CE313N: DESIGN OF FORMWORK

Teaching Scheme: 3L Total : 3Hr Total Credit: 3
Evaluation Scheme: 30MSE + 10ISA + 60ESE Total Marks: 100
Duration of ESE: 03 Hrs

COURSE DESCRIPTION -

This course covers the fundamental principles and practices of designing formwork and falsework systems for concrete structures. It includes the study of various formwork materials and accessories, calculation of loads acting on formwork (including concrete pressure), and the structural design of formwork components for common elements like slabs, beams, columns, and walls.

COURSE OUTCOMES

Upon successful completion of this course the students will be able to:

1. classify various formwork types, materials (timber, plywood, steel), and accessories; select appropriate systems based on project and material requirements
2. analyze and calculate formwork loads, including dead, live, concrete pressure, and environmental factors, as per IS 14687.
3. design and evaluate formwork components for slabs, beams, columns, and walls using timber and steel, ensuring strength, deflection control, and safety.
4. explain special formwork systems (slip, flying, climbing), identify causes of failure, recommend safety measures, and prepare layout drawings with quantity estimation.

Relevance of Program Outcomes (Pos) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	1	2	-	-	1	1					-	2	-
2	3	3	2	2	1	-	-					-	3	-
3	2	1	1	-	1	-	1					-	1	-
4	2	2	3	1	2	-	-					1	2	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction to Formwork [08Hrs]
Functions of formwork and falsework, essential requirements, classification by materials and elements, conventional and proprietary systems, timber and plywood properties, steel and aluminum formwork, material selection, and common accessories.

Loads and Pressures on Formwork [08Hrs]
Dead and live loads, environmental and construction loads, concrete pressure on vertical forms, pressure distribution, empirical formulae, IS 14687 guidelines, permissible stresses, deflection limits, and lateral stability.

Design of Formwork for Elements [08Hrs]
Design principles and assumptions, slab formwork design, beam formwork components, wall formwork with ties and bracing, column formwork, foundation formwork, and code-based checks.

Special Formwork Systems [06Hrs]
Slip formwork mechanism, flying form systems, tunnel and climbing forms, formwork for curved and precast structures, proprietary modular systems, and lost formwork concepts.

Scaffolding, Safety, and Economy [06Hrs]
Types and components of scaffolding, erection and safety measures, failure causes, inspection and dismantling procedures, stripping times, reshoring, and cost-saving practices.

Practical Application and Estimation [04Hrs]
Formwork layout preparation, quantity estimation, working drawing interpretation, site practices, supervision, inspection, and reuse planning.

Textbooks:

1. Peurifoy, R.L., Oberlender, G.D., and Jha, K.N.. Formwork for Concrete Structures (Latest ed.). McGraw Hill Education (India).
2. Hurd, M.K. Formwork for Concrete (Special Publication No. 4, Latest ed.). American Concrete Institute (ACI).

Reference Books:

1. Ratay, R.T. (Ed.). Temporary Structures in Construction (Latest ed.). McGraw Hill.
2. The Concrete Society (UK). Formwork: A Guide to Good Practice (3rd ed.).
3. Indian Concrete Institute (ICI).. Technical Monograph on Formwork. Chennai: ICI.
4. Austin, C.K. Formwork for Concrete. Cleaver-Hume Press Ltd.

Indian Standards (Mandatory):

1. IS 14687: 1999: Guidelines for Falsework for Concrete Structures. Bureau of Indian Standards (BIS), New Delhi. 1
2. IS 456: 2000: Plain and Reinforced Concrete - Code of Practice. BIS, New Delhi. 13
3. IS 883: 1994: Code of Practice for Design of Structural Timber in Building (Reaffirmed 2019). BIS, New Delhi. 1
4. IS 4990: 1993: Specification for Plywood for Concrete Shuttering Work (Reaffirmed 2021). BIS, New Delhi. 1

5. IS 875 (Parts 1-3): Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures. BIS, New Delhi. 23
6. IS 2750: 1964: Specification for Steel Scaffoldings. BIS, New Delhi. 1

CE314N: INTRODUCTION TO ENGINEERING SEISMOLOGY

Teaching Scheme: 3L **Total: 3Hr** **Total Credit: 3**
Evaluation Scheme: 30MSE + 10ISA + 60ESE **Total Marks: 100**
Duration of ESE: 03 Hrs

COURSE DESCRIPTION -

This course introduces the fundamental concepts of engineering seismology, covering topics such as plate tectonics, seismic waves, earthquake measurement, and seismotectonic features. The students will gain insights into how seismic activities are studied and quantified, and how they affect structures.

