West Bengal State Council of Technical & Vocational Education and Skill Development
(Technical Education Division)

Syllabus
of

Diploma in Civil Engineering [CE]

Part-III (5th Semester)

Revised 2022

CURRICULAR STRUCTURE FOR PART – IIIFIRST SEMESTER (FIFTH SEMESTER) OF THE FULL-TIME DIPLOMA COURSE IN CIVIL ENGINEERING

SL. NO.	SUBJECT CODE	SUBJECT OF STUDY	HOURS PER WEEK			CREDITS	Marks	Page No.
		THEORETICAL PAPERS	LECTURE	TUTORIAL	PRACTICAL			
1	CEPC501	Water Resource Engineering	2	0	0	2	100	
2	CEPC502	Estimating, Costing and Valuation	3	0	0	3	100	
		LABORATORY/SESSIONAL PAPERS						
3	CEPC503S	Design of RCC and Steel Structure Practices	0	0	2	1	100	
4	CEPC504S	Estimating, Costing and Valuation Practices	0	0	2	1	100	
5	CEPC505S	Water Resource Engineering Practices	0	0	2	1	100	
		ELECTIVE, PROJECT AND INTERNSHIP						
6	CEPE506	Elective - II: one subject out of Advanced Design of Structures (CEPE506/I) / Traffic Engineering (CEPE506/II)	3	0	0	3	100	
7	CEPE507	Elective - III: one subject out of Building Services and Maintenance (CEPE507/I) /Repair and Maintenance of of Structures (CEPE507/II)	3	0	0	3	100	
8	CEI508	Internship-II after fourth Semester	0	0	0	1	100	
9	CEPR509S	Major Project I	0	0	4	2	100	
10	CEPC510	Safety Engineering & Management in the Construction Sector	2	0	0	2	100	
		TOTAL	13	0	10	19	1000	

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Water Resource Engineering**	Course Code	**CEPC501**
Subject offered in Semester	Fifth	Number of Credits	2 (L:2, T: 0, P: 0)
Prerequisites	NIL	Course Category	**PC**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- To learn estimation of hydrological parameters.
- To understand water demand of crops and provisions to meet the same.
- To know planning of reservoirs and dams
- To design irrigation projects, canals and other diversion works.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III
Module C /Group C	Unit IV and V

Course Content:

Unit – I Introduction to Hydrology

- Hydrology: Definition and Hydrological cycle
- Rain Gauge: Symons rain gauge, automatic rain gauge
- Methods of calculating average rainfall: Arithmetic mean, Isohyetal, and Theissen polygon method.

- Runoff, concept of hydrograph, Factors affecting Run off, Computation of run–off [using runoff coefficient method]
- Maximum Flood Discharge measurement: Rational methods, Simple numerical problems.
- Simple numerical problems.

Unit– II Crop water requirement and Reservoir Planning

- Irrigation and its classification
- Crop Water requirement: Cropping seasons, Crop period, base period, Duty, Delta, CCA, GCA, intensity of irrigation, factors affecting duty, methods for improving duties, Problems on water requirement and capacity of canal, Kor irrigation, kor depth of water, kor period, paleo irrigation, capacity factor, outlet factor, time factor, cumec day, overlap allowance
- Methods of application of irrigation water, their merits and demerits, suitability
- Silting of reservoir, Rate of silting, factors affecting silting and control measures.
- Control levels and storage in reservoir - definition of different related technical terms explained with a neat sketch, Area capacity curve

Unit– III Dams and Spillways

- Dams and its classification: Earthen dams and Gravity dams (masonry and concrete)
- Earthen Dams – Components with function, typical cross section, seepage through embankment and foundation and its control.
- Methods of construction of earthen dam, types of failure of earthen dam and preventive measures.
- Gravity Dams – Forces acting on dam, Theoretical and practical profile, typical cross section, inspection gallery, drainage gallery, joints in gravity dam, concept of high dam and low dam.
- Spillways - Definition, function, location, types, spillway gates - types and function, Energy dissipaters and types.

Unit– IV Minor and Micro Irrigation

- Bandhara irrigation: Layout, components, construction and working, solid and open bandhara.
- Percolation Tanks – Need, selection of site.
- Lift irrigation Scheme - Components and their functions
- Drip and Sprinkler Irrigation- Need, components
- Well irrigation: types and yield of wells, advantages and disadvantages of well irrigation

Unit– V Diversion Head Works & Canals

Brief discourses on

- Weirs – components, parts, types only
- Diversion head works – Layout, components and their function.
- Barrages – components and their functions. Difference between weir and Barrage.
- Canals – Classification according to alignment and position in the canal network, Cross section of canal in embankment and cutting, partial embankment and cutting, balancing depth, Design of most economical canal section.
- Canal lining - Purpose, material used and its properties, advantages.
- Cross Drainage works - Aqueduct, siphon aqueduct, super passage, level crossing.
- Canal regulators - Head regulator, Cross regulator, Escape, Falls and Outlets

Suggested learning resources:

1. Punmia, B.C., Pande, B, Lal, Irrigation and Water Power Engineering, Laxmi Publications

2. Subramanayan, Engineering Hydrology, McGraw Hill.

3. Mutreja K N, Applied Hydrology, McGraw Hill

4. Sharma, R.K. and Sharma, T.K., Irrigation Engineering, S.Chand

5. Basak, N.N., Irrigation Engineering, McGraw Hill Education

6. Asawa, G.L., Irrigation and water resource Engineering, New Age

7. Dahigaonkar, J.G., Irrigation Engineering, Asian Book Pvt. Ltd., New Delhi.

8. Garg, S K, Irrigation and Hydraulic Structures, Khanna Publishers, Delhi.

9. Priyani V.B., Irrigation Engineering, Charotar Book Stall, Anand.

10. Relevant BIS codes

Course outcomes: After completing this course, student will be able to:

