Scheme of Instruction, Evaluation

and

Syllabi of

B.E. CIVIL ENGINEERING
(Minor)

With effect from Academic Year 2024-25

Estd. 1917

DEPARTMENT OF CIVIL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Osmania University

Hyderabad – 500 007, TS, INDIA

Estd. 1929

MINOR IN CIVIL ENGINEERING

S.N0	SEMESTER	Course Code	Course Title	Scheme of Instruction			Contact Hrs/ week	Scheme of Examination		Credits
				L	T	P		CIE	SEE	
1	**V**	MR 501 CE	Strength of Materials	3			3	40	60	3
2	**V**	MR 502 CE	Building Information System (PERT &CPM)	3			3	40	60	3
3	**V**	MR 503 CE	Fluid Mechanics	3			3	40	60	3
4	**VI**	MR 601 CE	Transportation Engg	3			3	40	60	3
5	**VI**	MR 602 CE	Water Supply and Wastewater treatment	3			3	40	60	3
6	**VI**	MR 603 CE	Building Materials and Construction	3			3	40	60	3
7	VII	MR 701 CE	Principles of Surveying	3			3	40	60	3
8	**VII**	MR 702 CE	Fundamentals of Geotechnical Engineering	3			3	40	60	3
	PRACTICALS									
8	**VI**	MR 651 CE	Building Planning and Drawing Laboratory	-	-	2	2	25	50	1
9	VII	MR 751 CE	Surveying Laboratory	-	-	2	2	25	50	1
`10	**VII**	MR 752 CE	Fluid Mechanics Laboratory	-	-	2	2	25	50	1
11	**VII**	MR 851CE	MR Project work	-	-	6	6	50	100	3
			TOTAL	18		12	-	-	-	**18**

MR 501 CE	**STRENGTH Of MATERIALS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Understand the basic concept of the stress and strain for different materials
2.	Know the mechanism of development of shear force and bending moments in beams
3.	Understand and analyze the stresses for the combined action of direct stress and shear stress
4.	Know the concept of bending stresses and shear stresses for different cross sections
5.	Understand the concepts of direct and bending, and thick and thin cylinder and their practical applications

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	Apply the fundamental concepts of stress and strain in the design of various structural components.
CO-2	Analyze principal stresses and principal planes through numerical and Mohr's circle method
CO-3	Analysis of beams to determine shear forces, bending moments subjected to different type of loads.
CO-4	Determine the bending stresses and shear stresses produced in a beam subjected to system of loads
CO-5	Describe direct & bending concept; and analysis of thin and thick cylinders with their practical applications

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	-	-	1	-	-	1	-	1	-	1	-	1
CO2	3	1	-	-	1	-	-	1	-	1	-	1	-	1
CO3	3	1	-	-	1	-	-	1	-	1	-	1	-	1
CO4	3	1	-	-	1	-	-	1	-	1	-	1	-	1
CO5	3	1	-	-	1	-	-	1	-	1	-	1	-	1

Correlation rating: Low/ Medium/High:1/2/3respectively.

Unit–I:

Simple Stresses and Strains- Concept of stress and strain, St. Venant's principle, stress and strain diagram, Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain Energy – Resilience– Gradual, sudden, impact and shock loadings – simple applications.

Unit- II:

Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain

Unit- III:

Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without over hangs. Calculation of maximum BM and SF and the point of contra flexure under concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Unit- IV:

Flexural Stresses-Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections. Shear Stresses- Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Unit- V:

Direct and Bending: Basic concept , Eccentric loading, limit of eccentricity-Core of sections-rectangular and circular, solid and hollow sections-wind pressure on chimneys and water pressure on dams. Thin Cylinders - Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder. Thick Cylinders: Lame's equations, stresses under internal and external fluid pressures - Compound cylinders - Shrink fit pressure

Suggested Reading:

1	Timoshenko, S. and Young, D. H., Elements of Strength of Materials, DVNC, New York, USA,2003
2	Kazmi, S. M. A., Solid Mechanics ,TMH, Delhi, India,2017
3	Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson, Prentice Hall, 2004
4	Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGraw Hill, 1979
5	D.S. Prakash Rao, Strength of Materials- A Practical approach, Volume 1, Universities Press,1999
6	Ferdinand P. Beer, E. Russel Jhonston Jr., John T. DEwolf , Mechanics of Materials - TMH 2002.
7	R. Subramanian ,Strength of Materials, Oxford University Press, New Delhi,2016

MR 502 CE	**BUILDING INFORMATION SYSTEM (PERT & CPM)**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60Marks	**CIE**		40Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student :	
1.	To Describe different techniques of construction management projects
2.	To Illustrate economics, resource allocation & basic concepts of optimization for construction projects
3.	To Understand the basics of MIS techniques and works measurement standards.
4.	To introduce the concepts of safety and safety engineering practices for construction management projects
5.	To comprehend the preparation of contracts and its laws

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Propensity to plan and schedule various phases in construction industry
CO-2	Ability to optimize the cost and construction time of various projects
CO-3	Application of MIS and work measurement techniques to cater for construction industry needs.
CO-4	Acquaintance with various safety measures and safety management practices
CO-5	Capability to manage and provide viable solutions for various construction projects

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	-	2	-	1	3	3	1	1	-	1	1	1
CO2	1	1	2	3	3	2	3	3	-	2	1	1	1	1
CO3	2	3	3	3	3	2	1	3	2	1	1	1	2	1
CO4	1	-	1	1	-	3	2	2	-	1	2	2	-	-
CO5	2	1	3	1	1	3	3	2	1	2	2	3	-	1

Correlation rating: Low/ Medium/High : 1/2/3 respectively.

Unit I

Basics of Construction: Features of construction, Construction project planning - Stages of project planning, Construction Schedule, work break-down structure.

