipment and sinking fund.	6
6	<b>Resource allocation and Updating:</b> Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numerical algorithms.	10

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7	<b>Safety measures in construction design:</b> Form works, their design, fabrication and uses.Uses and design of scaffoldings.Steel constructions; fabrication and erection techniques	6
<b>Total lectures</b>		<b>42</b>

### Suggested Textbook(s):

1. Punmia and Khandelwal K.K. - Project Planning and Control - Laxmi Publ. Delhi.
2. P. S. Gahlot and B.M. Dhir - Construction Planning and management- New Age international Publ. Delhi
3. Srinath, L.S. - PERT and CPM Principles and Applications -East West Press

### Suggested Reference Book(s):

1. Amit and B.L. Gupta – Construction Management and Machinery – Standard publishers Delhi.
2. Moder. J., C. Phillips and Davis - Project Management with CPM, PERT and Precedence Diagramming - Van Nostrand Reinhold Co.
3. Willis. E.M. - Scheduling Construction projects - John Wiley and Sons.

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignments (10) - 10 Presentation(1) -10 Attendance/Quiz - 5

### Course Outcomes (COs) contribution to the Programme Outcomes(POs)

Course Outcomes (Construction Technology and Management)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	2
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.0
CO-5	2	2	3	3	3	2	2	1	3	2	2	2	2.25
Average	2	2.4	2.6	2.6	2.6	1.4	1.6	1	2.2	2.2	1.6	2	

## Construction Management Computations

COURSE CODE: 18B1WCE641

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 1-0-4

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**Pre-requisite:** Individuals with knowledge of project management principles and hands-on experience with Windows operating system are the ideal participants for this course.

**Course Objectives:**

1. Create a project.
2. Create a Work Breakdown Structure, Relationships & Schedule the project
3. Analyze resources and cost, Manage risk.
4. Calculating various quantities in building construction
5. Preparation of schedule of bars and tenders

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Learn to Create a project, add activities and Create relationships	Assessment
CO-2	Learn to Assign and analyze resources and Analyze project performance	Assessment
CO-3	Learn to calculate various quantities related to building construction work	Assessment
CO-4	Learn to prepare schedule of bars and tenders.	Assessment

**Course Contents:**

Unit	Contents	Lectures
1	<b>Primavera Overview and Configuration:</b> Project Management Life Cycle, Understanding Data in P6, Overview and Navigation	2
2	<b>Structuring Projects:</b> Creating a Project, creating a Work Breakdown Structure, Adding Activities, Calendars, Creating Relationships, Scheduling, Assigning Constraints	2
3	<b>Implementing the Schedule:</b> Assigning Constraints, Customizing Activity Views, Understanding Roles and Resources, Assigning Roles and Resources, Project Workspace	2
4	<b>Updating and Managing the Schedule:</b> Optimizing the Project Plan, Base lining the Project Plan, Methods of Applying Progress, Executing the Project Plan, Analysing the Updated Project, Portfolios and Dashboards	2
5	<b>Estimator:</b> Creating new project, finding earthwork, masonry calculation, openings, plastering	3

<b>6</b>	<b>Estimator:</b> Preparing schedule of bars, prepare a building, chart, graphs and tenders.	3
<b>Total lectures</b>		<b>14</b>

**List of Experiments:**

Sr. no.	Description	Hours
<b>1</b>	Introduction to software Understanding Data in P6 and Overview and Navigation	3
<b>2</b>	How to Create a Project and create a Work Breakdown Structure	3
<b>3</b>	Adding Activities, Calendars and Creating Relationships in Primavera	3
<b>4</b>	Scheduling and Assigning Constraints in Primavera	3
<b>5</b>	How to Assign Constraints, Customize Activity Views and Assign Roles and Resources	3
<b>6</b>	Methods of Applying Progress and Executing the Project Plan in Primavera	4
<b>7</b>	Creating new project, finding earthwork	3
<b>8</b>	How to calculate masonry, openings and plastering	3
<b>9</b>	Preparing schedule of bars, prepare a building, chart, graphs and tenders.	3
<b>Total</b>		<b>28</b>

**Suggested Textbook(s):**

1. Kumar Niraj Jha, "Construction project management: Theory and Practices", published by Dorling Kindsley (2011)
2. Punamia & Khandelwal, "CPM and PERT", Laxmi Publications Ltd.
3. B. N. Dutta, "Estimation and Costing", USB Publisher & Distributors.