- ✓ Estimate hydrological parameters.
- ✓ Estimate crop water requirements of a command area and capacity of canals.
- ✓ Execute Minor and Micro Irrigation Schemes.
- ✓ Select the relevant Cross Drainage works for the specific site conditions.
- ✓ Design, construct and maintain simple irrigation regulatory structures

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Estimating, Costing and Valuation**	Course Code	**CEPC502**
Subject offered in Semester	Fifth	Number of Credits	3 (L:3, T: 0, P: 0)
Prerequisites	NIL	Course Category	**PC**
Question distribution	As per standing norms of WBSCT&VE&SD	Mark distribution	As per standing norms of WBSCT&VE&SD

Objective:- Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.
- To acquire knowledge on simple terms and concepts related to valuation

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III
Module C /Group C	Unit IV and V

Contents:

Unit – I Fundamentals of Estimating and Costing

- Estimating and Costing – Meaning, purpose, Administrative approval, Technical Sanction
- Types of estimates – Approximate and Detailed estimate.
- Types and Uses of Estimates: Revised estimate, Supplementary estimate, Repair and maintenance estimate, renovation estimate.

- Checklist of items in load bearing and framed structure.
- Standard formats of Measurement sheet, Abstract sheet, Face sheet.
- Modes of measurement and desired accuracy in measurements for different items of work as per IS:1200.
- Rules for deduction in different category of work as per IS:1200.
- Description / specification of items of building work as per PWD
- Approximateestimateforroads,culvert

Unit– II Approximate Estimates

- Approximate estimate- Definition, Purpose.
- Methods of approximate estimate - Service unit method, Plinth area rate method, Cubical content method, Approximate quantity method (with simple numerical)

Unit– III Detailed Estimate

- Detailed Estimate- Definition and Purpose, Data required for detailed estimate - Civil cost, GST, Contingencies, Supervision charges, Agency charges, Procedure for preparation of detailed estimate- Taking out quantities and Abstracting.
- Long wall and Short wall method, Centre line method – for building
- Bar bending schedule for footing, column, beam, Lintel, chajja and slab elements
- Provisions in detailed estimate: contingencies, work charged establishment, percentage charges, water supply and sanitary Charges and electrification charges etc.
- Prime cost, Provisional sum, Provisional quantities, Bill of quantities, Spot items or Site items.

Unit– IV Estimate for other Civil Engineering Works

- Earthwork - Quantities for roads, Embankment and canal by – Mid sectional area method, mean sectional area method, Prismoidal and trapezoidal formula method.
- Detailed estimate for septic tank, Community well.
- Case study – steel structure - industrial shed, chimney, transmission tower and like structure, frame and shutter of door window (wooden, steel)

Unit– V Rate Analysis and Valuation

- Rate Analysis: Definition, purpose and importance.
- Lead (Standard and Extra), lift, overhead charges, water charges and contractors' profit,
- Procedure for rate analysis.
- Task work- Definition, types. Task work of different skilled labour for different items.

- Categories of labours, their daily wages, types and number of labours for different items of work.
- Transportation charges of materials - Lead and Lift, Hire charges of machineries and equipments.
- Preparing rate analysis of different items of work pertaining to buildings and roads.
- Definition, purpose and importance of valuation.
- Factors affecting the value of a property. Simple definitions and concepts on scrap value, salvage value, market value, booked value, assessed value, sinking fund, depreciation,obsolescence.
- Different methods of valuation.

Suggested learning resources:

1. Chakraborti,M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.
2. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors Pvt. Ltd. New Delhi.
3. PWD Schedule of Rates.
4. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.
5. Peurifoy, Robert L. Oberlender, Garold, Estimating construction cost (fifth edition), McGraw Hill Education, New Delhi.
6. Rangwala,S.C., Estimating and Costing, Charotar Publishing House PVT. LTD., Anand.
7. Birdie,G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. New Delhi.
8. Patil,B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
9. Manual of Specifications and Standards for DBFOT projects, EPC works.

Course outcomes:

After completing this course, student will be able to:

- ✓ Select modes of measurements for different items of works.
- ✓ Prepare approximate estimate of a civil engineering works.
- ✓ Prepare detailed estimate of a civil engineering works.
- ✓ Justify rate for given items of work using rate analysis techniques.
- ✓ Acquire general ideas on valuation.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Design of R.C.C and Steel Structure Practices**	Course Code	**CEPC503S**
Subject offered in Semester	Fifth	Number of Credits	1 (L:0, T: 0, P: 2)
Prerequisites	NIL	Course Category	**PC**
Question distribution		Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

• To learn the concept of limit state design of tension and compression steel members.

• To understand design of steel beams.

• To learn the concept of limit state design of RCC beams.

• To know the limit state design of RCC columns.

List of Practical to be performed [application of CAD is mandatory]:

Sl no 6 to 11 is compulsory, one from 13 &14 is desirable and at least one from the rest

1	Draw any five commonly used rolled steel sections and five built up sections.
2	Summarize the provisions of IS 800 required for the design of a. tension member b. compression members c. flexural members in report form.
3	Draw sketches for a. single lacing b. double lacing and c. battening of a given built up columns.
4	Draw cross section, strain diagram & stress diagram for a. singly reinforced section and b. doubly reinforced section.
5	Draw sketches of different types of column footings.
6	Prepare a plan and draw sectional elevation showing reinforcement detailing in the longer and shorter direction of a single span [four edges discontinuous] for a. one way slab and b. two way slab
7	Prepare a plan and draw sectional elevations showing reinforcement detailing in the longer and shorter direction of two or more span of a two-way slab (having two adjacent edges discontinuous) inclusive of reinforcement for negative moment at support and torsional reinforcement where required.