Development of management techniques, Bar charts, Gantt charts, CPM, PERT techniques, and Network analysis example

Unit II

Cost analysis: Cost reduction in construction management. Cost time analysis, Crashing the Network. Resource allocation and levelling: Various allocation methods, economical manner of resource allocation. Optimization: application of LP for solving simple networks

Unit III

Construction management: Nature and purpose of construction management, Principles of construction management, functions and responsibilities of construction manager, application of MIS to construction.

Method study Definition, Objective, and Procedure for selecting the work, recording facts, symbols and flow process charts. Time study - Concept of standard time and various allowances, time study, equipment performance rating

Unit IV

Safety Engineering: Basic construction safety regulations, Safety program, Construction accidents and causes, Direct and Indirect loss due to accident. Location hazards and elimination, Safety in demolition of buildings, Safety in storage and handling of materials and equipments.

Unit V

Contracts Management – Basics, Importance of contracts, Types of Contracts, parties to a contract, PPP document. Construction Equipment basics: Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials.

Suggested Reading:

1.	Robert L. Peurifoy and William B. Ledbetter, Construction Planning, equipment, and methods, McGraw-Hill International Editions, New Delhi, 1985
2.	Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.
3.	Mahesh Varma, Construction Equipment and its Planning and Application, Metropolitan Book Company Pvt. Ltd., New Delhi, 1994.
4.	H. N. Ahuja, Construction performance control by networks, John willey & sons, New York, 1976.
5.	Frank Harris and Ronald Mc. Caffer, Modern Construction Management. Blook well science L1d, 2001.
6.	Punmia, B C, Ashok K Jain and Arun K Jain. Building Construction, Eleventh Edition, Laxmi Publications Ltd, New Delhi, 2016
7.	Arora, S P, and S P Bindra. A textbook of Building construction. Fifth Edition, New Delhi, Dhanpatrai publications, 2010.

MR 601 CE	**TRANSPORTATION ENGINEERING**					
Pre-requisites		**L**	**T**	**P**	**C**	
		3	-	-	3	
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Understand basic terminology, development plans and standards relate Airport Engineering.
2	Understand the significance of geometric design of highways with specifications and standards
3	Study the basic techniques for collecting and analyzing traffic data, diagnosing problems .
4	Provide details of tests and requirements of materials used for highway construction
5	Impart knowledge on analysis and design concepts of Flexible and rigid pavements

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	Assimilation of the various concepts of Highway developments and able to conduct the highway alignment surveys
CO-2	Assimilation of the various concepts of Highway geometric design
CO-3	Understanding and application of concepts related to traffic engineering
CO-4	Knowledge related to suitable selection of pavement materials based on the applicable tests
CO-5	Able to analyze stresses and prepare design requirements for flexible pavements and rigid pavements

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	2								2	
CO2	2	2	2	2	2								3	1
CO3	2	2	3	1	1		2					1	2	2
CO4	2	2		1	2		2				2		3	2
CO5	2	2	2	1	2		2				2	1	1	2

Correlation rating: Low/ Medium/High:1/2/3 respectively

UNIT-I

Highway development and planning-Classification of roads, Jayakar Committee, road development plans in India before and after independence, Current road projects in India; factors affecting highway alignment, engineering surveys and project preparation.

UNIT-II

Geometric design of highways- Introduction; highway cross-sectional elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, Super-elevation problems.

UNIT-III

Traffic Engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; Type of road markings & Signs; design of signals, capacity analysis and design of rotary intersections, parking facilities; accident studies and prevention measures.

UNIT-IV

Pavement materials- Materials used in Highway Construction; desirable properties, tests, requirements for different types of pavements: Soils, Stone aggregates, bituminous binders, bituminous paving mixes, introduction to Marshall Mix method; grades of cement concrete: desirable properties, overview on tests on cement and hardened concrete, requirements for different types of pavements.

UNIT V

Design of Pavements-Types of pavements and factors affecting design of flexible and rigid pavements, performance; stresses in flexible and rigid pavements; overview on design of flexible pavements as per IRC:37-2018; Overview on design of concrete pavements as per IRC:58-2015Surface and Sub-surface drainage systems.

Suggested Reading:

1.	Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2.	Kadiyali, L.R, Lal N.B, 'Principles and Practices of Highway Engineering' Khanna Publishers, 2013
3.	Srinivasa Kumar R, Transportation Engineering, Universities Press, 2018
4.	IRC: 37 (2018), 'Guidelines for the design of flexible pavements', Indian Roads Congress, New Delhi
5.	IRC: 58 (2015), 'Guidelines for the design of plain jointed rigid pavements', Indian Roads Congress, New Delhi

MR 503 CE	**FLUID MECHANICS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Understand concepts of various fluid properties
2.	Understand the basic concepts of fluid motion
3.	Knowledge of forces due to fluids and energy principles

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Analyze and solve problems of basic principles in Fluid Mechanics
CO-2	Understanding of Classification of fluids, Stream function and Velocity Potential function and flow net
CO-3	Able to measure the pressure using different approaches and Application of Continuity and - Bernoulli's equation to Fluid mechanics problems.
CO-4	Applications of laminar flows in circular pipes and rough and smooth boundaries- variation of friction factor.
CO-5	Knowledge of turbines and pumps and development of characteristics curves

Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	2		1		1					1	2	
CO2	2	2	2	1	1		1					1	2	
CO3	2	2	2	2	1							1	2	
CO4	2	2	2	2	1	1						1	2	1
CO5	2	2	2	2	1							1	2	

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

Unit – I:

Fluid Properties: Basic concepts: Specific weight, specific volume, specific mass, gravity, viscosity, bulk modulus, vapour pressure, capillarity and surface tension, viscosity-Newton's law of viscosity, Newtonian and Non-Newtonian fluids, classification of fluids-ideal and real.

