

Course No.	Course Title	L	T	P/D	Hours	Credit
CED-421	Structural Design – III (R.C.C)	3	1	0	4	3

Special beams:

- i. **Combined Shear, Bending and Torsion:** Design of beam for torsion combined with flexure and shear
- ii. **Deep beam:** minimum thickness, Design of Deep Beam.

Design of Walls:

- i. **Design of shear wall:** Classification, loads, design of rectangular and flanged shear walls
- ii. **Retaining wall:** Cantilever retaining wall and Counterfort retaining wall.

Design of Storage Structures:

- i. **Design of water tanks:** Analysis of beams curved in plan, design of R.C.C. rectangular and circular water tanks resting on ground, design of underground tanks, design of overhead water tanks.
- ii. **Bunkers and Silos:** Necessity of Bunkers and Silos, design of square/rectangular and circular bunkers, design of Silos, silo for storage cement.
- iii. **Cooling tower:** analysis and design of Cooling tower components.

Chimneys: design factors, load combinations, various stress, and design of chimneys.

Analysis and Design of Prestressed Structures: Introduction to Prestressed Concrete, Methods, Losses, Analysis and Design of Prestressed Rectangular & Flanged Beam by Stress Methods only.

Yield Line Theory of Slab for Analysis and Design: Virtual work method and Equilibrium method slab with different end conditions.

Books:

- 1) N.KrishnaRaju, Advanced Reinforced Concrete Design, CBS.
- 2) B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Reinforced Concrete Structures Vol -II, Laxmi.
- 3) V.N.Vazirani & M.M.Ratwani, Concrete Structures, Khanna Publishers.
- 4) Varghese, P.C.: Advanced Reinforced Concrete Design, Prentice-Hall, New Delhi.
- 5) B.C.Punmia, Ashok Kumar Jain & Arun Kumar Jain, Limited State Design of Reinforced Concrete Structures, Laxmi
- 6) S.S.Bhavikatti, Advanced R.C.C Design (R.C.C. Vol-II), New Age
- 7) S.N.Sinha, Reinforced Concrete Design, Tata Mcgraw Hill Education
- 8) IS456 2000: Code of Practice for Plain and Reinforced Concrete
- 9) T.Y. Lin, Design of Prestressed Concrete
- 10) Krishna, Raju N., Prestressed concrete, Tata McGraw Hill, New Delhi
- 11) Rajagopalan, N., Prestressed concrete, Narosa Publishing House, New Delhi
- 12) Standard Specifications and code of Practice for PSC.

Course No.	Course Title	L	T	P/D	Hours	Credit
CED-422	Bridge Engineering & Tunneling	3	1	0	4	3

Introduction: Definitions, components of a bridge, classification, importance and Site Selection, water way.

Investigation for bridge: Site selection, data drawing, design discharge linear water way, economical span, location of piers and abutments, vertical clearance above HFL scour depth. Traffic projection, investigation report choice of bridge type, selection of Bridge cross-section and longitudinal form, Characteristics of each type.

Introduction and Standard Specifications for Road and Railway bridges: Introduction to bridge codes, Various Loads to be considered for the Design of Road and Railway bridge; General design consideration; Traffic aspects.

Bridge Superstructures Design:

- ✓ **Culverts:** Design of R.C.C slab culvert (Design of deck slab), Pipe culvert and Box culvert based on variety of IRC vehicle loading.
- ✓ **RC Slab and Tee Girder Bridges:** Design of solid deck slab, Longitudinal beam and Cross beam based on variety of IRC vehicle loading; Load distribution using Courbon's method, Orthotropic Plate theory, Morice & Little method of load distribution, Hendry-Jaegar method and Pigeaud's Method of panel design
- ✓ **Non-Composite Bridges(Steel bridges):**
 - *Masonry Bridge:* Design of Brick (or) Stone masonry arch bridges.
 - *Steel Trussed Bridge:* Design of Pratt type truss girder highway bridges – Design of top chord, bottom chord, web members – Effect of repeated loading.
 - *Steel Plate Girder Bridge-* Design of Plate girder railway bridges for railway loading; Wind effects – Design of web and flange plates – Design of intermediate vertical and end bearing stiffeners; welded connection between them; lateral bracing; Cross frame.
- ✓ **Composite Bridges:** General Aspects of composite bridges, Design of R.C.C (or) P.C.C deck slab and Plate girder based on IRC vehicle loading; Design of various types of Shear connectors.
- ✓ **Prestressed Concrete Bridges:** Introduction to prestressed concrete, design of Pre-tensioned and Post-tensioned Bridges, design of superstructure-(Slab bridge design, Slab and T-beam bridge design, Slab and continuous beam design)
- ✓ **Continuous Bridges:** General Aspects, Advantages and Analysis of continuous bridges, Analysis and Design of continuous bridges
- ✓ **Box-Girder Bridges:** Structural Behaviors of Box-Girder Bridges- Flexural, Wide flange width (Shear Lag) effect, Torsion and Distortional warping effects. Thin-walled structures theory.
- ✓ **Cantilever, Arch, Cable Stayed , Suspension bridges and Integral Bridges:** Design of Cantilever, Arch, Cable Stayed, Suspension Bridges and Integral Bridges