8	Draw a sectional elevation showing reinforcement detailing of a beam having three span of unequal /equal length with cross section details at midspan and support
9	Prepare a plan and draw a sectional elevation showing reinforcement detailing for a typical isolated square footing having one column
10	Prepare a plan and draw a sectional elevation showing reinforcement detailing of a typical waist slab and landing for single flight of a dog-legged stair
11	Prepare a plan and draw a sectional elevation showing reinforcement detailing of a typical lintel with chajja
12	Interpret the actual RCC Structural Drawings used on site with reference to reinforcement details of various structural elements and Prepare a checklist for reinforcement provided from actual drawings used on site for various structural elements.
13	Prepare a detailed report of site visit for reinforcement detailing of structural elements like beams, columns, staircase & footing.
14	Prepare a detailed report of site visit for study of different elements of a bridge and roof truss

Suggested learning resources:

1. Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
2. Dayarathnam, P., Design of Steel Structures, S. Chand and Company, Delhi.
3. Subramanian N., Design of Steel Structures, Oxford University Press.
4. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
5. Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune,2014.
6. Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co., New Delhi.
7. Krishna Raju, and N.Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
8. Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill Publications, New Delhi.
9. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.

Course outcomes: After completing this course, student will be able to perform:

- Design of steel tension and compression member.
- Design of steel beams including check for shear.
- Design of singly and doubly reinforced RCC beam.
- Design of shear reinforcement in RC beams.
- Design of RCC column as per IS 456.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Estimating, Costing and Valuation Practices**	Course Code	**CEPC504S**
Subject offered in Semester	Fifth	Number of Credits	1 (L:0, T: 0, P: 2)
Prerequisites	NIL	Course Category	**PC**
Question distribution		Marks distribution	

Objective:- Following are the objectives of this course:

- To learn the procedure for estimating and costing of Civil Engineering works.
- To perform rate analysis for different items associated with construction projects.

List of Practical to be performed:

Application of spreadsheet is advised

SL no 6 to 11, 13 and 17 is compulsory and at least two from the rest

1	Prepare the list of items to be executed with units for detailed estimate of a given structure from the given drawing.
2	Prepare a report on market rates for given material, labour wages, hire charges of tools & equipment required to construct the given structure as mentioned in at Serial number 1 above.
3	Study of items with specification given in the PWD Schedule of Rates. (for any ten item)
4	Recording in Measurement Book (MB) for any four items
5	Prepare bill of quantities of given item from actual measurements. (any four items).
6	Prepare approximate estimate for the given civil engineering works for buildings, road and culvert.

7	Prepare detailed estimate from the given set of drawings using "standard measurement and abstract format" for (G+1), 2 BHK RCC framed structure Residential Building using description of item from PWD Schedule of Rates along with face sheet and prepare quarry chart, lead statement.
8	Prepare detailed estimate from the given set of drawings of Door(panelled door) and Window(partly glazed) - frame and shutter [wooden]
9	Calculate the reinforcement quantities from the given set of drawings for a room size of 3 m X 4 m with bar bending schedule (footing, column, beam, lintel with chajja, slab)
10	Prepare rate analysis for the given five item of works.
11	Prepare detailed estimate of road of one kilometre length from the given drawing.
12	Prepare detailed estimate of small Septic tank from the given set of drawings.
13	Prepare detailed estimate of Tube well with Hand pump from the given set of drawing.
14	Assess the valuation of an old building from the given drawing by any one method.
15	Prepare detailed estimate for a two lane bituminous road and culvert (slab type)
16	methods of stack measurement at site for stone chips etc
17	Prepare detailed estimate of steel roof truss

Suggested learning resources:

1. Chakraborti,M., Estimating and costing, specification and valuation in civil engineering, Monojit Chakraborti, Kolkata.
2. Datta, B.N., Estimating and Costing in Civil engineering, UBS Publishers Distributors Pvt. Ltd. New Delhi.
3. PWD Schedule of Rates.
4. Ministry of Road Transport and Highways (MORT&H) Specifications and Analysis of Schedule of Rates.
5. Peurifoy,Robert L. Oberlender,Garold, Estimating construction cost (fifth edition), McGraw Hill Education, New Delhi.
6. Rangwala,S.C., Estimating and Costing, Charotar Publishing House PVT. LTD., Anand.

7. Birdie,G.S., Estimating and Costing, Dhanpat Rai Publishing Company(P) Ltd. New Delhi.
8. Patil,B.S., Civil Engineering Contracts and Estimates, Orient Longman, Mumbai.
9. Manual of Specifications and Standards for DBFOT projects, EPC works.

Course outcomes: After completing this course, student will be able to:

- Select modes of measurements for different items of works.
- Prepare approximate estimate of a civil engineering works.
- Prepare detailed estimate of a civil engineering works.
- Justify rate for given items of work using rate analysis techniques.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Water Resource Engineering Practices**	Course Code	**CEPC505S**
Subject offered in Semester	Fifth	Number of Credits	1 (L:0, T: 0, P: 2)
Prerequisites	NIL	Course Category	**PC**
Question distribution		Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- To learn estimation of hydrological parameters.
- To understand water demand of crops and provisions to meet the same.
- To know planning of reservoirs and dams.
- To get acquainted with irrigation projects, canals and other diversion works.

List of Practical to be performed:

Sl no 1 to 6 mandatory, at least one from Sl no 7-11 and at least one from the rest

1.	Calculate average rainfall for the given area using isohyetal, Theissen polygon method [only simple cases]
2.	Compute the yield of the Catchment area demarcated in the previous problem
3.	Delineation of contributory area for the given outlet from the given toposheet
4.	Estimate water requirement of crops in different season from data provided by the subject teacher.
5.	Estimate capacity of the canal for the data provided by the subject teacher.
6.	Calculate reservoir capacity from the data provided by the subject teacher.
7.	Draw a neat sketch showing different control levels and storage for a reservoir.