**Other useful resource(s):**

1. nptel.ac.in/

**Evaluation Scheme:**

<b>1</b>	Mid Sem. Evaluation	20 Marks
<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	2	3	2	1	2	2	1	3	3	1	3	2.16
CO2	3	2	3	3	3	2	2	2	3	2	2	3	2.5
CO3	2	2	2	2	1	2	3	2	2	2	2	3	2.08
CO4	2	2	3	2	1	2	2	1	2	1	2	2	1.83
<b>Average</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2.5</b>	<b>2</b>	<b>1.75</b>	<b>2.75</b>	

## Construction Planning and Control

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Construction Technology and Management

### *Course Objectives:*

1. To study the elements of construction planning and scheduling and to apply appropriate tools and techniques like networks and coding systems.
2. To study the monitoring of projects through cost control
3. To study the elements of quality control and safety of construction projects
4. To study the concept of gathering and using project information

### *Course Outcomes:*

S. No.	Course Outcomes	Level of Attainment
CO1	Understand the basic development of construction plans	Assessment
CO2	Evaluate the construction schedules using techniques and methods	Usage
CO3	Assessment of project budget, forecasting of cost control	Assessment
CO4	Understanding and framing of quality assurance and quality control	Usage
CO5	Understand information and database processing models	Usage

### **COURSE CONTENT:**

S No.	Content	Lectures
1.	<b>BASIC CONCEPTS IN CONSTRUCTION PLANS:</b> Basic Concepts in the Development of Construction Plans - Choice of Technology and Construction Method - Defining Work Tasks - Defining Precedence Relationships Among Activities -Estimating Activity Duration. Estimating Resource Requirements for Work Activities -Coding Systems.	<b>5</b>
2.	<b>CONSTRUCTION SCHEDULES:</b> Relevance of Construction Schedules - The Critical Path Method - Calculations for Critical Path Scheduling -Activity Float and Schedules -Presenting Project Schedules Critical Path Scheduling for Activity-on-Node and with Leads. Lags and Windows . - Calculations for Scheduling with Leads, Lags and Windows - Resource Oriented Scheduling - Scheduling with Resource Constraints and Precedence - Use of Advanced Scheduling Techniques - Scheduling with Uncertain Duration -Calculations for Monte Carlo Schedule Simulation - Crashing and Time/Cost Trade-offs – Scheduling in Poorly Structured Problems - Improving the Scheduling Process	<b>14</b>
3.	<b>INTRODUCTION TO PROJECT BUDGET:</b> The Cost Control Problem -The Project Budget - Forecasting for Activity Cost Control - Financial Accounting Systems and Cost Accounts - Control of Project Cash Flows – Schedule Control- Schedule and Budget Updates - Relating Cost and Schedule Information	<b>18</b>

4.	<b>QUALITY AND SAFETY MANAGEMENT:</b> Quality and Safety Concerns in Construction -Organizing for Quality and Safety – Work and Material Specifications -Total Quality Control -Quality Control by Statistical Methods - Statistical Quality Control with Sampling by attributes – Statistical Quality Control with Sampling by Variables – Safety.	<b>3</b>
5.	<b>PROJECT INFORMATION :</b> Types of Project Information - Accuracy and Use of Information -Computerized Organization and Use of Information -Organizing Information in Databases - Relational Mode of Databases - Other Conceptual Models of Databases - Centralized - Database Management Systems - Databases and Applications Programs – Information - Transfer and Flow.	<b>2</b>
<b>TOTAL LECTURES</b>		<b>42</b>

**Suggested Textbook(s):**

1. Chitkara. K.K. “Construction Project Management: Planning Scheduling and Control”, Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Calin M. Popescu, Chotchall Charoengam, “Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications”, Wiley, New York, 2005.

**Reference book:**

1. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall Pittsburgh, 2000.
2. Moder, J., C. Phillips and E. Davis, “Project Management with CPM, PERT and Precedence Diagramming”, Van Nostrand Reinhold Company, Third Edition, 2003.
3. Willis, E. M., “Scheduling Construction Projects”, John Wiley & Sons, 2006.
4. Halpin, D. W. “Financial and Cost Concepts for Construction Management”, John Wiley & Sons. New York, 2005.

**Other useful resource(s):**

1. <https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-ce16/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Construction Planning and Control)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	2	2	2	2	3	x	x	1	1	1	3	<b>2</b>
CO-2	3	3	2	2	2	3	x	x	2	1	1	3	<b>2.2</b>
CO-3	3	3	3	2	2	2	x	x	2	2	1	3	<b>2.3</b>
CO-4	3	3	3	3	3	2	x	x	2	2	3	3	<b>2.7</b>
CO-5	3	3	3	3	3	2	x	x	2	2	3	3	<b>2.7</b>
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>2.6</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>0</b>	<b>0</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>3</b>	

## Construction Techniques

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Construction Technology and Management

### *Course Objectives:*

1. To study the substructure construction techniques.
2. To create awareness on tall structure construction elements
3. To know about the techniques used for large span structures
4. To study the elements of repair construction.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO1	Students will be familiar with substructure construction techniques	Familiarity
CO2	Students will be able to evaluate construction of tall structures	Assessment
CO3	Students will be able to understand construction of tunnels, bridges and domes	Assessment
CO4	Students will be able to understand the construction techniques related to lattice towers, transmission lines and offshore construction.	Assessment
CO5	Students will be able to evaluate and suggest suitable repair measures for various construction issues.	Usage

### **COURSE CONTENT:**

S.No	Description	Hours
1	<b>SUB STRUCTURE CONSTRUCTION:</b> Box Jacking: Need – elements – concept – precautions – advantages. Pipe jacking: Technique – factors – applications – advantages. Diaphragm walls – methods – sheet piles – applications – advantages. Piling techniques: Classifications – factors. Well and caisson: Types – sinking method – precautions. Cofferdam: Purpose – types – techniques. Cable anchoring – screw anchor – necessity- applications. Grouting: Need – materials – techniques – applications – gunning and shotcreting. Well points - dewatering – techniques	12
2	<b>TALL STRUCTURES CONSTRUCTION:</b> Concrete in tall buildings – types of concrete pumps – factors – blockage – causes - clearing –safety. Slip form techniques: Vertical - chimney – horizontal – concrete paving methods. Suspended form work: Purpose – methods – advantages - erection techniques. Prestressing techniques – in situ prestressing in high rise structures.	8