UNIT II

Fluid Kinematics: Fundamentals of fluid flow-description of flow pattern, stream lines, path lines, streak lines, stream tubes, classification of fluids, steady and unsteady flows, laminar and turbulent flows, uniform and non-unsteady flows, rotational and irrotational flows, laminar and turbulent flows, uniform and non- uniform flow, one, two and three dimensional flows, stream function, and velocity potential function.

UNIT III

Fluid Statics: Fluid pressure at a point, variation of pressure in a fluid, measurement of pressure - simple and differential manometers.

Fluid Dynamics: Convective and local acceleration, concept of continuity, three- dimensional continuity equation, body forces and surface forces, body force potential, Euler's equation of motion for 3-D flow, Bernoulli's equation by integration of Euler's equation, significance of Bernoulli's equation and its limitations, applications of Bernoulli's equation- venturimeter, Pitot tube. Impulse-momentum equation and its applications- forces on a pipe bend

UNIT IV

Flow Through Pipes: Introduction, types of flows-laminar and turbulent, Reynolds experiment, Darcy-Weisbach equation, and steady laminar flow through circular pipes- Hagen-Poiseuille's equation, hydro-dynamically smooth and rough boundaries- criteria and resistance to flow of fluid in smooth and rough boundaries, variation of friction factor.

UNIT V

Hydraulic turbines: Classification, specific speed, velocity triangles, power developed, efficiencies, principles of design of impulse and reaction turbines, turbine laws and constants, characteristic curves, selection of turbines. Pumps and various efficiencies and characteristic curves

Suggested Reading:

1.	K.Subramanya, '*Theory and Applications of Fluid Mechanics*', Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1993
2.	Vijay Gupta and Santosh K. Gupta, '*Fluid Mechanics and its applications*', Wiley Eastern Ltd., New Delhi,1984
3.	K.L. Kumar, '*Engineering Fluid Mechanics*', Eurasia Publishing House Pvt Ltd.,New Delhi, 2009
4.	Valentine, H.R., '*Applied Hydrodynamics*', Butterworths & Co Ltd., London, 1959
5	P.N. Modi and S.M.Seth, '*Hydraulics and Fluid Mechanics*', Standard Book House, New Delhi, 2013

MR 602 CE	WATER SUPPLY AND WASTEWATER TREATMENT					
Pre-requisites		**L**	**T**	**P**	**C**	
		3	-	-	3	
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Introduction to the basic concepts and requirements of environmental engineering
2.	Knowledge about different sequential unit operations of water and wastewater treatment processes
3.	Inputs on engineering principles for analyzing various environmental issues
4	Awareness towards the sustainability of standards for water resources

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Aptitude to plan for protected water supply system needs and requirements
CO-2	Ability to design sequential unit operations in water treatment plants
CO-3	Acquaintance with collection procedures and design of sewerage systems
CO-4	Capacity to design for the safe disposal of wastewater and its reuse
CO-5	Knack to analyze, execute and maintain standards for sustainable development of the society

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	--	--	1	3	3	3	2	2	2	3	2
CO2	3	2	2	1	1	2	3	2	1	2	2	2	1	2
CO3	2	--	2	--	3	1	2	2	1	1	1	1	3	1
CO4	2	1	2	1	1	2	1	1	--	1	1	2	2	1
CO5	2	1	3	--	2	1	3	1	2	2	1	2	1	3

Correlation rating:Low / Medium / High: 1 / 2 / 3 respectively.

UNIT-I

Water Supply: Need for planned water supply schemes, water demand for industrial and agricultural water requirements, Sources of water, standards and quality issues, water quality requirements for different beneficial uses, Population Forecast.

UNIT – II

Water Treatment: water treatment through aeration, coagulation flocculation, and sedimentation, Filtration, Disinfection, and Softening methods

UNIT – III

Distribution of Water: Methods of layout of distribution pipes, design of distribution by Hardy Cross method for simple networks, various types of pipes and valves used in water supply systems.

UNIT-IV

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations.
Conveyance of sewage: Sewers shapes, design of sewerage systems, operation and maintenance of sewers, sewage pumping, sewer appurtenances

UNIT-V

River cleaning plans: Self-purification of streams, BOD and COD concepts, wastewater treatment, aerobic and anaerobic treatment system, suspended and attached growth systems, quality requirements of recycled water for various purposes. Principles of Septic Tank

Suggested Reading:

1.	Fair, G. M. and Geyer, J. C. *Water and Wastewater Engineering, vol. I and II*, John Wiley & Sons, Inc., New York, 1954
2.	Hammer, M.J. and Hammer, M.J. Jr., *Water and Wastewater Technology*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
3.	Metcalf & Eddy, *Wastewater Engineering, treatment, disposal, and reuse*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995
4.	Gilbert, M. Masters., *Introduction to Environmental Engineering and Science*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995
5	Norris, Robert, *Handbook of Bioremediation*, CRC Press, 1993

MR 603 CE	**BUILDING MATERIALS AND CONSTRUCTION**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Study about the basic building materials
2	Know the smart building materials
3	Understand the construction of formwork

Course Outcomes :	
On completion of this course ,the student will be able to :	
CO-1	Differentiate between various building materials i.e .both conventional and smart Building materials
CO-2	Describe the role of aggregates in concrete preparation and have knowledge of mix Design methods of concrete
CO-3	Demonstrate the importance of energy conservation, damp proof course and fire Protection and crack propagation in buildings
CO-4	Analyze different type of plasters, paints, varnishes, distempers and their constituents.
CO-5	Describe different materials used and construction of various formworks and scaffoldings

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2			1	3	1				2	2	
CO2	2		2			1	3	1				2	2	
CO3	2		2			1	3	1				2	2	
CO4	2		2			1	3	1				2	2	
CO5	2		2			1	3	1				2	2	

Correlation rating: Low/ Medium/ High:1/2 /3respectively.