8.	Draw a labeled sketch of the given different types of earthen dam section
9.	Draw the theoretical and practical profile of the given high type gravity dam section.
10.	Draw a labeled sketch of the given diversion head works and Cross Drainage works.
11.	Draw a labeled sketch of a canal section - a. in partly cutting and partly filling b. fully in cutting c. fully in filling.
12.	Prepare a presentation on the technical details of any one micro or minor irrigation scheme.
13.	Prepare a model of any irrigation structure using suitable material.
14.	Prepare summary of the technical details of any existing water resource project in West Bengal

Course outcomes: After completing this course, student will be able to:

- Estimate hydrological parameters.
- Estimate crop water requirements of a command area and capacity of canals.
- Understand Minor and Micro Irrigation Schemes.
- Select relevant Cross Drainage works for the specific site conditions.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Elective - II: Advanced Design of Structures**	Course Code	**CEPE506/I**
Subject offered in Semester	Fifth	Number of Credits	3(L:3, T: 0, P: 0)
Prerequisites	NIL	Course Category	**PE**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- To analyze T and L shaped beam sections.
- To understand the concept for design of one way and two way slabs.
- To identify short and long columns and their design provisions.
- To understand the concepts involved in the design of bolted and welded connections.
- To know the provisions of BIS code for design of built up sections.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III
Module C /Group C	Unit IV and V

Course Content:

Unit 1: **Design of Concrete Slab (LSM)**

- Design and detailing of simply supported one-way slabs for flexure, check for deflection control, and shear.
- Design and detailing of one-way cantilever slabs and cantilevers chajjas for flexure, check for deflection control and check for development length and shear.

- Design and detailing of two-way simply supported slabs for flexure with corner free to lift.
- Design and detailing of dog-legged stair.
- Simple numerical problems on design of one-way simply supported slabs, cantilever slab, two-way simply supported slab, waist slab and landing slab of a dog-legged stair.

Unit 2: Design of Axially Loaded Concrete Column and Footing (LSM)

- Assumptions in limit state of collapse – compression
- Definition and classification of columns, effective length of column. Specification for minimum reinforcement; cover, maximum reinforcement, number of bars in rectangular, square and circular sections, diameter and spacing of lateral ties.
- Analysis and design of axially loaded short, square, rectangular and circular columns with lateral ties only; check for short column and check for minimum eccentricity may be applied.
- Types of footing, Design of isolated square footing of uniform thickness for flexure, and shear.
- Simple numerical problems on the design of axially loaded short columns and isolated square footing.

Unit-3 Design of Steel Tension Members and Compression Members by L.S.M

- Tension Members - introduction and different provision of relevant code, Design Strength of Tension members against yielding of gross section requirements: Deflection limits, Vibration, Durability and Fire resistance against rupture of critical section and due to block shear. Problems on determination of design strength of given members and designing tension members using rolled steel sections for given loads.
- Compression Members - Effective Length and Effective Sectional Area of Compression members, Design Stress and design strength – Buckling Class of cross sections– Imperfection factor– Stress reduction factor– Thickness of elements.
- Analysis and design of axially loaded column.
- Introduction to lacing and battening (No numerical problem on Lacing and Battening).

Unit- 4 Column Bases by L.S.M

- Slab base and Gusseted base – Code Provisions (IS:800-2007) – Minimum thickness and Effective Area of Base plate.
- Design of Slab base for axially loaded columns using bolts /welds.
- Introduction to Gusseted base(no numerical problems on gusseted Base).

Unit- 5 Steel Roof Truss

- Types of steel roof truss & its selection criteria.
- Calculation of panel point load for Dead load; Live load and wind load as per I.S. 875-1987.
- Analysis and Design of steel roof truss. Design of Angle purlin as per I. S. Arrangement of members at supports.

Suggested learning resources:

1. Shah, V. L., and Gore, V., Limit State Design of Steel Structures, Structures Publications, Pune.
2. Subramanian N., Design of Steel Structures, Oxford University Press.
3. Sairam, K.S., Design of Steel Structures, Pearson Publication, Chennai, Delhi.
4. Shah, V. L., and Karve, S.R., Limit State Theory and Design of Reinforced Concrete Structures, Structures Publications, Pune.
5. Sinha N.C., and Roy S.K., Fundamentals of Reinforced Concrete, S. Chand & Co.,
6. Krishna Raju, and N.Pranesh, R.N., Reinforced Concrete Design Principles and Practice, New Age International, Mumbai.
7. Pillai, S.U., and Menon, Devdas, Reinforced concrete Design, McGraw Hill
8. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice Hall India Learning Private Limited, Delhi.
9. Subramanian N., Design of Reinforced Concrete Structures, Oxford University Press.
10. Dr. N. R. Chandak, Design of Steel Structure, S.K.Kataria & Sons.

Course outcomes: After completing this course, student will be able to perform:

- Design of R.C.C one way, two way and waist slab
- Design of R.C.C axially loaded short column and isolated column footing
- Design of steel tension member, compression member and column base by limit state method
- Design of steel roof truss

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Elective – II: Traffic Engineering**	Course Code	**CEPE506/II**
Subject offered in Semester	**Fifth**	Number of Credits	**3(L:3, T: 0, P: 0)**
Prerequisites	NIL	Course Category	**PE**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Objective:- Following are the objectives of this course:

- To understand the issues involved in traffic flow.
- To know and understand the tools for traffic studies.
- To delineate various traffic control measures.
- To understand measures for preventing accidents.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III and V
Module C /Group C	Unit IV

Contents:

Unit – I: Fundamentals of Traffic Engineering.

- Traffic engineering- Definition, objects, scope
- Relationship between speed, volume and density of traffic
- Road user's characteristics- physical, mental, emotional factors.
- Vehicular characteristics-width, length, height, weight, speed, efficiency of breaks.

- Road characteristics - gradient, curve of a road, design speed, friction between road and tyre surface.
- Reaction time - factors affecting reaction time. PIEV Theory.

Unit– II: Traffic Studies

- Traffic volume count data - representation and analysis of data.
- Necessity of Origin and Destination study and its methods.
- Speed studies - Spot speed studies, and its presentation.
- Need and method of parking study.