3	<b>LARGE SPAN STRUCTURES CONSTRUCTION:</b> Tunnelling: Purpose – aspects – shafts – mucking – construction techniques – advantages – trenchless technology. Bow string bridges: Systems – arrangements – advantages. Suspension and cable stayed bridges: Parallel – radial patterns – concept. Domes: Types – structural framing – erection methods. Aerial transportations – components – advantages – applications.	8
4	<b>SPECIAL STRUCTURE CONSTRUCTION:</b> Lattice tower: Definition – techniques. Rigging of transmission line structures: Definition –precaution – stages involved. Advanced construction techniques in offshore construction practice: Various operations – under water concrete - vacuum dewatering of concrete flooring. Articulated structure – definition – mechanism	6
5	<b>REPAIR AND STRENGTHENING TECHNIQUES:</b> Mud Jacking: Techniques – behavior of slab – advantages. Micro piles: Uses – stages – applications- benefits. Shallow profile pipeline laying – procedure – specifications – sub aqueous pipelines –laying methods. Sheet piles protection techniques. Water proofing: Need – above and below ground. Under pinning: Need – methods. Demolition and dismantling: Principles – methods – modern demolition techniques – controlled demolition – mechanical method – hydro demolition – advantages – sequence of demolition – beams – columns – walls – general sequence.	8
<b>Total Lectures</b>		<b>42</b>

#### Suggested Textbook(s):

1. Roy Chudley, Roger Geeno ,”Advanced Construction Technology” Latest Edition.
2. Ponnuswamy .S, ”Bridge Engineering “Second Edition.
3. Sankar, S.K. And Saraswati, S., Construction Technology, Oxford University Press, New Delhi, 2008.
4. Gahlot .P.S & Sanjay Sharma ,”Building repair and maintenance management “CBS Publications.2006

#### Suggested/Resources:

1. Robertwade Brown, "Practical Foundation Engineering Handbook", McGraw Hill Publications, 2005.
2. Patrick Powers .J, "Construction Dewatering: New Methods and Applications" John Wiley & Sons, 2002.
3. Micheal T.Kubal ,”Construction Waterproofing Handbook”.

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

Approved in Academic Council held on 28 July 2021

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Construction Techniques)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.17</b>
CO2	3	2	3	3	3	2	x	x	3	2	x	3	<b>2.67</b>
CO3	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
CO4	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
CO5	2	1	2	2	3	2	2	1	3	2	3	2	<b>2.08</b>
<b>Average</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	<b>2.25</b>	<b>1.25</b>	<b>2.6</b>	<b>2</b>	<b>2</b>	<b>2.6</b>	

## Construction Financial Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Construction Technology and Management, Costing and Estimation

**Course Objectives:**

1. To understand the Economics in civil engineering
2. To understand concept of alternatives for decision making
3. To analyse financial returns
4. To evaluate the value added tax.
5. To understand the concept financial management, construction costing and financial statement analysis

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the Economics in civil engineering	Familiarity
CO-2	Understand concept of alternatives for decision making	Familiarity
CO-3	Analyze financial returns	Assessment
CO-4	Evaluate the value added tax	Usage
CO-5	Understand the concept financial management, construction costing and financial statement analysis	Assessment

**COURSE CONTENT**

S No.	Description	Lectures
1.	<b>Economics</b> : Role of Civil Engineering in Industrial Development - Support matters of Economy as related to Engineering- Market demand and supply - Quality control and Quality Production -Audit in economic law of returns, governing production	<b>8</b>
2.	<b>Equivalence Factors</b> : Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalency - Single payment in the future - Present payment compared to uniform series payments - Future payment compared to uniform series payments - Arithmetic gradient, Geometric gradient	<b>8</b>
3.	<b>Financial Returns Analysis:</b> Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.	<b>8</b>
4.	<b>Evaluating Alternative Investments:</b> Real Estate - Investment Property, Equipment Replace Analysis, and Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.	<b>6</b>

5.	<b>Construction Costing:</b> Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management, Inventory valuation, Mortgage Financing - International financial management foreign currency management. Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes. Fixed contract Pricing- Cost plus pricing- Escalation clause- Construction cost control, Personnel costs, Equipment costs, Job in directs and markup. Balance sheet and Profit and Loss accounts – ratios analysis, Fund flow statement, Cash flow statement, Working Capital Management, Financial Control - Management accounting.	12
<b>TOTAL LECTURES</b>		<b>42</b>

**Suggested Textbook(s):**

4. Anthony Higham, Carl Bridge, Peter Farrell, (2016), Project Finance for Construction, Routledge
5. Senthil, L. Madan and N. Robindro Singh (2011), Engineering Economics and Cost Analysis, Lakshmi Publications, New Delhi.