Bridge Substructure Design:

✓ **Bridge Piers, Abutments, wing-wall and approaches:**

Types of piers and abutments, Loads to be considered in piers, abutments and wing wall design. Stability analysis of pier and abutment.

✓ **Bridge Foundations:** Types of Bridge foundations, Pile and well foundations.

✓ **Bridge Bearings and expansion joints:** Necessity of bearings, Types of bearings and expansion joints, Design of Elastomeric Bearings, Necessity and types of expansion joints

Tunneling:

Site investigation, Data collection, Methods of tunneling, Design of support system, design of lining, Analysis, design and construction of tunnels.

Books

1. Johnson Victor, D. (2008), "Essentials of Bridge Engineering", 6th Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Krishna Raju, N. (2006), "Design of Bridges", 3rd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. N. Rajgopal (2006), "Bridge Superstructure", Narosa Publishing House, New Delhi
4. V. K. Raina(2002),"Concrete bridge Practice: Analysis, Design and Economics", Tata McGraw Hill.
5. Aswani,M.G., Vazirani, V.N. and Ratwani, M.M(1975), "Design of concrete bridges", Khanna publishers.
6. Ponnuswamy S.(1996), "Bridge Engineering", Tata McGraw-Hill, New Delhi.
7. T.R.Jagadish and M.A.Jairam, "Design of Bridge structures, Prentice hall of India, New Delhi
8. Phatak D.R. (1990), "Bridge Engineering", SatyaPrakashan, New Delhi.
9. Bakht,B. and Jaegar, L.G.(1985),"Bridge Analysis Simplified," McGraw-Hill, New Delhi.
10. L. Fryba(1996), "Dynamics of Railway Bridges", Thomas Telford.
11. Indian Standard Codes and IRC codes related to bridges

Elective –III (Structure)

Course No.	Course Title	L	T	P/D	Hours	Credit
CEE 424 (a)	Prestressed Concrete Design	3	1	0	4	3

Introduction to prestressed concrete: Materials to be used, steel and its properties, concrete and its requirements.

General principles of prestressing: Assumption, general principles, eccentric tendons, bent tendons and parabolic tendons. Analysis of prestressed beams, load balancing concept.

Prestressing systems: Classification of prestressed concrete members, externally and internally prestressed members, pretensioning and post tensioning.

Losses in prestress: Losses due to length effect, curvature effect, loss of stress at anchoring stage, due to shrinkage and creep of concrete, elastic shortening of concrete, relaxation of steel- temperature effects.

Design of prestressed beams: Principle of design, I.S. Code provisions, design of rectangular and I-section and continuous beams.

Shear: Shear stresses, principal tensile stresses, shear reinforcement, effect of vertical prestressing.

Tension and compression members: Design of tension members and compression members.

End-block: Stress- analysis, transmission zones, bursting and spalling stresses, anchor plates placed symmetrically and eccentrically. Design problems.

Circular prestressing: General principles, methods of design.

Ultimate load design: Assumptions, modes of failure of beam sections, under and over-reinforced beam sections. I.S. recommendations and design problems.

Books

1. T.Y. Lin, Design of Prestressed Concrete
2. Krishna, Raju N., Prestressed concrete, Tata McGraw Hill, New Delhi
3. Rajagopalan, N., Prestressed concrete, Narosa Publishing House, New Delhi
4. Standard Specifications and code of Practice for PSC.