Unit– III: Road Signs and Traffic Markings

- Traffic control devices –definition, necessity, types.
- Road signs - definition, objects of road signs.
- Classification as per IRC: 67- Mandatory or Regulatory, Cautionary or warning, informatory signs, Location of cautionary or warning sign in urban and non-urban areas, Points to be considered while designing and erecting road signs.
- Traffic markings- definition, classification, carriage way, kerb, object marking and reflector markers.

Unit– IV Traffic Signals and Traffic Islands

- Traffic signals- Definition, Types, Traffic control signals, pedestrian signals.
- Types of traffic control signals - Fixed time, manually operated, traffic actuated signals andlocation of signals.
- Compute signal time by fix time cycle, Webster's and IRC method and sketch timing diagramfor each phase.
- Conflict points
- Traffic islands –Definition, advantages and disadvantages of providing islands.
- Types of traffic islands - rotary or central, channelizing or Refuge Island.
- Road intersections or junctions - Definition, Types of road intersection.
- Intersection at grade- Types, basic requirements of good intersection at grade.
- Grade separated intersection- advantages and disadvantages, types - flyovers-partial andfull Cloverleaf pattern, Diamond intersection, Trumpet type, underpass.

Unit– V Road Accident Studies and Arboriculture

- Road Accidents-Definition, types and causes for collision and non-collision accidents.
- Measures to prevent road accidents.

- Collision and condition diagram.
- Street lighting –definition, necessity, types-luminaire, foot candle, lumen, factors affectingtheir utilization and maintenance.
- Arboriculture- definition, objectives, factors affecting selection of type of trees.
- Maintenance of trees - protection and care of road side trees.

Suggested learning resources:

- Khanna S.K., Justo, C E G and Veeraragavan, A., Highway Engineering, Nem Chand and Brothers, Roorkee.
- Kadiyali L.R., Transportation Engineering, Khanna Book Publishing Co., Delhi
- Vazirani, V N , Chaondola, S P, Transportation Engineering Vol. I & II, Khanna Publishers. Delhi.
- Saxena, S C, Traffic planning and design, Dhanpat Rai & Sons Delhi.
- Kumar R S, Introduction to Traffic Engineering, University Press (India), Pvt. Ltd.
- Dr. Sharma, S. K., Principles, Practices and Design of Highway Engineering , S. Chand &Company Ltd., New Delhi

Course outcomes: After completing this course, student will be able to:

- Analyze road traffic characteristics.
- Undertake various types of road traffic studies.
- Use relevant road traffic signs, signal and markings.
- Identify the intersection depending on the traffic flow.
- Suggest preventive measures to avoid accidents by analyzing the traffic conditions at site.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Elective - III : Building Services and Maintenance**	Course Code	**CEPE507/I**
Subject offered in Semester	Fifth	Number of Credits	3(L:3, T: 0, P: 0)
Prerequisites	NIL	Course Category	**PE**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives:

Following are the objectives of this course:

- To know the procedure for classifying various types of buildingservices.
- To know the fire safety requirements for multi-storeyedbuilding.
- To devise suitable plumbing system for given type ofbuilding.
- To understand the procedure for rain water harvesting and solar waterheater.
- Toknowthesystemfordesigninglighting,ventilationandacousticsforanybuilding.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III and V
Module C /Group C	Unit IV

Course Content:

Unit – I Overview of Building Services

- Introduction to building services, Classification of buildings as per National Building code, Necessity of building services, Functional requirements of building, Different types of buildingservice-si.e.HVAC(Heat,VentilationandAirConditioning),Escalatorsandlifts,firesafety, protectionandcontrol,plumbingservices,rainwaterharvesting,solarwaterheatingsystem, lighting, lightening proof arrangement in building, acoustics, sound insulation and electric installationetc.
- Role and responsibility of Building Service Engineers and Plumbers, licensing of a plumber, Introduction to BMS (Building Management Services), Role of BMS, concept of smart building.

Unit– II Modes of vertical communication

- Objectives and modes of vertical communication inbuilding.
- Lifts**:**Differenttypesofliftsanditsuses,ComponentpartsofLift-LiftWell,Travel,Pit,Hoist Way, Machine, Buffer, Door Locks, Suspended Rope, Lift Car, Landing Door, Call Indicators, EmergencyCall Push, machine roometc., Design provisions for basic size calculation of space enclosure to accommodate lift services, number of required lifts in multi-storeyed apartment, Safetymeasures.
- Escalators**:** Different Types of Escalators and its Uses, Components of escalators, Design provisions for basic size calculation of space enclosure to accommodate escalator services, Safetymeasures.
- Ramp: Necessity, design consideration, gradient calculation, layout and Special features required for physically handicapped andelderly,safety measures.

Unit– III Fire Safety

- Fire protection requirements for multi-storeyed building, causes of fire in building, Fire detecting and various extinguishing systems, Working principles of various fire protection systems.
- Safety against fire in residential and public buildings (cinema hall, theatrehall,

mall and other multi-storeyed buildings), National Building Code provision for fire safety, Fire resisting materials and their properties, Fire resistant construction, procedures for carrying out fire safety inspections of existing buildings, Provisions forevacuation.

Unit– IV Plumbing Services

- Importanceofplumbing,AHJ(AuthorityHavingJurisdiction)approval,PlumbingTerminology and fixtures: Terms used in plumbing, Different types of plumbing fixtures, shapes/ sizes, capacities, situation and usage, Traps,Interceptors.
- System of plumbing for building water supply: storage of water, hot and cold water supply system.
- System of plumbing for building drainage: Types of drainage system such as two pipe system, one pipe system, types of Vents and purpose of venting, Concept of grey water and reclaimedwater, maintenance of building drainage.
- Different types of pipes, common joints and valves, materials, and jointing methods, fittings, hanger, supports and valves usedin plumbing and their suitability.