**Suggested Reference Book(s):**

1. Steven J. Peterson, (2012), Construction Accounting & Financial Management, Pearson, USA
2. Karl E. Case, Ray C. Fair and Sharon E. Oster (2017), Principles of Economics, Pearson, New Delhi.
3. Leland Blank and Anthony Tarquin, (2017), Engineering Economy, 7th Edition, McGraw Hill Education, New Delhi.
4. Bose, D. C., (2010), Fundamentals of Financial management, 2nd ed., PHI, New Delhi.

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105/103/105103023/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Construction Financial Management)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	<b>2.4</b>
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	<b>2.3</b>
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	<b>2.2</b>
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	<b>2.2</b>
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	<b>2.5</b>
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

## Heavy/Civil Construction Equipment, Methods, and Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Building material and Construction Technology, Geotechnical Engineering, Pavement Construction

### Course Objectives:

1. To understand the elements of equipment cost and evaluating investment alternatives.
2. To familiarize with construction equipment and their capabilities
3. To properly select heavy equipment based on applications, utilization, productivity and other factors.
4. To develop basic understanding of unit price and earthwork quantities.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To associate the knowledge of construction of sub structures and super structures and analyze the techniques of erection of construction units	Familiarity
CO-2	To demonstrate basic knowledge about construction equipment and machineries and clearly explain about the hauling and conveying equipment.	Assessment
CO-3	To identify and manage with respect to time and their motion and movements	Usage
CO-4	To clearly explain the equipments used for aggregate and concreting and understand clearly the latest construction equipments used in industry	Usage

### Course Contents:

Unit	Contents	Lectures
1	<b>CONSTRUCTION EQUIPMENT MANAGEMENT:</b> Identification – Planning - Equipment Management in Projects - Maintenance Management – Replacement - Cost Control of Equipment - Depreciation Analysis – Safety Management	10
2	<b>EQUIPMENT FOR EARTHWORK:</b> Fundamentals of Earth Work Operation, Earth Moving Operations, Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Earth Movers	10
3	<b>OTHER CONSTRUCTION EQUIPMENTS:</b> Equipment for Dredging, Trenching, Tunnelling, Drilling, Blasting - Equipment for Compaction - Erection Equipment - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Foundation and Pile Driving Equipment –Equipment for Demolition	6

<b>4</b>	<b>MATERIALS HANDLING EQUIPMENT:</b> Storage Handling equipment – Engineered Systems – Industrial Trucks – Bulk Material handling – OnRails Transfer Cart –Conveyors - Hauling Equipment – tractors, Trucks, Tippe	<b>8</b>
<b>5</b>	<b>EQUIPMENT FOR PRODUCTION OF AGGREGATE AND CONCRETING:</b> Crushers – Feeders - Screening Equipment – Pneumatic - Batching plants – Mixers – Concrete Pumps – Transit Mixers – Dumpers – Concrete Placers - Handling Equipment - Hauling, Pouring and Pumping Equipment – Transporters	<b>8</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Textbook(s):**

1. Sharma S.C., “Construction Equipment and Management”, 5th edition, Khanna Publishers, New Delhi, 2011.
2. Dr.MaheshVarma, “Construction Equipment and its planning and Application”,Metropolitan Book Company, New Delhi. 1988

**Suggested Reference Book(s):**

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., “Construction Planning, Equipment and Methods”, McGraw Hill, Singapore, 2006
2. Deodhar, S.V., “Construction Equipment and Job Planning”,4th edition, Khanna Publishers, New Delhi, 2010

**Other useful resource(s):**

1. Link to SWAYAM course content: [https://onlinecourses.nptel.ac.in/noc21\\_ce21/preview](https://onlinecourses.nptel.ac.in/noc21_ce21/preview)

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10  Quizzes (2) -10  Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Heavy/Civil Construction Equipment, Methods, and Management)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	3	2	2	2	3	2	1	1	<b>2.08</b>
CO-2	3	2	2	2	3	2	2	2	3	1	1	2	<b>2.08</b>
CO-3	3	2	3	2	3	3	2	3	3	1	2	1	<b>2.33</b>
CO-4	2	3	3	2	3	2	3	2	3	1	2	1	<b>2.25</b>
<b>Average</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>3</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>3</b>	<b>1.25</b>	<b>1.5</b>	<b>1.25</b>	

## Computer Applications in Environmental Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P:1-0-4

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**Pre-requisite:** Environmental Engineering and Software lab in Civil engineering

**Course Objectives:**

1. Physical Characteristics of waste water Sample.
2. Inorganic Constituents of waste water Sample
3. Biological Characteristics of wastewater Sample.
4. Jar Test.
5. Judge the suitability of water for drinking purposes.