Unit-I

Introduction: Uses of stones as building materials, classification, characteristics, dressing and polishing of stones, methods of quarrying and construction.

Bricks: Methods of manufacturing bricks. Classification and methods of construction.

Timber: Timber as a building material and its uses. Methods of seasoning and preservation laminates and their uses, defects in Timber.

Cement: Introduction to cement, different grades, IS specifications and OPC and PPC Cements (blended cements).

Mortar and Sand: Characteristics of good mortar makings and, availability of sand and its classification, Bulking of sand, manufacturing methods of mortar. Different types of mortars-preparation, setting and curing.

Unit-II

Coarse and fine Aggregate: Characteristics of good coarse and fine aggregates for manufacture of concrete, Significance and application of coarse and fine aggregate for the production of good quality concrete. Concrete: Introduction to Nominal mix and Design mix, Stages involved in preparation of concrete

Unit-III

Type of joints in Concrete - Construction, expansion, contraction, and isolation joints. Cracks in Buildings-Type of cracks in buildings, principal causes-moisture movement, thermal variations, elastic deformation, creep, chemical reaction. Smart building Materials: Energy conservation in buildings-use of recycled materials, regional Materials and industrial waste products as means of sustainable development. Green Building Materials

Unit-IV

Plastering and Pointing: Different types of plasters and plastering process , defects in plastering.

Paints, Varnish and Distemper : Constituents, characteristics of good paints, bases, vehicles ,thinner sand coloring pigments. Painting of different types of surfaces varnish and its types, application. Distemper, dry and oil bound, and application of distemper.

Unit-V

Formwork-Types of Formwork ,types of materials used in form work-Scaffoldings- Types of Scaffoldings, Scaffolding Erection & dismantling, Scaffolding Inspection-Fire protection in structures-Classification of fire, general causes of fire, detection of fire, methods for fire control, Analysis for structural components for fire resistance (wood, steel, concrete and masonry). Damp Proof Course-Causes of dampness, effects of dampness, methods of damp proofing

Suggested Reading:

1.	V.N.Vazirani, and S.P.Chandola (1993), Engineering Materials, Khanna Publishers.
2.	Sushil Kumar(1992), Building Construction, Standard Publishers.
3.	S.P.Arora and S.P.Bindra (1999), Text book on Building Construction, Dhanpath Raj Publications.
4.	M.S.Shetty (2012), Concrete Technology, S.Chand Publishers.
5.	Gurucharan singh (2019), Building materials and construction, 17thEdition, Standard book house.

MR 701 CE	**PRINCIPLES OF SURVEYING**					
Pre-requisites	Mathematics and Engineering Drawing		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60Marks	**CIE**		40Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Understand the basic measurement techniques and equipment used in chain surveying including applicable corrections.
2.	Understand the basic measurement techniques by compass surveying and analysis of field data with applicable corrections.
3.	Understand and interpret the basic concepts of plane table surveying and levelling surveying by using different types of levelling equipment and with analysis of field data including applicable corrections.
4.	Acquire knowledge on use of Theodolite with compass and chain measurements and analysis of field data including applicable error corrections including
5.	Acquire the knowledge on working principles of various modern field Surveying equipment such as Total Station, EDM and GPS including the filed methods applicable for land surveying

Course Outcomes :	
On completion of this course, the student will be able to:	
CO-1	Apply basic land-surveying principles related to chain tools and analyze filed data related to linear and angular measurements including applicable error corrections.
CO-2	Apply basic land-surveying principles related to compass with other tools and analyze filed data related to linear and angular measurements including applicable error corrections.
CO-3	Apply the principles of plane table surveying to mapping onsite and levelling surveying to determine reduced levels and analyze these filed data with applicable error corrections and finally prepare contour maps.
CO-4	Interpret the principles of measurement of horizontal and vertical angles with Theodolite for traverse measurements and solving inaccessible object measurements with applicable trigonometrics.
CO-5	Interpret the principles of measurements made by using various modern surveying equipment such as Total Station, EDM and GPS and apply methods of measurements related to land surveying.

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2	1		1			1	1	1		1	1
CO2	3	3	2	1	2	1			1	1	1		1	1
CO3	3	2	2	1					1	1			1	
CO4	2	2	1	1										
CO5	2	2	1	1	2	1			1	1	1	2		1

Unit I

Introduction and Basic Concepts: Introduction, Objectives, classification and principles of surveying, Conventional symbols, Surveying accessories. Measurement of Distances and Directions- Linear distances- Approximate methods, Direct Methods- Chains- Tapes, ranging, Chain Corrections - Tape corrections.

Unit II

Prismatic Compass- Bearings, included angles, Free Needle Method, Fast Needle Method, Dip, Magnetic Declination, Local Attraction and corrections.

Unit III

Introduction to Plane Table surveying: Principles, Instruments used, Basic principle and methods of surveying and errors in plane table surveying.

Introduction to Levelling surveying: Principles of levelling- Instruments used - reducing levels; differential, Height of Instrument method and Rise & Fall methods, reciprocal leveling, Digital and Auto Level, contouring: Characteristics, uses; areas and volumes.

Unit IV

Theodolite Surveying: Types of Theodolites, Fundamental Lines, temporary adjustments, measurement of horizontal angle by repetition method and reiteration method, measurement of vertical Angle, Trigonometrical leveling - Base is accessible and inaccessible with all cases.