Unit– V Lighting, Ventilation and Acoustics

- Concept of SWH (Solar water heating), component parts of SWH, various system of SWH (heat transfer, propulsion, passive direct system, active direct system, Do-it-yourself), installation andmaintenance.
- Concept of lighting, types of lighting (natural and artificial), factors influencing the brightness of room, factors affecting selection of artificial lighting, installation of light (direct, half-direct,indirect,half-indirectanddirect-indirect),typesoflightcontrol(manualswitch, one way and two way switch, remote switch, timer switch and photo-electric cell switch), typesof lamps(incandescent,tungstenhalogenandelectricdischarge),Lampselectionasperroom sizes.
- Concept of ventilation, necessity and Types ofventilation.
- Building Acoustic, Objectives, acoustic Control in a building, acoustic material (porous absorber and cavityresonator), factors to be considered in acoustic design

of cinema halls and auditoriums.

Suggested learning resources:

1. Patil, S. M., Building Services, Seema Publication,Mumbai.

2. MantriandSan-deep.,TheAtoZofPracticalBuildingConstructionanditsManagement,Satya Prakashan, NewDelhi**.**

3. Bag S P, Fire Services in India: History, Detection, Protection, Management, Mittal Publications, NewDelhi.

4. Deolalikar,S. G., Plumbing Design and Practice,McGraw-Hill,

5. AkhilKumar-Das.,PrinciplesofFireSafetyEngineering:UnderstandingFireandFireProtection, PHI Learning Pvt. Ltd, NewDelhi.

6. Shraman N L, Solar panel installation guide & user manual**,** The Memory Guru ofIndia.

7. Gupta M K, Practical handbook on building maintenance - Civil works, Nabhi-Publications.

8. BIS., National Building Code Part1, 4, 8, 9., Bureau of Indian Standard, NewDelhi

9. BIS., IS 12183(Part 1):1987 Code of practice for plumbing in multistoried buildings., Bureau of Indian Standard, NewDelhi

10. BIS., 2008 Uniform Plumbing Code – India (UPC- I)., Bureau of IndianStandard

Course outcomes:

After completing this course, student will be able to:

- Classify various types of building services as per functionalrequirements.
- Propose the fire safety requirements for multi-storeyedbuilding.
- Devise suitable water supply and sanitation system for given type ofbuilding.
- Evaluate the potential of rain water harvesting and solar water heater system for the given type ofbuilding.
- Justify the necessity of designing the system of lighting, ventilation and acoustics for the given type ofbuilding.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Elective - III : Repair and Maintenance of Structures**	Course Code	**(CEPE507/II)**
Subject offered in Semester	Fifth	Number of Credits	3 (L:3, T: 0, P:0)
Prerequisites	NIL	Course Category	**PE**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- To learn about types of maintenance techniques
- To understand causes of various types of damages.
- To know about relevant materials for repair.
- To learn methods of retrofitting for different structures.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III and V
Module C /Group C	Unit IV

Course Content:

Unit – I Basics of maintenance

•Types of Maintenances - repair, retrofitting, re-strengthening, rehabilitation and restoration.

• Necessity, objectives and importance of maintenance.

•Approach of effective management for maintenance.

•Periodical maintenance: check list, maintenance manual containing building plan, reinforcement details, material sources, maintenance frequency, corrective maintenance procedures and sources. Pre- and post- monsoon maintenance.

Unit– II Causes and detection of damages

•Causes of damages due to distress, earthquake, wind, flood, dampness, corrosion, fire, deterioration, termites, pollution and foundation settlement.

•Various aspects of visual observations for detection of damages.

•Load test and non-destructive tests (brief description). NDT tests on damaged structure such as rebound hammer, ultrasonic pulse velocity, rebar locator, crack detection microscope, digital crack measuring gauge.

•Chemical test - Chloride test, sulphate attack, carbonation test, pH measurement, resistivity method, Half-cell potential meter (Introduction and demonstration only).

Unit– III Materials for maintenance and repairs

•Types of repair material, material selection.

•Essential parameters for maintenance and repair materials such - bond with substrate, durability.

•Waterproofing materials based on polymer modified cement slurry, UV resistant acrylic polymer, ferro-cement.

•Repairing materials for masonry: plastic/aluminum nipples, non-shrink cement, polyester putty or 1:3 cement sand mortar, galvanized steel wire fabrics and clamping rods, wire nails, ferro-cement plates.

•Repairing materials for RCC: epoxy resins, epoxy mortar, cement mortar impregnated with polypropylene, silicon, polymer concrete composites, sealants, fiber reinforcement concrete, emulsions and paints.

Unit– IV Maintenance and repair methods for masonry Construction

•Causes of cracks in walls - bulging of wall, shrinkage, bonding, shear, tensile, vegetation.

•Probable crack location: junction of main and cross wall, junction of slab and wall, cracks in masonry joints.

•Repair methods based on crack type - For minor & medium cracks (width 0.5 mm to 5mm): grouting and for major cracks (width more than 5mm): fixing mesh across cracks, RCC band, installing ferro-cement plates at corners, dowel bars, propping of load bearing.

•Remedial measures for dampness & efflorescence in wall.

Unit– V Maintenance and repair methods for RCC Construction

- Repair stages such as concrete removal and surface preparation, fixing suitable formwork, bonding/passive coat and repair application, various methods of surface preparation

- Repair options such as grouting, patch repairs, carbonated concrete, cleaning the corroded steel, concrete overlays, latex concrete, epoxy bonded mortar and concrete, polymer concrete, corrosion protection such as jacketing.
- Building cracks and its prevention, common methods for dormant crack repairs such as Epoxy injection, grooving and sealing, stitching, grouting, guniting, shotcreting
- Strengthening methods for live cracks such as addition of reinforcements, Jacketing, brackets, collars, supplementary members i.e. shoring, underpinning and propping of framed structure.