Elective –III (Structure)

Course No.	Course Title	L	T	P/D	Hours	Credit
CEE 424(b)	Repair and Rehabilitation of Structures	3	1	0	4	3

Introduction Importance of repair, rehabilitation and retrofitting as a part of construction engineering. Causes of distress, evaluation methods for condition, strength, serviceability.

Repair- Materials, techniques and quality control methods for concrete, Criteria for rehabilitation

Restoration and Retrofitting—Evaluation (seismic qualification) of existing buildings -Aging, weathering development of cracks, improper load path, asymmetry Retrofit techniques required in structures resulting from change in function, loading, and seismic forces.

Materials and equipments for restoration and retrofitting

Methodologies for retrofitting: For walls, roofs, slabs, columns and foundation of building in stones, brick or reinforced concrete structures.

Books

1. Xilin Lu, Retrofitting Design of Building Structures.
2. Mohiuddin Ali Khan Butterworth Heinemann, Earthquake Resistant Structures
3. Denison Campbell, Allen and Harold, Design, Build and Retrofit by Concrete Structures, Materials, Maintenance and Repair, Roper, Longman Scientific and Technical UK
4. Allen, R.T. and Edwards, S. C., Blakie ,Repairs of Concrete Structures, UK
5. Michael N. Fardis ,Seismic design, assessment and retrofitting of concrete buildings, Springer

Course No.	Course Title	L	T	P/D	Hours	Credit
CED-424 (c)	Environmental Impact Assessment	3	1	0	4	3

Introduction: Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development. Evolution of environmental impact assessment (EIA) , Current screening process in India. A step-by-step procedure for developing EIA. Elements of Environmental Analysis . Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Water Quality Impact Analysis and energy impact analysis. Impact Assessment Methodologies-Matrices, overlays, network analysis. Case studies of Industrial EIA and Water resources projects. Brief introduction about Environment legislation and Environmental Audit.
Environmental Impacts of Road, Rail, Dam and thermal power project-A case study

Books:

1. Environmental Impact Assessment for Developing Countries: Asit K. Biswas
2. Environmental Impact Analysis Handbook : G.J. Rau and C.D. Wooten
3. Environmental Impact Assessment : L. Canter
4. Environmental Impact Assessment Theory and practice Peter Wathern

Course No.	Course Title	L	T	P/D	Hours	Credit
CEE-424(d)	AIR POLLUTION & CONTROL	3	1	0	4	3

Introduction: Sources and classification of air pollutants; Standards and guidelines for Air Quality Parameter

Meteorology: Factors influencing air pollution, wind roses, plume behaviour, estimation of plume rise. Effects of Air Pollutants: Effect on man, material, vegetation, art treasures. Air pollution disasters, Economic effects

Global effects of Air Pollutants: Green house effect, acid rains, ozone hole, heat islands.

Indoor air pollution: sources, effects and status of indoor air pollution, control of indoor air pollution

Air pollution due to automobiles: Vehicular emissions, motor fuel combustion, automobile emission control, general concepts of transport planning for prevention of air pollution.

Industrial air pollution and its control Technology: Dilution, control at source by equipments, setting chambers, cyclones, fabric filters, electrostatic precipitators, scrubbers.

Books:

- 1 Air Pollution : J.H. Seinfeld
- 2 Air Pollution Control and Design for Industry - Paul N. Cheremiseriniff.
- 3 Air Pollution and Industry - R.D. Ross
- 4 Introduction to Air Pollution and Control - Muralikrishna

Course No.	Course Title	L	T	P/D	Hours	Credit
CEE-425 (c)	Construction Quality and Safety Management	3	1	0	4	3

QUALITY PLANNING:

Quality policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi’s concept of quality – Codes and Standards

QUALITY CONTROL:

Selection of new materials - Influence of drawings, detailing, specification, standardization - Bid preparation - Construction activity, environmental safety, social and environmental factors - Natural causes and speed of construction - Life cycle costing - Value engineering and value analysis.

QUALITY ASSURANCE :

Objectives - Regularity agent, owner, design, contract and construction oriented objectives, methods - Techniques and needs of QA/QC - Different aspects of quality - Appraisals, Factors influencing construction quality - Critical, major failure aspects and failure mode analysis, -Stability methods and tools, optimum design - Reliability testing, reliability coefficient and reliability prediction.