Unit V

Modern Field Survey Systems: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories – Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, Surveying with GPS.

Suggested Reading:

1.	Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2.	Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
3.	Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
4.	Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5.	Anji Reddy, M., Remote Sensing and Geographical Information System, B.S. Publications, 2001
6	Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

MR 702 CE	**FUNDAMENTALS OF GEOTECHNICAL ENGINEERING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	To provide understanding of Soil as a three phase particulate medium
2.	To learn the basic concepts of seepage, compressibility and shear strength characteristics soils
3.	To gain knowledge of Foundation systems and their suitability
4	To provide basic concepts of ground improvement Techniques

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Acquire understanding of soils as a three phase particulate medium. Ability to identify and classify the soils. Ability to understand the basic concepts of soil moisture interaction
CO-2	Learn the compressibility characteristics of soils.
CO-3	Gain basic understanding of shear strength of soils, earth pressure and slope stability analysis.
CO-4	Learn the fundamentals of Foundation systems and their suitability
CO-5	Gain basic understanding of Ground Improvement Techniques and their suitability

Articulation matrix of Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2									2	2	2
CO2	2	2		3	2				3	3				
CO3	2	2		3	2	3								2
CO4	3			2	2	3			2	2	2		2	2
CO5	2	3			3	2	1	1			1	2	3	2

Correlation rating: **Low / Medium / High: 1 / 2 / 3 respectively.**

UNIT - I

Origin & Classification of Soils: Soil as a pseudo-elastic three phase particulate medium Physical Properties of soil: Weight ratios (Water content, Density, Unit weights, Specific Gravity); Volume ratios (void ratio, porosity, degree of saturation, relative density);

Interrelationships.Classification and Identification of soils for general and engineering purposes as per IS: 1498-1970.

Basic concepts of soil moisture interaction
Soil Moisture states - Capillarity in soils - Permeability in soils – Seepage – Quick condition

UNIT - II
Basic Concepts of Compressibility of soils:
Compaction Process: Compaction Mechanism; factors affecting compaction. Laboratory determination of compaction characteristics - Field surface compaction – applications.
Consolidation Process: Spring analogy – Basic understanding about Terazaghi's theory of one dimensional consolidation (derivation not included) and related applications.
•

UNIT - III
Basic concept of Shear Strength:
Significance of Shear strength in soils - Mohr - Coulomb equation - shear strength parameters – Basic understanding about the laboratory tests - applications.
Earth Pressure: States of earth pressure - Active, passive, at rest condition; Rankine's theory: computation of active and passive earth pressure in c-less and cohesive soils;
stability of earth retaining gravity wall.
Slope stability: Definition and classification of slopes -types of slope failure – Basic understanding of stability analysis.

UNIT – IV
Introduction to Foundation Engineering:
Necessity of Foundation – Types of foundation systems.
Shallow Foundations and their suitability – Basic understanding of bearing capacity of shallow foundations – settlement of shallow foundations.
Deep foundations – Types - Pile foundations – necessity, types – basic understanding of load carrying capacity of pile foundations. Types and suitability of Pier Foundations and Caisson Foundations.

UNIT – V
Basic concepts of Ground Improvement – soil stabilization – vibro-compaction methods – pre-compression methods – soil retention systems – applications of geosynthetics.

Suggested Reading:

1.	Lambe, T.W. and Whitman, R.V., "*Soil Mechanics*", John Wiley & Sons Inc., NY, 1969.
2.	Coduto, "*Geotechnical Engineering",* Mc Graw Hill Publications
3.	Bowles, E. (2012). "Foundation analysis and Design", McGraw-Hill Publications.
4.	Das, B.M. (2012). "Principles of Foundation Engineering", Sengrece Publications.
5	Purushotham Raj, (2016), Ground Improvement Techniques, Laxmi Publications.
6	Arora, K.R., "*Soil Mechanics and Foundation Engineering*", Standard Publishers Distributors, revised and enlarged sixth edition, 2007.
7	Relevant IS Codes

LABORATORY COURSES

MR 651 CE	**BUILDING PLANNING AND DRAWING LABORATORY**					
Pre-requisites			**L**	**T**	**P**	**C**
				-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	To prepare you to design a system, component, or process.
2	To meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health, safety,
3	To prepare you to design a system for its manufacturability and sustainability

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand isometric basics and principles ,create drawings of AUTOCAD
CO-2	Able to understand symbols and sign conventions
CO-3	Detailing of Masonry bonds
CO-4	Understand terms, elements, and methods of building drawing.
CO-5	Establish fundamentals of Isometrics, building Information Modeling(BIM)

Articulation matrix of Course out comes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	2	-	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	2	2	-	2	-	2	-	-
CO3	2	2	1	-	-	-	2	2	-	2	-	2	-	-
CO4	2	2	1	-	-	-	2	2	-	2	-	2	-	-
CO5	2	2	2	-	-	-	2	2	-	2	-	2	-	-

Correlation rating: Low/Medium/High: 1/2/3respectively.

Unit-I

ISOMETRIC PROJECTIONS covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids, Draw the sectional orthographic views of geometrical solids.

AutoCAD: Setting up and use of Layers, layers to create drawings.

Unit-II

SYMBOLS AND SIGN CONVENTIONS: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Unit-III

MASONRY BONDS: English Bond and Flemish Bond–Corner wall and Cross walls- One brick wall and one and half brick wall.