Suggested learning resources:

1. Gahlot, P. S., Sharma, S., Building Repair and Maintenance Management, CBS Publishers & Distributors Pvt. Ltd., New Delhi
2. Guha, P. K., Maintenance and Repairs of Buildings, New Central Book Agencies
3. Hutchin Son, B. D., Maintenance and Repairs of Buildings, Newnes-Butterworth
4. Relevant BIS codes
5. CPWD Maintenance Manual 2012

Course outcomes: After completing this course, student will be able to:

•Decide which type of maintenance is needed for a given damaged structure

•Assess causes of damages various types of structures.• Select the relevant material for repair of the given structure.

•Apply relevant method of retrofitting for re-strengthening of structures.

•Suggest relevant technique to restore the damages of the given structural elements

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Internship-II after fourth Semester**	Course Code	**CEI508**
Subject offered in Semester	**Fifth**	Number of Credits	**1 (L:0, T: 0, P: 0)**
Prerequisites	NIL	Course Category	**I**
Question distribution		Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- To participate in industrial environment and Civil Engineering activities.
- To study on supervision of field level works.
- To work part of working drawings.
- To be involved with online courses.

NOTE: Activity(s) from the following has to be performed and prepare a report on the activity together with presentation before the subject teacher.

Activities may be arranged by the West Bengal State Council of Technical and Vocational Education & Skill Development.

Board of Practical Studies, MSME or Department of Small Scale Industries or other engineering department of State Government may be involved. Initiative from the Department of Technical Education, Training and Skill Development is highly solicited.

Activities centering Private organization in the arena of civil engineering construction/ planning and design/ supervision/marketing etc may also be considered.

It may be arranged in-campus or off-campus; online or offline mode or blended mode.

Activities may be conducted continuously for stipulated period of time or may be arranged in a staggered fashion – in the later case Saturday and Sunday may be utilized for the Internship Program and accordingly class schedule will have be to arranged.

Activities may be performed by a group of students or may be done by individually under the guidance of subject teacher(s)

At least one activity has to be performed:

1	To participate and study site layout, excavation of sites, masonry works, concreting or any other field level construction activities at site.
2	To study and observe on Soil Testing and prepare Report required for multi-storey building construction or any other Civil Engineering Construction Project.
3	To visit Civil Engineering consultancy-cum-design office, study and get brief idea about Staad-Pro or any other design or civil engineering software.
4	To visit company related to workshop oriented or fabrication jobs and get brief ideas on these.
5	To be accustomed with Massive open online courses (Moocs) under Swayam Platform; register and study on course selected by Civil Engineering Faculty of the Institute for duration as fixed by WBSCTVESD. NO certificate to be produced during internal or external sessional examination. Only knowledge student can gather will be judged and evaluated accrodingly.
6	To undertake any other suitable training or Internship programme selected by Civil Engineering Faculty of the Institute for duration as fixed by WBSCTVESD

After completion of each internship, the student should prepare a comprehensive report to indicate what he/she has observed and learnt in the training period. The student may contact Industrial supervisor/Faculty member/TPO for assigning topics and problems and should prepare the final report on assigned topics. The training report should be signed by the Industrial supervisor/Internship Faculty member, TPO and HOD.

The internship report will be evaluated on the basis of following criteria (as applicable):

Sl no	Criteria for evaluation of Internship Report
1	Origianlity
2	Adequacy and purposeful writeup
3	Orgainizaton, format, drawing,sketches style language
4	Practical applications and relationship with basic

	theory
5	Concepts taught in the course outcomes
6	Attendance record, daily diary,quality of the internship report

Seminars must be arranged for the students based on his/her training report, before an internal committee constituted by the concerned department of the institute. The evaluation will be based on the following criteria:

Sl no	Criteria for evaluation of Internship Report
1	Quality of content presented
2	Proper planning for presentation
3	Effectiveness of presentation
4	Depth of knowledge and skills
5	Viva voce

Course outcomes: After completing this course, student will be able to:

- Understand the brief knowledge of industrial activities.
- Perform online courses under Moocs or other courses.
- Project the industrial activities with his/her different courses of Diploma in Civil Engineering.

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Major Project I**	Course Code	**CEPR509S**
Subject offered in Semester	**Fifth**	Number of Credits	**2 (L:0, T: 0, P: 4)**
Prerequisites	NIL	Course Category	PR
Question distribution		Marks distribution	As per standing norms of WBSCT&VE&SD

Objective: - Following are the objectives of this course:

- To collect the information for a given project.
- To apply principles, theorems and bye-laws in the project planning and design.
- To interpret and analyze the data.
- To develop professional abilities such as persuasion, confidence, and perseverance and communication skill.
- To develop presentation skill.
- To enhance creative thinking.

The project report shall be in the following format:

(The project shall be undertaken by a group of 4 to 6 students)

- Topic and objectives
- Collection of data, required survey work,
- Management and construction procedure
- Resources scheduling and networking
- Design details
- Required drawing set
- Utility to society if any
- Conclusion

NOTE: Same Planning, Drawings and detailing of the problem given in the semester 4 will have be used in Major Project I and Major Project II in semester 5 and 6. All draw-

ing will be done using CAD.

Contents:-

- Title of the Project:-Planning and designing of (G+2) Residential Complex for Middle Income Group.
- The details of the Project are given below:-

(Same topic from the 4th semester shall be considered)

- Each building (RCC framed structure) shall comprise of two symmetrical flat per floor each containing two rooms, bath, WC, kitchen, front verandah with a provision of common staircase and mumty for utilization of roof space and overhead water tank (around 210 sq m. covered area for each building unit and total 100 Nos of flat in the Complex of around 10000 sq m. of total land area) Ground floor to be used for parking spaces.
- The following provisions are to be considered during the project planning:- a) Security room(Single room with WC, Load bearing wall structure), b) Central Park, c) Play Ground, d) Hume Pipe Culvert in between the complex and the 12m wide main road, e) Boundary Wall with main gate, f) Submersible Pump, g) Pump House (Load bearing wall structure), h) Surface Drainage System, i) Bituminous road over WBM inside the complex etc.