✓ **Water and wastewater**

- MATLAB
- Statistica, Berkeley Madonna
- Microsoft Excel type of software could be used for mathematical modeling, statistical analysis, solving differential equations, etc.
- Sewer GEMS
- Modflow
- Hydromantics-GPS-X
- WatPro-Predicting Water modelling
- SIMBA

✓ **Environment Assessment and Decision Making**

- SimaPro/ Gabi- Life Cycle Assessment/ Carbon foot printings
- openLCA

✓ **Environmental data, measuring, monitoring and planning:**

- ArcMap 10: Geographical Information System (GIS) software.
- qGIS : Open-source GIS software
- LEAM : Land use evolution and Impact assessment model

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.	Familiarity
CO2	Determination of various inorganic impurities in wastewater.	Assessment

CO3	Determine physical, chemical and biological characteristics of water and wastewater.	Assessment
CO4	Analyze material balance for different environmental systems.	Usage
CO5	Assess the quality of water and wastewater	Usage

**Course Contents:**

S.No	Description	Hours
1	Understanding of MATLAB software and its usability	2
2	Application and working of Statistica, Berkeley Madonna and its use with the experiments value.	2
3	Analysis of sewer Gem for determination of wastewater parameters	2
4	Detailed working, application and usability of Mode flow and Hydromantics-GPS-X in regard of water samples.	2
5	Detailed working, application and usability of WatPro-Predicting Water modelling and SIMBA	2
6	Analysis of data using SimaPro or Open LCA	2
7	Analysis and application of ArcMap 10: Geographical Information System (GIS) software, qGIS : Open-source GIS software and LEAM : Land use evolution and Impact assessment model	2
		<b>14</b>

**List of Experiments:**

S.No	Description	Hours
1	Determination of pH and Temperature of water and wastewater sample.	2
2	Determination of total solids, suspended solids and dissolved solids of water and wastewater sample.	2
3	Determination of specific conductivity of water and wastewater sample.	2
4	Determination of turbidity.	2
5	Determination of chlorides of water and wastewater sample.	2
6	Determination of type and extent of alkalinity of water and wastewater sample.	2
7	Determination of type and extent of acidity of water and wastewater sample.	2

8	Determination of temporary and permanent hardness.	2
9	Determination of optimum dose of coagulant.	2
10	Determination of Sulphates of water and wastewater sample.	2
11	Determination of Kjeldahl Nitrogen (Inorganic) of the sample.	2
12	Determination of dissolved oxygen.	2
13	Determination of Biological oxygen demand (BOD).	2
14	Determination of Chemical oxygen demand (COD).	2
<b>Total Lab hours</b>		<b>28</b>

**Suggested/Resources:**

1. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington:APHA.
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc.,2002
3. Kotaiah, B., and Kumara Swamy, N., Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007
4. Mathur, R.P., Water and Wastewater testing: A laboratory Manual(2013).

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem.Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Environmental Engineering Lab)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	1	1	1	1	1	1.83
CO-2	3	3	3	3	3	1	1	1	1	1	1	3	2.00
CO-3	3	3	2	3	2	3	2	1	1	1	2	1	2.00
CO-4	3	3	3	2	3	2	1	1	1	1	1	1	1.83
<b>Average</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1.83</b>

Approved in Academic Council held on 28 July 2021

## **Building Drawing**

COURSE CODE:18B17CE771

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

: 1-0-4

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**Pre-requisite:** Individuals with knowledge of engineering drawing, understanding of architectural terminology and compatible with using windows operating system.

### **Course Objectives:**

1. Learn the AutoCAD user interface.
2. Create sites, profiles, and cross-sections.
3. Use plan production tools to create plan and profile sheets.
4. Prepare detail drawings and Generate perspective view.
5. Creating a 3D building model with walls, curtain walls, windows, and doors
6. Adding floors, ceilings, and roofs to the building model.
7. Adding component features, such as furniture and equipment.
8. Setting up sheets for plotting with text, dimensions, details, tags, and schedules.

### **Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Create, edit, view, and analyze surfaces and sites, profiles, and cross-sections, Prepare detail drawings	Assessment
CO-2	Generate perspective view of simple building and use plan production tools to create plan and profile sheets.	Assessment
CO-3	Adding floors, ceilings, and roofs to the building model, component features, such as furniture and equipment.	Assessment
CO-4	Creating a 3D building model with walls, curtain walls, windows, and doors	Assessment

### **Course Contents:**

Unit	Contents	Lectures
1	Product Overview, AutoCAD Civil 3D Workspaces, Start Tab, AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Tool space	2
2	Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Break lines and Boundaries, Surface Analysis Tools	2
3	Creating Alignment from Objects, Creating and Modifying alignments, Labels and Tables, Create Profiles from Surface, Generate perspective view of simple building	2
4	Creating a Corridor, Creating Sections, Plan Production Tools, Prepare detail drawings for single and two storied residential building	2

5	Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools, Setting Up Levels and Grids	2
6	Working with Doors and Windows, curtain walls, views, Adding Components, Modeling Floors, ceilings and roofs, Stairs, Railings, and Ramps	2
7	Creating Construction Documents, Adding Tags and Schedules and Creating Details in building	2
<b>Total lectures</b>		<b>14</b>

**List of Experiments:**

Sr. no.	Description	Hours
1	AutoCAD Civil 3D User Interface, AutoCAD Civil 3D Tool space, Draw symbols , conventions and Abbreviations	3
2	Lines and Curves, Introduction to Parcels, Creating and Editing Parcels by Layout Overview, Surface Process, Break lines and Boundaries	3
3	Surface Process, Break lines and Boundaries	3
4	Generate perspective view of simple building	3
5	Plan Production Tools, Prepare detail drawings for single and two storied residential building	3
6	Introduction to BIM and Autodesk Revit, Basic Sketching and Modify Tools	3
7	Doors and Windows, curtain walls	3
8	Floors, ceilings and roofs, Stairs, Railings, and Ramps	3
9	Adding Tags and Schedules and Creating Details in building	4
<b>Total</b>		<b>28</b>