Unit-IV

BUILDING DRAWING: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing, Site plan, floor plans, elevation and section drawing of small residential buildings, Foundation plan, Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes .Use of Notes to improve clarity

Unit-V

PICTORIAL VIEW: Principles of isometrics and perspective drawing, Perspective view of building, Fundamentals of Building Information Modeling (BIM)

Suggested Reading

1.	Bhatt N.D., Panchal V.M.& Ingle P.R.,(2014),Engineering Drawing, Charotar Publishing House
2.	Shah,M.B.& Rana B.C.(2008) ,Engineering Drawing and Computer Graphics, Pearson Education
3.	N.Kumara Swamy, A.Kameswara Rao, Building, Planning and Drawing, **Charotar Publishing House Pvt. Ltd. - Anand**
4.	S.S.Bhavikatti, ,M.V.Chitawadagi, Building Planning and Drawing (2014). **I K International Publishing House Pvt. Ltd**

R 751 CE	**SURVEYING LABORATORY**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	Know the importance of Theodolite, total station and their practical applications
2.	Study the basic concept of trigonometrical leveling, and field applications
3.	Analyze the horizontal and vertical curves for survey work related to Roads and Railways
4	Know the principles of aerial photogrammetry and its applications
5	Study the various concepts of GPS, GIS and remote sensing for field work.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Understand the basic working principles of theodolite and total station
CO-2	Calculation of applicable corrections to the measured values
CO-3	Computation of omitted measurements areas
CO-4	Computation of setting out data for setting out of horizontal and vertical curves by various methods
CO-5	Learn various applications of the Photogrammetry, GIS and GPS for land surveying

Articulation matrix of Course outcomes with PO's:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	2	1	3	1	1	2	1	3	1	1	1	-	1
CO2	3	2	-	1	2	-	1	1	1	1	1	1	2	-
CO3	2	2	-	1	2	-	1	1	1	1	1	1	2	-
CO4	3	2	2	2	2	2	1	1	2	1	1	2	2	2
CO5	2	2	-	3	3	1	2	1	2	1	1	2	1	2

Correlation rating: Low/ Medium/High:1/2/3respectively.

List of Experiments:

1. Applications of traversing to locate a building and field objects by taking perpendicular and oblique offsets; and recording in the field book.
2. To determine the area of the given site by cross staff survey
3. Closed traverse by chain and compass, plotting and adjustment by graphical method
4. Plane tabling: Radiation and intersection methods
5. Introduction to leveling: Fly leveling using dumpy level
6. Measurement of horizontal angles by repetition and reiteration methods using Vernier Theodolite.
7. Measurement of vertical angle: Application to simple problems of height and distance by measuring angle of elevation and depression
8. Single plane method: Determination of R.L. of an elevated Object using two Instrument Stations which are placed in a same vertical plane- when base of the Object inaccessible.
9. Two plane method: Determination of R.L. of an elevated Object using two Instrument Stations which are not placed in the same vertical plane- when base of the Object inaccessible.
10. Setting out of a simple circular curve by linear method
11. Setting out of a simple circular curve by angular method
12. Setting out of a transition curve by linear method
13. Introduction to Total station and applications: To determine difference in elevation of any two given points. The introduction includes, setting up of the Total station over a station, input values, field measurements, downloading of the data in to a computer

MR 752 CE	**FLUID MECHANICS LABORATORY**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	2-	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Calibration of flow measuring devices
2.	Verification of the Bernoulli's theorem
3.	Conduct of the Turbines and pumps experiments

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Ability to measure flow in closed conduits and flumes
CO-2	Application of Bernoulli's principle in Hydraulics
CO-3	Ability to Conduct of experiments of turbines and pumps
CO-4	Carry out to experiments independently and conduct investigations
CO-5	Develop oral and written communication and function as team person

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	-	2	1	-	-	1	2	3	-	1	2	1
CO2	3	2	-	2	1	-	-	1	2	3	-	1	2	2
CO3	3	2	-	2	1	-	-	1	2	3	-	1	2	2
CO4	3	2	-	2	1	-	-	1	2	3	-	1	2	2
CO5	-	-	1	-	-	-	-	2	3	3	-	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments:

1. Determination of C_d and C_v of an orifice
2. Calibration of a mouth piece
3. Determination of C_d of a mouth piece for unsteady flow in a hemi-spherical tank
4. Calibration of a rectangular notch

5. Verification of Bernoulli's principle
6. Calibration of a Venturimeter
7. Determination of major and minor losses in the pipes
8. Determination of Vane coefficient
9. Study of main characteristic curves of a centrifugal pump
10. Study of characteristic curves of Francis turbine.

MR 851 CE	**MR- PROJECT WORK**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	6	3
Evaluation	**SEE**	100 Marks	**CIE**		75 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	To enhance practical and professional skills.
2.	To familiarize tools and techniques of systematic literature survey and prepare documentation
3.	To expose the students to industry practices and ability to work as team.
4	To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the Academic program to real-world problems
CO-2	Ability to collect the relevant literature and information in an organized manner
CO-3	Evaluate different solutions based on economic and technical feasibility
CO-4	Effectively plan a project and confidently perform all aspects of project management
CO-5	Demonstrate effective technical write up and oral communication skills

Articulation matrix of Course outcomes with PO's:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	3	3	2	3	2	2	1	2	3	1	1	2	2
CO2	3	3	3	2	2	2	1	1	2	3	1	1	2	2
CO3	3	3	3	2	2	2	1	1	2	3	1	1	2	2
CO4	3	3	3	2	3	2	1	1	2	3	2	1	2	1
CO5	3	3	3	2	3	2	1	1	2	3			2	1

Correlation rating: Low/ Medium/High:1/2/3respectively.