COURSE OUTCOMES

Upon successful completion of this course the students will be able to:

1. identify the causes and characteristics of earthquakes.
2. interpret seismic data and comprehend earthquake measurement techniques.
3. evaluate the impact of seismic waves on structures and design considerations.
4. study the basic concept of hazard curves and risk assessment.

Relevance of Program Outcomes (Pos) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	1	2	-	-	1	1					-	2	
2	3	3	1	2	1	-	-					-	3	-
3	2	1	1	-		-	1					1	1	-
4	2	2	3	1	2	-	1					1	2	-

1–Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Fundamentals of Engineering Seismology – [08Hrs]

Basics of seismology, seismic sources, earthquake occurrence., Plate tectonics and global seismicity, Elastic rebound theory, fault types, and strain energy release, Historical earthquakes and their significance in engineering.

Seismic Waves and Ground Motion – **[08Hrs]**

Seismic Waves – Body waves (P and S), Surface waves (Love and Rayleigh),Wave propagation, velocity, attenuation, and reflection/refraction, Instrumentation: Seismometers and Accelerometers, Strong ground motion characteristics.

Earthquake Measurement and Analysis - [08Hrs]

Earthquake Measurement – Magnitude and intensity scales (Richter, Moment Magnitude, MSK, Modified Mercalli), Seismic zoning maps of India, Recording of earthquakes and ground motion parameters, Time history and response spectrum analysis introduction.

Seismotectonics of India - [08Hrs]

Seismotectonics of India – Major faults and seismic zones, Intraplate and interplate earthquakes, seismic gaps, Case studies of major Indian earthquakes, Earthquake recurrence and return period estimation.

Seismic Hazard Analysis and Risk Assessment - [08Hrs]

Introduction to Probabilistic Seismic Hazard Analysis (PSHA).,Deterministic vs. probabilistic approaches, Basic concepts of hazard curves and risk assessment, Applications in structural engineering and urban planning.

Text Books

1. Engineering Seismology, M.W. Hough, Oxford University Press.
2. Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, PHI Learning.
3. Seismology and Earthquake Engineering, C. F. Richter, McGraw-Hill.
4. Structural Dynamics: Theory and Computation, Mario Paz, Springer.

Reference books

1. Seismic Design of Building Structures, Michael R. Lindeburg, PPI.
2. Earthquake Tips, C.V.R. Murty, IIT Kanpur.
3. Introduction to Seismology, Peter Shearer, Cambridge University Press.
4. IS 1893 (Part 1): 2016 Criteria for Earthquake Resistant Design of Structures, BIS, New Delhi.

CE315N: ENGINEERING HYDROLOGY AND HYDROLOGIC SYSTEMS

Teaching Scheme: 3L **Total : 3 Hr** **Total Credit: 3**
Evaluation Scheme: 30MSE + 10ISA + 60ESE **Total Marks: 100**
Duration of ESE: 03 Hrs

COURSE DESCRIPTION -

The course aims to introduce students to advanced techniques of hydrological analysis that are of relevance to engineering and environmental design, planning and management. The course is focused on developing the skill of using modern techniques and softwares like remote sensing, GIS for watershed management.

COURSE OUTCOMES-

Upon successful completion of the course, the students will be able to

1) identify advanced hydrological processes and techniques necessary for predicting design floods.
2) apply the concepts and techniques necessary for an understanding and runoff hydrographs and unit Hydrographs.
3) apply advanced computer models for hydrological prediction.
4) carry out basic hydrologic computations.