**Suggested Textbook(s):**

- V. B. Sikka, “Civil engineering drawing”, Charotar Publication
- Gurcharan singh, Subash chander, “Civil engineering drawing”, published by Standard Publishers Distributors
- R. S. Malek G. S. Meo, “Civil engineering drawing”, Computech Publication Ltd New Asian

**Other useful resource(s):**

1. [nptel.ac.in/](http://nptel.ac.in/)
2. [www.Autodesk.com](http://www.Autodesk.com)
3. [www.drawingnow.com](http://www.drawingnow.com)

4. [www.learn-to-draw.com](http://www.learn-to-draw.com)

**Evaluation Scheme:**

<b>1</b>	Mid Sem. Evaluation	20 Marks
<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	<b>Total</b>	<b>100 marks</b>

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.16</b>
CO2	3	2	3	3	3	2	2	2	3	2	2	3	<b>2.5</b>
CO3	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
CO4	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
<b>Average</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2.5</b>	<b>2</b>	<b>1.75</b>	<b>2.75</b>	

## Simulations in Geotechnical Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 1-0-4

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**Pre-requisite:** Geotechnical Engineering and Software lab in Civil engineering

### *course Objectives:*

1. To introduce constitutive soil models
2. To learn finite element analysis in geotechnical engineering application using PLAXIS 2D.
3. To learn finite element analysis in geotechnical engineering application using GEO 5.
4. To learn finite element analysis in geotechnical engineering application using ABAQUS.

### *Course Outcomes:*

S.No.	Course Outcomes	Level of Attainment
CO1	Students will be familiar with different soil models used in constitutive modelling	Assessment
CO2	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures using Plaxis.	Usage
CO3	Students will be able to evaluate strength reduction method, calculation of deformation, elemental forces, stress contours using Plaxis.	Usage
CO3	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures.	Usage
CO4	Students will be able to solve geotechnical problems related to slope stability, foundation and retaining structures using ABAQUS.	Usage

### **LIST OF EXPERIMENTS AND LECTURES:**

S. No	Description	Hours (P+L)
1	Introduction of different constitutive soil models in Plaxis	2+1
2	FEM Analysis through modeling of shallow foundations in PLAXIS	2+1
3	Axisymmetric FEM Analysis through modeling of pile foundation using PLAXIS	2+1
4	Slope stability analysis using Strength reduction method (SRM) in PLAXIS	4+2
5	Determination of deformation and element forces through modeling of nail or geosynthetic reinforced embankment or cut in PLAXIS	4+2
6	Analysis of retaining wall.	2+1

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7	Analysis of anchored structure through modelling	2+1
8	Slope stability analysis	2+1
9	Axisymmetric modelling of deep foundation in layered soils using ABAQUS	4+2
10	Slope stability analysis for calculation of factor of safety using ABAQUS	2+1
11	Study of embankment deformation under static load using ABAQUS	2+1
<b>Total Labs</b>		<b>28+14</b>

**Suggested Textbook(s):**

1. Plaxis Introductory: Student Pack and Tutorial Manual 2010 CRC Press, Inc. Boca Raton, FL, USA ©2011 ISBN:9076016100 9789076016108
2. Engineering Manual (Part 1) Geotechnical Software suite Geo 5
3. Engineering Manual ABAQUS examples problem guide Simulia™, Dassault Systèmes®

**Suggested/Resources:**

1. Applied Soil Mechanics with ABAQUS Applications 1st Edition by Sam Helwan
2. Applications of Computational Mechanics in Geotechnical Engineering by Luís Ribeiro e Sousa, M.M. Fernandes, Eurípedes Vargas Jr., Roberto Azevedo Publisher: Taylor & Francis, Year: 2007  
ISBN: 041543789X, 9780415437899
3. Geotechnical Modelling by David Muir Wood (1st Edition) Publisher CRC Press ISBN 9780419237303 - CAT# RU29142

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Simulations in Geotechnical Engineering)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.17</b>
CO2	3	2	3	3	3	2	x	x	3	2	x	3	<b>2.67</b>
CO3	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
CO4	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
CO5	2	1	2	2	3	2	2	1	3	2	3	2	<b>2.08</b>
<b>Average</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	<b>2.25</b>	<b>1.25</b>	<b>2.6</b>	<b>2</b>	<b>2</b>	<b>2.6</b>	

## Computational Models in Transportation Engineering

COURSE CODE:  
COURSE CREDITS: 3  
CORE/ELECTIVE: Elective  
L-T-P: 1-0-4

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**Pre-requisite:** Highway Engineering

### *Course Objectives:*

- To provide a platform to undergraduate students for practical implementation of flexible pavement design.
- To study the structural evaluation using Falling Weight Deflectometer.
- To understand the basics of MXROAD, HDM-4 and Hawkeye Software (ARRB).