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

Text Books:

1. James, J.O’ Brian, Construction Inspection Handbook – Quality Assurance and Quality Control, Van Nostrand, New York, 1989.
2. Kwaku, A., Tenah, Jose, M. Guevara, Fundamentals of Construction Management and Organization, Reston Publishing Co., Inc., Virginia, 1985.
3. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, Tata McGraw-Hill, 1982.
4. Construction safety management, By Raymond E. Levitt, Nancy Morse Samelson, John Wiley & Sons.

Reference Books:

1. Construction quality management, By Siu-lam Tang, Syed M. Ahmed, Raymond T. Aoieong, S. W. Poon.
2. Total quality in construction projects, By R. Baden Hellard, Thomas Telford London

Course No.	Course title	L	T	P/D	Hours	Credit
CEE-425 (a)	Hydro Power Engineering	3	1	0	4	3

Hydro Power Development: Estimation of available water power, flow and power duration curves, firm power and secondary power, plant capacity, installed capacity, constraints in hydropower development, operation and maintenance of hydropower plants, small hydropower development.

Classification & Components of hydro-power plants: Classification of hydro-power plants based on storage characteristics, operating head, load, capacity. Principal components of hydro-electric scheme.

Hydro electric plants: Layout of hydropower plants, types of power houses, various components, investigations and studies, safety requirements. Storage zones of a reservoir, reservoir sedimentation, trap efficiency, life of a reservoir, principle of desilting, design of desilting basins. Alignment and location of various types of intakes, trashracks, design of intake structures. Conveyance channels and tunnels, water hammer, surge tanks, design of surge tanks, penstocks classification and layout, hydraulic design of penstocks, hydraulic valves and gates, tail race channels.

Economics of hydro power installation: Engineering feasibility, political consideration, economic feasibility, analysis of cost of hydro power, preparation of pre-feasibility report, detailed project report, cost and estimate report.

Books

1. Hydro-electrical Engineering : Creager and Justin
2. Water Power Engineering : Barrows
3. Water Power Development (Vol.-I and II) : Mosony L. Emil
4. Hydro –Electric and Pump storage Plants – MG Jog , Wiley Eastern Limited
5. Micro Hydroelectric Power Stations – By L. Monition,
6. Hydro Power Plant Familiarization- NPTI Publication.
7. Water power engineering-The theory, investigation and development of water powers by Daniel W. Mead, Member ASCE, Mcgraw-Hill Book Co.

Course No.	Course title	L	T	P/D	Hours	Credit
CEE-425 (b)	Ground water Engineering	3	1	0	3	3

Ground water: Regional flow and geologic control of groundwater, water bearing formations, aquifers, aquicludes and aquitards, confined and unconfined and leaky aquifers, ground water origin, modes of occurrence, yield of water and water quality. Permeability, states of flow, Darcy's laboratory permeability tests, formation constants.

Ground water exploration: Exploration by geologic and hydraulic methods, surface geophysical methods, map and tracer techniques, Groundwater Interaction with Streams and Lakes. Model studies of Groundwater: Digital computer models, application of F.D. and F.E. methods (Elementary Treatment only). Artificial Recharge: Necessity -Different methods of artificial recharge - Selection of method - Examples of artificial recharge schemes adopted in India and abroad.

Well hydraulics: Governing flow, equilibrium and non-equilibrium well equations, effect of hydro-geologic conditions on draw down, draw down from pumping tests, well interference and well efficiency, radius of influence, recharge and boundary conditions, effect of partial penetration, thesis equation.

Design of well: Methods of well drilling, Cable tool method, California stove-pipe method, direct rotary, drilling, drilling fluids, air and jet drilling, drilling with earth augers, grouting and sealing of well casing. Casing diameter, casing material, well depth, well screens length, slot opening and diameter, open area, entrance velocity, design of wells, Development of water wells, method of development, back washing, mechanical surging.