The project report shall include:-

1) Load calculation & design of all structural components, structural details – reinforcement of: floor slab (as a whole), critical beam, central column and corner column including footing (Drawing of trench plan), tie beam(tie beam layout plan, and reinforcement detailing), stair with landing etc.

2) Details structural drawing of

a. RCC footing, Column, Beam, Lintel and chajja, staircase – landing slab and waist slab, stringer beam etc., floor slab and roof slab

b. drawing of various types of doors and windows etc. used in construction

3) Prepare bar bending schedule and determine cutting length of all structural items of workshop

4) Prepare a design mix for the project

5) Specification of different items of works

Course outcomes: After completing this course, student will be able to:

- **Design various structural members of the building.**
- **Prepare the drawing and detailing of project by using various drafting softwares**.
- Prepare bar bending schedule of an items of works
- Write specifications for different items of works.
- **Solve the problem by working in a group.**

Name of the Course	**Diploma in Civil Engineering**	Course duration	6 semester
Course Title	**Safety Engineering & Management in the Construction Sector**	Course Code	**CEPC510**
Subject offered in Semester	**Fifth**	Number of Credits	2 (L:2, T: 0, P: 0)
Prerequisites	NIL	Course Category	**PC**
Question distribution	As per standing norms of WBSCT&VE&SD	Marks distribution	As per standing norms of WBSCT&VE&SD

Course Objectives: Following are the objectives of this course:

- to be able to comprehend the various safety guidelines applicable for different construction industries
- to be able to understand various hazard and contaminant discharges related to various construction industries
- to be able to plan and implement effective control measures to prevent health hazards, accident and unwanted contaminant discharge from different construction industries.

Module /Group [as per directives from WBSCT&VE&SD in framing questions of end semester]	**Distribution of unit**
Module A/Group A	Unit I and II
Module B/Group B	Unit III
Module C /Group C	Unit IV and V

Course Content:

Unit 1: Safety Philosophy:

Physical, Physiological and Psychological Factors of Safety. Safety Education and Training. Employees Participation in Safety. Economics of Safety. Behavioral Safety culture and motivation. Safety Laws: Provisions of Factories Act and Rules, Employees State Insurance Act.

Unit 2:Safety Management system & Guidelines:

Key elements of Safety Management system & Guidelines (ISO 14001, ISO 45001:2018/OHSAS 18001 etc.), ILO Legislation – Convention and Recommendation concerning Safety, Health and Environment – Safety, Health and Environment as Human Right Issue, Awareness programme, types of occupational health hazards in industries, physical, chemical, biological, mechanical and psychological hazards, common work related or occupational diseases, occupations involving risk of contracting these diseases, mode of causation of the diseases and its effect, diagnostic methods, methods of prevention, notifiable occupational diseases, compensation for occupational diseases, evaluation of injuries, medical services in an industrial establishment and its functions, occupational health audit and survey, occupational diseases relating to construction work, emergency medical treatment of injuries and rehabilitation at construction site. Personal protective equipment Introduction and requirements and assessment of PPE, type of PPE. Non respiratory personal protective devices: head protection, ear protection, face and eye protection, hand protection, feet protection, body protection. Supply, use, care and maintenance of personal protective equipment. Requirements under Factories Acts and Rules. Respiratory personal protective devices, Classification of hazards, classification of respiratory personal protective devices, selection of respirators, instructions and hints in the use of breathing apparatus, supply, use, care and maintenance of breathing apparatus, training in the use of breathing apparatus.

Unit 3: Safety in Construction and Demolition Operation:

a. Safety in Conventional Construction Operations: Underground works, above ground works, underwater portions, movements of construction machinery, special works, safety in use of explosives. Safety in stacking, storage and transport of construction materials: reinforcements, cement, sand, aggregates, chemicals, organic binders, gas cylinders. Safety in use of construction machinery and equipment: batching plant, mixers, earth moving equipment, cranes, pile driving equipment, excavators, drilling equipment, welding equipment, gas cutting equipment, grinding equipment, derricks, compressors, crushers, layers.

b. Safety in Special Construction Operations: Transmission towers, railways, power plants, transformer installations. Working at heights and prevention of falls of persons: high incidence of serious accidents in working at heights, types of operations, planning operations, safety features associated with construction, design and use of gangways, floors, ladders of different types, scaffolds of different types, other safety requirements while working at height, prevention of falls at floor level.

Potential tripping, slipping hazards. Precautions from falling of materials. Laws and Regulations – Relevant Provisions of Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act and Rules – National Building Codes.

Unit 4: Hygiene Concept, definition and importance of hygiene in construction industry:
Difference between domestic hygiene and industrial hygiene. Physical hazards – heat stress and its control, ventilation, noise, vibration, illumination, thermal radiation, X rays, ultra violet radiation, ionizing and non-ionizing radiations, sensitization to different air, water and waste water, soil contaminant related to construction industries, permissible exposure limits, effects of exposure, preventive and control measures.

Unit 5: Strategic management and planning for prevention and control of contaminant discharge from process operation in construction industries:
sensitization to different process operation in different construction industries, identification of sources of contamination and hazards, planning for control and prevention, implementation through proper measures, planning for control and prevention, safety audits, non compliance reports, turn around time for post audit compliance and implementation through proper measures.

Reference books:

- ISO 14001
- ISO 45001:2018/OHSAS 18001
- ILO Legislation
- Jha, N. Kumar, Patel, Dilip A, Singh Amarjit, Cosntruction Safety Management, Pearson India Education Seervices Pvt. Ltd, Noida, UP.
- Haldar, S.K., Occupational Health & Hygiene in Industry, CBS Publishers
- Das, Akhil Kumar, Principles of Industrial Safety Management by, PHI

Course outcomes: After completing this course, student will be able to:

- understand the basic tenets of safety engineering
- interpret the existing safety engineering guidelines and recommendations
- identify various safety requirements in conventional and special construction and associated demolition sectors.
- Understand hygiene and safety associated with construction industries
- analyze the problems related to safety hazard and contaminant discharge from construction industries and to suggest remedial measures.