### **Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will know the principles and procedures of Design of Flexible Pavements used in highways	Familiarity and Usage
CO-2	Students will know the principles and procedures of Structural Evaluation using FWD used in highways	Familiarity and Usage
CO-3	Student will know the design components of MXROAD	Familiarity and Usage
CO-4	Students will be able to manage pavements maintenance using HDM-4 and Hawkeye software.	Familiarity and Usage

### **List of Experiments and Lectures:**

S. No.	Description	Hours (P+L)
1	Introduction to IITPAVE software, components and its use in Flexible Design Pavement (IRC: 37-2018)	4+2
2	To determine the effective subgrade Modulus/CBR using IITPAVE software	2+1
3	To determine the tensile strain and vertical subgrade strain using IITPAVE software.	2+1
4	Introduction to KGPBACK software, components and its use in structural evaluation using Falling Weight Deflectometer (IRC: 115-2014)	4+2
5	To determine the back-calculated elastic modulus of various pavement layers using KGPBACK software	2+1
6	Introduction to MXROAD and its components	2+1

7	Horizontal and Vertical Alignment Design using MXROAD	4+2
8	Introduction to HDM-4 and its components	2+1
9	Pavement Management System using economic decision-making process in HDM-4, and application areas	4+2
10	Introduction to Hawkeye Processing Toolkit Software (ARRB) and its applications	2+1
<b>Total Labs + Lectures</b>		<b>28+14</b>

**Suggested Textbook(s):**

1. Highway Engineering Lab Manual by 'A.K.Justo & S.K.Khanna' Nemchand Publ.
2. Highway Engineering by S. K. Khanna & C.E.G.Justo.(2017)
3. IRC codes and Manuals
4. Bentley MXROAD user manuals
5. HDM-4 manuals

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Principles and practices of Highway engg, L.R.Kadyali & N.B.Lal, , Khanna Publishers, Delhi (2006)
3. Kerali, H. G., Odoki, J. B., & Stannard, E. E. (2000). Overview of HDM-4. *The Highway Development and Management Series, 4.*
4. Reddy, M. S., & Ali, S. A. Highway Design by Using MX Road Software.

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

Course outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	1	3	3	0	0	1	1	1	0	<b>1.58</b>
CO-2	3	3	3	1	3	3	0	0	1	1	3	0	<b>1.75</b>
CO-3	3	3	2	2	3	3	0	2	2	1	3	0	<b>2.00</b>
CO-4	3	3	2	2	3	3	0	2	1	1	3	0	<b>1.92</b>
Average	<b>3.00</b>	<b>3.00</b>	<b>2.50</b>	<b>1.50</b>	<b>3.00</b>	<b>3.00</b>	<b>0.00</b>	<b>1.00</b>	<b>1.25</b>	<b>1.00</b>	<b>2.50</b>	<b>0.00</b>	

## Construction Management Computations

COURSE CODE: 18B1WCE641

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 1-0-4

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**Pre-requisite:** Individuals with knowledge of project management principles and hands-on experience with Windows operating system are the ideal participants for this course.

### Course Objectives:

1. Create a project.
2. Create a Work Breakdown Structure, Relationships & Schedule the project
3. Analyze resources and cost, Manage risk.
4. Calculating various quantities in building construction
5. Preparation of schedule of bars and tenders

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Learn to Create a project, add activities and Create relationships	Assessment
CO-2	Learn to Assign and analyze resources and Analyze project performance	Assessment
CO-3	Learn to calculate various quantities related to building construction work	Assessment
CO-4	Learn to prepare schedule of bars and tenders.	Assessment

### Course Contents:

Unit	Contents	Lectures
1	<b>Primavera Overview and Configuration :</b> Project Management Life Cycle, Understanding Data in P6, Overview and Navigation	2
2	<b>Structuring Projects :</b> Creating a Project, creating a Work Breakdown Structure, Adding Activities, Calendars, Creating Relationships, Scheduling, Assigning Constraints	2
3	<b>Implementing the Schedule :</b> Assigning Constraints, Customizing Activity Views, Understanding Roles and Resources, Assigning Roles and Resources, Project Workspace	2
4	<b>Updating and Managing the Schedule :</b> Optimizing the Project Plan, Baseline the Project Plan, Methods of Applying Progress, Executing the Project Plan, Analysing the Updated Project, Portfolios and Dashboards	2

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<b>5</b>	<b>Estimator</b> : Creating new project, finding earthwork, masonry calculation, openings, plastering	3
<b>6</b>	<b>Estimator</b> : Preparing schedule of bars, prepare a building, chart, graphs and tenders.	3
<b>Total lectures</b>		<b>14</b>

**List of Experiments:**

<b>Sr. no.</b>	<b>Description</b>	<b>Hours</b>
<b>1</b>	Introduction to software Understanding Data in P6 and Overview and Navigation	3
<b>2</b>	How to Create a Project and create a Work Breakdown Structure	3
<b>3</b>	Adding Activities, Calendars and Creating Relationships in Primavera	3
<b>4</b>	Scheduling and Assigning Constraints in Primavera	3
<b>5</b>	How to Assign Constraints, Customize Activity Views and Assign Roles and Resources	3
<b>6</b>	Methods of Applying Progress and Executing the Project Plan in Primavera	4
<b>7</b>	Creating new project, finding earthwork	3
<b>8</b>	How to calculate masonry, openings and plastering	3
<b>9</b>	Preparing schedule of bars, prepare a building, chart, graphs and tenders.	3
<b>Total</b>		<b>28</b>

**Suggested Textbook(s):**

1. Kumar Niraj Jha, "Construction project management: Theory and Practices", published by Dorling Kindesley (2011)
2. Punamia & Khandelwal, "CPM and PERT", Laxmi Publications Ltd.
3. B. N. Dutta, "Estimation and Costing", USB Publisher & Distributors.