Relevance of Program Outcomes (POs) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	1	2	2	3		2					2		
2	1	3	1	2	3							3	1	
3	3	2		3	2		3						2	
4	1	3	3	1	2		2					3		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction: **[06Hrs]**
Systems Concept, Linear and Non Linear Systems, Lumped and Distributed Systems, Deterministic and Stochastic Systems, Time Invariant Systems, Unit Hydrograph Theory, S – Curve Hydrograph, Instantaneous Unit Hydrograph.

Rainfall – Runoff Analysis: **[06Hrs]**
Review of Rational Methods, Conceptual Model, Clarke and Nash Models, Derivation of Unit Hydrograph for un-gauged Catchments, Synthetic Unit Hydrograph.

Hydrologic Statistic: **[08Hrs]**
Hydrological data and its sources, Probabilistic Treatment of Hydrologic Data, Frequency and Probability Functions, Statistical Parameters, Frequency Analysis, Annual Maximum and Partial Duration Series Models, Regional Frequency Analysis, Design Flood.

Hydrologic Flood Routing: **[10Hrs]**
Reservoir Routing, Channel Routing, Estimation of Flood Routing Models, Flood Forecasting, Analog Models, Real Time Flood Forecasting. Applications of Remote Sensing and GIS in Hydrology: Land Use and Soil Mapping Using Remote Sensing, Watershed Management Using Remote Sensing Techniques, Concepts of Geographical Information Systems (GIS) and its Application in Hydrologic Studies.

Climate Change: **[10Hrs]**
Global Circulation Model (GCM), Regional Circulation Model (RCM), Data collection and analysis, downscaling of climate parameters, uncertainty of regional climate projections, climate change impact, adaptation strategies, Risk and Vulnerability of Agriculture, climate forecasting, Soil and Water Assessment Tool (SWAT) Hydrological Model, Socioeconomic scenarios, Policy Initiatives for Climate Change Adaptation in India.

References:

1. Chow, V.T., Maidment, D.R. and Mays, L.W. (1988), " Applied Hydrology", McGraw Hill Inc. N York
2. Singh, V.P. (1986), "Hydrologic Systems", Prentice Hall Inc., N York
3.Singh, V.P. (1992), "Elementary Hydrology", Prentice Hall of India, N Delhi
4.Haan C.T., (1995), "Statistical Methods in Hydrology", East West Press, New Delhi
5. Viessman, W., Lewis, G.L. and Knapp, J.W. (1989), "Introduction to Hydrology", Harper & Row Publications Inc., Singapore
6.Ponce, W.F. (1987), "Engineering Hydrology", Prentice Hall Inc. N York.
7. Lillesand, T.M. and Kiefer, R.H. (1994) "Remote sensing and Image Interpretation", John Wiley & Sons.
8. Subramanya, K. (2011), "Engineering Hydrology", Tata McGraw Hill Education Private Limited, New Delhi.

CE316N: GROUNDWATER ENGINEERING

Teaching Scheme: 3L **Total : 3Hr** **Total Credit: 3**
Evaluation Scheme: 30MSE + 10ISA + 60ESE **Total Marks: 100**
Duration of ESE: 03 Hrs

COURSE DESCRIPTION

This course covers fundamentals of subsurface flow and transport, emphasizing the role of groundwater in the hydrologic cycle, the relation of groundwater flow to geologic structure, and the management of contaminated groundwater.

COURSE OUTCOMES-

Upon successful completion of this course the students will able to:

1**)** learn about the basics of ground water Engineering including the hydrogeological cycle and water level fluctuations.
2) design water wells and well drilling.
3) manage groundwater resources.
4) learn about the basics of hydrology of groundwater and to make a clear understanding of groundwater flow equations of velocity equations.