Books

1. Todd. D.K., Groundwater Hydrology, Johnwiley and Sons, New York.
2. Raghunath, H.M. ,Ground water, Wiely Eastern, New Delhi, 1989.
3. Ground water and well : F.G. Driscoll
4. Manual of ground water and tube-wells technical report : H.D. Sharma and A.S. Chawla Ground water Engineering : K.R. Karanth
5. Jacob Bear, Hydraulics of Groundwater, McGraw Hill, 1979.
6. Walton W.C., Groundwater Resources Evaluation, McGraw Hill Book Co., New York.
7. Abdel, Aziz Ismail Kashef, Groundwater Engineering, McGraw Hill Book Co., New York.

Course No.	Course title	L	T	P/D	Hours	Credit
CED-426	Structural Drawing – III (R.C.C)	0	0	3		1

- i. **Drawing of shear wall:** rectangular and flanged shear walls
- ii. **Retaining wall:** Cantilever retaining wall and Counterfort retaining wall.

Storage Structures:

- i. **Design of water tanks:** R.C.C. rectangular and circular water tanks resting on ground, underground tanks & overhead water tanks with staging.
- ii. **Swimming pools:**
- iii. **Bunkers and Silos:** square/rectangular and circular bunkers, design of Silos, silo for storage cement.
- iv. **Cooling tower:** Cooling tower components.

Chimneys: Chimneys.

Bridge Superstructures Design:

- ✓ **Culverts:** R.C.C slab culvert, Pipe culvert and Box culvert
- ✓ **RC Slab and Tee Girder Bridges:** Drawing for RC Slab and Tee Girder Bridges
- ✓ **Non-Composite Bridges(Steel bridges):**
 - **Masonry Bridge:** Brick (or) Stone masonry arch bridges.
 - **Steel Trussed Bridge:** Pratt type truss girder highway bridges
 - **Steel Plate Girder Bridge-** Plate girder railway bridges
- ✓ **Composite Bridges:** R.C.C (or) P.C.C deck slab with Plate girder and Shear connectors.

Bridge Substructure Design:

- ✓ **Bridge Piers, Abutments, wing-wall and approaches:**
- ✓ **Bridge Foundations:** Pile and well foundations.
- ✓ **Bridge Bearings and expansion joints:** Types of bearings and expansion joints.

Tunneling:

Drawing for tunnels.

Books

1. D.Krishnamurthy, Structural Design And Drawing Vol-I,II&III,CBS
 2. N.KrishnaRaju, Structural Design and Drawing, Oxford University Press.
 3. Murugesan&PadminiSubbarayan, Structural Drawing and Detailing, Pratheeba Publishers.
 4. N.KrishnaRaju, Advanced Reinforced Concrete Design, CBS.
 5. B.C.Punmia, Ashok Kumar Jain&Arun Kumar Jain, Reinforced Concrete Structures Vol-II, Laxmi.
 6. V.N.Vazirani&M.M.Ratwani, Concrete Structures, Khanna Publishers.
 7. Varghese, P.C.: Advanced Reinforced Concrete Design, Prentice-Hall, New Delhi.
 8. B.C.Punmia, Ashok Kumar Jain&Arun Kumar Jain, Limited State Design of Reinforced Concrete Structures, Laxmi
 9. S.S.Bhavikatti, Advanced R.C.C Design (R.C.C. Vol-II), New Age
 10. IS 456 2000: Code of Practice For Plain And Reinforced Concrete
 11. Johnson Victor, D. (2008), "Essentials of Bridge Engineering", 6th Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
 12. Krishna, Raju N., Prestressed concrete, Tata McGraw Hill, New Delhi
 13. Krishna Raju, N. (2006), "Design of Bridges", 3rd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
 14. N. Rajgopal (2006), "Bridge Superstructure", Narosa Publishing House, New Delhi
 15. V. K. Raina (2002), "Concrete bridge Practice: Analysis, Design and Economics", Tata McGraw Hill.
 16. Aswani, M.G., Vazirani, V.N. and Ratwani, M.M (1975), "Design of concrete bridges", Khanna publishers.
 17. Ponnuswamy S. (1996), "Bridge Engineering", Tata McGraw-Hill, New Delhi.
 18. T.R. Jagadish and M.A. Jairam, "Design of Bridge structures, Prentice hall of India, New Delhi
 19. Rajagopalan, N., Prestressed concrete, Narosa Publishing House, New Delhi
- Standard Specifications and code of Practice for Bridges