The Department will initiate the project allotment to the students depending upon their choice and merit. The department will appoint a project coordinator who will coordinate the following: Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries) Grouping of students and Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to

understand current problems in their domain and methodologies to solve these problems. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5thweek to the last week of the semester which should be strictly adhered to. Each group will be required to: 1. Submit a one-page synopsis before the seminar for display on notice board. 2. Give a 30 minutes presentation followed by 10 minutes discussion. 3. Submit a technical write-up on the talk. At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above. The seminar presentation should include the following components of the project:

a. Problem definition and objectives
b. Literature survey
c. Broad knowledge of available techniques to solve a particular problem.
d. Planning of the work, preparation of bar (activity) charts
e. Presentation- oral and written.

HONORS IN CIVIL ENGINEERING

S.N0	SEMESTER	Course Code	Course Title	Scheme of Instruction			Contact Hrs/week	Scheme of Examination		Credits
				L	T	P		CIE	SEE	
1	**V**	HR 501 CE	Integrated Waste Management for smart cities	3			3	40	60	3
2	**V**	HR 502 CE	Water Resources Systems-Modeling Techniques and Analysis	3			3	40	60	3
3	**VI**	HR 601 CE	Dynamics of Structures	3			3	40	60	3
4	VI	HR 602 CE	AI ML Applications in Civil Engineering	3			3	40	60	3
5	VII	HR 701 CE	Tall Buildings	3			3	40	60	3
6	VII	HR 702 CE	Intelligent Transportation System	3			3	40	60	3
	PRACTICALS									
8	**V**	HR 551 CE	Advanced Structural Engineering Laboratory	-	-	2	2	25	50	1
9	**VI**	HR 651 CE	Advanced Water Resources Engineering Laboratory	-	-	2	2	25	50	1
`10	**VII**	HR 751 CE	Advanced Transportation Engg Laboratory	-	-	2	2	25	50	1
11	VIII	HR 851CE	HR-Project Work	-	-	6	6	50	100	3
			TOTAL	18		12	-	-	-	**18**

Note: 1.The Honor Programme in BE in Civil Engineering is offered to the Civil Engineering students from V Semester onwards.

2. Students shall complete 18 credits to be eligible to get Honors degree in Civil Engineering.
3. Students need to choose 6 subjects/ 5 subjects +3 Labs/ 5 Subjects+ Hon. Project-II
4. The list of subjects to be offered in the Major will be expanded by utilizing NPTEL/MOOCs courses from time to time by the Departmental committee

HR 501 CE	**INTEGRATED WASTE MANAGEMENT FOR SMART CITIES**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	To understand the theory and application of the finite element method for analyzing structural systems.
2.	To learn Approximation theory for structural problems as the basis for finite element methods.
3.	To learn formulations for a variety of elements in one, two, and three dimensions. Implementations of element formulations will be examined using Matlab.
4	To understand modeling and analysis of structures using planar, solid, and plate elements
5	To understand the theory and application of the finite element method for analyzing structural systems.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Describe current issues in solid waste and status in first 20 cities
CO-2	Apply fundamentals of municipal solid waste management
CO-3	Apply various disposal methods of solid waste
CO-4	Explain management of construction and demolition waste
CO-5	Explain management of electronic waste

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	2	2	2	1	1			1		1	1	1
CO2	2	2	2	2	2	1	1			1		1	1	
CO3	2	2	2	2	2							1	1	
CO4	2	2	2	2	2	1	1					1		1
CO5	2	2	2	2	2	1	1					1	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

YNIT I
INTPOΔYXTION TO ΣOΛIΔ ΩAΣTE MANAΓEMENT:

Municipal Solid Waste Sources; composition; generation rates Swachh Bharat Mission and Smart Cities Program, Current Issues in Solid Waste Management and Review of MSW Management Status in First List of 20 Smart Cities in the Country.

UNIT –II

MUNICIPAL SOLID WASTE MANAGEMENT – FUNDAMENTALS- Municipal Solid Waste, Characteristics and Quantities, Collection, Transportation, Segregation
and Processing.

UNIT-III

DISPOSAL OF MUNICIPAL SOLID WASTE- Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid- Waste. Municipal Solid Waste (MSW) Rules 2016.

UNIT-IV

CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT- Overview of C&D Waste – Sources, Effects, and Regulations, Beneficial Reuse of C&D waste Materials

UNIT-V

ELECTRONIC WASTE (E-WASTE) MANAGEMENT- Sources, Effects, Issues and Status in India and globally, controlling measures, E-Waste Management Rules 2016 and Management Challenges

Suggested Reading:

1.	William A Worrell and P. AarneVeslind, "Solid Waste Engineering", 2nd Edition cengage Learning, 2012 (ISBN-13: 978-1-4390-6217-3)
2.	George Tchobanoglous, Hilary Theisen and Samuel A Vigil, "Integrated Solid Waste Management", Tata McGraw Hill, 1993.
3.	The Central Public Health and Environmental Engineering Organization (CPHEEO), "Manual on Solid Waste Management", India, 2016
4.	. "Municipal Solid Waste Management Rules 2016", Central Pollution Control Board, Govt. of India, 2016.
5	"Electronic Waste Management Rules 2016", Central Pollution Control Board, Govt. of India, 2016.
6	"Construction and Demolition Waste Management Rules 2016", Ministry of Environment and Forest and Climate Change, Govt. of India, 2016.

HR 502CE	**WATER RESOURCES SYSTEMS- MODELING TECHNIQUES AND ANALYSIS**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Introduction to various steps in water resources systems approach.
2.	Economic decision making in water resources.
3.	Identification of decision variables for linear and dynamic programming models and solution procedures for simple problems.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Ability to understand water resources systems concepts their stages and procedures.
CO-2	Application of Cash flow diagrams and solution to Water Resources problems based on economic aspects
CO-3	Ability to formulate WRE problems by L.P. and D.P models and solving simple problems.
CO-4	Ability to decide based on economic evaluation criteria for decision making of simple water Resources systems
CO-5	Ability to formulate L.P models for water Resources systems problems

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	2	2	2	1	1			1		1	1	1
CO2	2	2	2	2	2	1	1			1		1	1	
CO3	2	2	2	2	2							1	1	
CO4	2	2	2	2	2	1	1					1		1
CO5	2	2	2	2	2	1	1					1	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT

Introduction: Objectives of water resources development, plan formulation, planning models and solution procedures, basic steps involved in water resources systems approach, cash flow diagrams, annuities, discounting (Net Present Value, Internal Rate of Return, and Benefit Cost Ratio), and non-discounting techniques (urgency, payback, and average rate of return), cost comparison, determination

of project benefits, economic and financial analysis of projects.