Relevance of Program Outcomes (POs) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	1	2	2	3		2					2		
2	2	3	2	2	3		3					3	1	
3	3	2	1	3	2		3					2	2	
4	2	3	3	1	2		2					3		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Ground Water: **[08Hrs]**

Zone of aeration, saturation, soil water, adsorbed water, capillary water, capillary potential, storage coefficients of aquifers, porosity, specific yield, specific retention, unconfined and confined aquifer, fluctuation of water table, fluctuation of the piezometric surfaces, ground water potential in India, geophysical methods for groundwater explorations.

Well Hydraulics: **[08Hrs]**

Darcy's law, permeability and transmissivity, Theim and Dupuit's theory for unconfined and confined aquifers. Groundwater flow potential, Ground water theory for one, two dimensional problem, Differential equations governing groundwater flow for steady and unsteady state problems, use of finite difference method to solve simple ground water flow problem.

Evaluation of aquifer properties: **[08Hrs]**

aquifer tests control well, observation well, measurement during test, Theis method, Jacob and Chow's method of determination of aquifer parameters, Theis' recovery method, bounded aquifer, interference among wells, Image well theory and its application in groundwater flow.

Groundwater well losses, water well design and well drilling: **[08Hrs]**

well screen, development and completion of wells, Rotary drilling and Rotary percussion drilling, maintenance of wells. Groundwater Modeling: Groundwater flow, sand models, viscous fluid models, membrane model, thermal model, electric analog model and mathematical models.

Groundwater development and management: **[08Hrs]**

Conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, waste water recharge, recharge by urban storm runoff, groundwater storage changes, percolation from tanks, recharge from irrigated fields, dating of groundwater, estimation of groundwater discharge, groundwater resource evaluation in India, groundwater quality.

References:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Raghunath, H.M. "Ground Water" New Age International (P) Limited, New Delhi.
3. Karanth, K. R. "Ground Water Assessment Development and Management", Tata McGraw Hill Publishing Company Limited, New Delhi
4. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
5. L. Harvil and F. G. Bell, Ground Water Resources and Development, Butterworth's, London.
6. Herbert F Wang and Mary P. Anderson "Introduction to Ground Water Modeling", W.H.Freeman and Company, NewYork

CE363N: DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Teaching Scheme: 3L **Total : 3Hr** **Total Credit: 3**
Evaluation Scheme: 30MSE + 10ISA + 60ESE **Total Marks: 100**
Duration of ESE: 03 Hrs

COURSE DESCRIPTION

This course provides fundamental knowledge of earthquake-resistant design. Students will learn the basic principles of earthquake engineering, characteristics of seismic ground motion, seismic design philosophy, IS 1893 and IS 13920 provisions, and design of various structural components for earthquake resistance.

COURSE OUTCOMES-

Upon successful completion of this course the students will be able to:

1. study the basics of engineering seismology and seismic design philosophy.
2. analyze and design earthquake-resistant structural elements using IS codes.
3. apply ductile detailing techniques to RC structures as per IS 13920.
4. identify sources of weakness in RC framed building and to study base isolation system.

Relevance of Program Outcomes (Pos) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	2	1	2	2	3		2					2		
2	2	3	2	2	3		3					3	1	
3	3	2	1	3	2		3					2	2	
4	2	3	3	1	2		2					3		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction to Engineering Seismology [06Hrs]

Definition, causes of earthquake, seismic waves, earthquake parameters, magnitude, intensity, seismic zoning map of India, past earthquakes in India.

Seismic Design Philosophy [06Hrs]

Philosophy, performance criteria, design earthquake, response reduction factor, importance factor, design lateral load, load combinations as per IS 1893.

Seismic Design of RC Structure [10Hrs]

Design of multi-story RC structure with foundation as per latest IS: 1893 by Equivalent static lateral load method and Response Spectrum Method, Introduction to Time history method, Capacity based design of soft story RC building, design of Shear Walls, Ductile detailing as per latest IS:13920.

Seismic Retrofitting and Rehabilitation of Structures [12Hrs]

Seismic retrofitting, Sources of weakness in RC framed buildings, Classification of retrofitting techniques, Conventional and non-conventional methods, Comparative study of various methods and case studies. Introduction to Base Isolation systems. IS code provisions for retrofitting of masonry structures, failure modes of masonry structures and repairing techniques.