**Other useful resource(s):**

1. [nptel.ac.in/](http://nptel.ac.in/)

**Evaluation Scheme:**

<b>1</b>	Mid Sem. Evaluation	20 Marks
<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	<b>Total</b>	<b>100 marks</b>

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO1	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.16</b>
CO2	3	2	3	3	3	2	2	2	3	2	2	3	<b>2.5</b>
CO3	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
CO4	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
<b>Average</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2.5</b>	<b>2</b>	<b>1.75</b>	<b>2.75</b>	

## Modeling and Simulation and Computer Applications

COURSE CODE:  
COURSE CREDITS: 3  
CORE/ELECTIVE: ELECTIVE  
L-T-P: 3-0-0

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**Pre-requisite:** Engineering Mathematics; Basics of Computer Programming

### *Course Objectives:*

1. To bridge the gap between physical problem and mathematical modeling.
2. To enable the solution of complicated mathematical problems through numerical techniques.
3. Realistic modelling and simulations that take into account precise geometry and material properties, realistic representations of physical and natural processes, and rational predictions.

### **Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Introduction to numerical methods for solving different mathematical problems with highest possible level of accuracy	Familiarity
CO-2	Use of numerical techniques to determine the solution of complicated engineering problems	Assessment
CO-3	Select the most appropriate solution scheme for modeling a system and use their engineering knowledge to thereby design the solution procedure and use this knowledge for the society.	Assessment
CO-4	Identify the problems in Civil Engineering which need simulation for their solution and obtain their solution.	Assessment

### **Course Contents:**

Unit	Contents	Lectures required
1.	Introduction to Mathematical Modelling Methods: Errors and their sources; Taylor Series Expansion, Introduction to SCILAB, SCILAB Script	2
2.	Basic System Models; System Models of Combined Systems; Introduction to Dynamic Response and System Transfer Function	4
3.	Direct Solution of Linear Systems: Gauss Elimination Method; Gauss Jordan Method; Pivoting, Factorization, Cholesky Decomposition; Singularity; Banded Matrices and their storage; Iterative Solutions using SCILAB	4

4.	Direct Solution of Non-linear Systems: Newton Raphson iterations to find roots of a 1D nonlinear equation. Generalization to multiple dimensions. Newton Iterations, Quasi Newton iterations; Iterative Solution using SCILAB	4
5.	Curve fitting method, linear and non-linear fitting, Linear interpolation, Lagrange interpolation method, Newton Interpolation formula, practical examples using SCILAB	4
6.	Numerical differentiation, central difference methods, higher order derivatives, errors, practical examples using SCILAB	6
7.	Numerical integration, Simpson's 1/3 rule, Simpson's 3/8 rule, local and global error analysis, practical examples using SCILAB	4
8.	Eigenvalue problems, Heun's method, Euler's method, Runge Kutta Method, Gerschgorin disc theorem, Jacobi method, Practical examples using SCILAB	6
9.	Simulation Techniques, Random numbers, Monte Carlo Method, Importance of Sampling, Metropolis Algorithm, Heat-bath algorithm, practical examples using SCILAB	8
TOTAL		42

**Suggested Textbook(s):**

*Simulation-Based Reliability Assessment for Structural Engineers(New Directions in Civil Engineering)* by Mark Pavel, CRC press

**Suggested Reference Book(s):**

*Numerical Methods* by D. Dahlquist, and A. Bork, Dan Prentice-Hall.

**Other useful resource(s):** Link to NPTEL courses –

1. <https://nptel.ac.in/courses/105/105/105105043/>
2. <https://nptel.ac.in/courses/112/107/112107214/>
3. <https://nptel.ac.in/courses/115/103/115103114/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Throughout the Semester	Assignment (4) – 10 Quizzes(2)-10 (Best Score) Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course outcomes (Modelling, Simulation and Computer Applications)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	3	2	1	2	2	1	0	2	2	3	3	<b>2.00</b>
CO-2	2	3	2	1	1	2	1	2	2	0	3	2	<b>1.75</b>
CO-3	1	3	1	2	3	0	1	3	1	2	1	3	<b>1.75</b>
CO-4	2	2	2	1	2	1	1	0	3	0	3	2	<b>1.58</b>
<b>Average</b>	<b>2.00</b>	<b>2.75</b>	<b>1.75</b>	<b>1.25</b>	<b>2.00</b>	<b>1.25</b>	<b>1.00</b>	<b>1.25</b>	<b>2.00</b>	<b>1.00</b>	<b>2.50</b>	<b>2.50</b>	