Concept of Base Isolation and Seismic Dampers [06Hrs]

Base isolation, types of isolators, working principle, energy dissipation devices, types of dampers.

Text Books

1. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, PHI Learning, 2013.
2. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press, 2010.
3. IS 1893 (Part 1): 2016 – Criteria for Earthquake Resistant Design of Structures.
4. IS 13920: 2016 – Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces.

Reference Books

1. T. Pauley and M.J.N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, 1992.
2. Anil K. Chopra, Dynamics of Structures – Theory and Applications to Earthquake Engineering, Pearson Education.
3. R.W. Clough and J. Penzien, Dynamics of Structures, McGraw-Hill International Edition.

CE364N: WATER RESOURCES SYSTEMS – PLANNING AND MANAGEMENT

Teaching Scheme: 3L **Total : 3Hr** **Total Credit: 3**
Evaluation Scheme: 30MSE + 10ISA + 60ESE **Total Marks: 100**
Duration of ESE: 03 Hrs

COURSE DESCRIPTION

This course focuses on concepts of water resource systems and methods of system analysis. Students will be able to learn water quantity management as well as water quality management.

COURSE OUTCOMES

Upon successful completion of this course the students will be able to:

1. carry out economic analysis of water resources projects.
2. apply concepts of systems analysis for planning of water resources systems.
3. perform basic economic analysis to evaluate the economic feasibility of water resources and environmental engineering projects.
4. formulate and solve deterministic optimization models for design and operation of water resources systems.

Relevance of Program Outcomes (Pos) and strength of co-relation

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
1	1	1	2	2	3		2					2		
2	2	3	1		3		3					3	1	
3	2	1	1	3	2		3					2	2	
4	3	2	3		2		2					3		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction: **[08Hrs]**
General Principles of Systems Analysis to Problems in Water Resources Engineering, Objectives of Water Resources Systems, Economic Analysis of Water Resources Systems: Principles of Engineering Economy, Capital, Interest and Interest rate, Time Value of Money, Depreciation, Benefit Cost Evaluation, Discounting Techniques, Socio Economic Analysis.

Methods of Systems Analysis: **[10Hrs]**
Linear Programming Models, Simplex Method, Sensitivity Analysis, Dual Programming, Dynamic Programming Models,
Non-linear Programming, Gradient Techniques, Stochastic Programming, Simulation, Multi Objective Optimization.

Water Quantity Management: **[10Hrs]**
Surface Water Storage Requirements, Storage Capacity and Yield, Reservoir Design, Water Allocations for Water Supply, Irrigation, Hydropower and Flood Control, Reservoir Operations, Planning of an Irrigation System, Irrigation Scheduling, Groundwater Management, Conjunctive Use of Surface and Subsurface Water Resources.

Water Quality Management: **[08Hrs]**
Water Quality Objectives and Standards, Water Quality Control Models, Flow Augmentation, Wastewater Transport Systems, River Water Quality Models.

Legal Aspects of Water & Environment Systems: **[04Hrs]**
Principles of Law Applied to Water Rights and Water Allocation, Water Laws. Environmental Protection Law.

References:
1. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1982) —Water Resources Systems Planning and Analysis“, Prentice Hall Inc. N York
2. Chaturvedi, M.C. (1987), —Water Resources Systems Planning and Management“, Tata McGraw Hill Pub. Co., N Delhi
3. Hall. W.A. and Dracup, J.A. (1975), —Water Resources Systems“, Tata McGraw Hill Pub. N Delhi
4. James, L.D. and Lee (1975), —Economics of Water Resources Planning“, McGraw Hill Inc. N York
5. Kuiper, E. (1973) —Water Resources Development, Planning, Engineering and Economics“, Buttersworth, London.
6. Biswas, A.K. (1976) —Systems Approach to Water Management“, McGraw Hill Inc, N York.
7. Taha, H.A. (1996) —Operations Research“, Prentice Hall of India, N Delhi.