UNIT II

Water Resources Planning: Concept of Water Resources Planning, Categories of Water Use, Stages and Flow Activities, Relationship among stages, Data Collection and Processing, Estimation of Future Water Demands for Irrigation, Municipal Use, Industrial and Hydropower, Planning for Operation.

UNIT-III

Optimization techniques: Linear programming (introduction, geometrical approach and interpretation, basic concepts of simplex method), Dynamic Programming (basic concepts, general approach to recursive optimization, formulation of multistate problems), application to water resources engineering problems

UNIT-IV

Stochastic optimization: Introduction to stochastic linear and stochastic dynamic programming, two stage linear programming, linear programming with chance constraints. Simulation: Basic concepts and application to water resources engineering problems

UNIT-V

River basin planning models: Irrigation planning model, resource inputs of irrigation, crop diversification, costs of inputs, formulation of linear programming models for single reservoir, multi reservoir cases with single and multiple objectives.

Suggested Reading:

1.	Loucks, D. P., Stedinger, J. R., and Douglas, A.H. 'Water Resources Planning and Analysis', Prentice-Hall, New York. 1981
2.	Kuiper Edward (1965), 'Water Resources Project Economics', Butterworths and Company Ltd., London.
3.	Jain, S.K. and Singh V.P. '*Water Resources Systems Planning and Management*', Elsevier Science, B.V., Amsterdam. 2003
4.	Taha, H. A. 'Operations Research an introduction', Prentice-Hall of Indial, New Delhi. 1982
5	Pramod. A. Bhave "*Water Resources Systems*" Narora Publishing House, 22, Medical Association Road, Dharyagunj, New Delhi, 2011
6	Vedula S and P P Mujumdar Water Resources Systems Modelling Techniques and Analysis , TMH Publishers, 2017.

HR 601 CE	**DYNAMICS OF STRUCTURES**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Study the various types as well as characteristics of loading and formulate the equations of motion.
2.	Learn the response of un-damped and damped SDOF and MDOF systems under various loadings
3.	Learn the response of un-damped and damped SDOF and MDOF systems under various loadings
4.	Use the seismic codes in analysis and design of civil engineering structures.
5	Understand the dynamic response by numerical methods.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Formulate dynamic equation of motions for given conditions and analysis methods for dynamic systems.
CO-2	To determine the displacement of SDOF system subjected to various dynamic loading
CO-3	To determine the displacement of MDOF system subjected to various dynamic loading using different methods of analysis
CO-4	To determine the displacement of MDOF system using approximate method of analysis.
CO-5	Apply the structural dynamics theory to earthquake analysis, response, and design of structures

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO2	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO3	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO4	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO5	3	2	1	2	1	-	-	1	1	1	-	2	1	-

Correlation rating: Low/ Medium/ High:1/2 /3respectively.

UNIT - I

Introduction to Structural Dynamics: Objectives of dynamic analysis–Types of prescribeddynamic loading – Characteristics of a dynamic problem – Methods of discretization: Lumped mass Procedure

/ Consistent mass procedure/generalized displacements

Single Degree Freedom Systems–Formulation of Equation of Motion: D"Alemberts"s Principle / Method of Virtual Work– Influence of Gravity Forces and Ground Motion on equation of motion – Generalised SDOF systems: Rigid Body Assemblage

UNIT - II

Single Degree of Freedom Systems: Response of Un-damped/Damped free vibrations of SDOF systems – Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading, Resonant Response / Vibration Isolation – Un-damped / Damped vibrations of SDOF systems subjected Periodic loading Response of SDOF systems subjected Impulse loads: Half-sine pulse/Rectangular pulse/Triangular Pulse/ Shock spectra / Approximate method of impulse load analysis.

UNIT - III

Multi Degree Freedom Systems: Formulation of Equations of Motion / Evaluation of Lumped-Mass Matrix and consistent mass matrix/ Evaluation of Stiffness Matrix. Un-damped Free Vibrations: Analysis of Frequency matrix and mode shape matrices using detrimental equation, Orthogonality Conditions/ Normalizing Mode shapes/Analysis of Dynamic Response/Normal Coordinates/ Uncoupled Equations of Motion for un-damped systems/Conditions for damping orthogonality – Mode super position procedure for damped forced vibration

UNIT – IV

Practical Vibration Analysis: Stodola Method, Holtzer Method–Fundamental mode only, Reduction of degrees of freedom, basic concepts in matrix iteration

UNIT - V

Earthquake Resistant Design: Brief exposure to relevant IS Codes of Practice, analysis by Equivalent static method, Response Spectra method.

Suggested Reading:

1.	Clough, Ray. W, and Penzien, Joseph. "Dynamics of Structures", 3rd addition 1993 Tata McGraw Hill Company Limited, New Delhi
2.	Anil K Chopra "Dynamics of Structures: Theory and Applications to Earthquake Engineering", 5th edition 2019 Prentice-hall International Series I Civil Engineering and Engineering Mechanics
3.	Mario Paz (Author), Young Hoon Kim (Author)"Structural Dynamics: Theory and Computation", 6th edition 2018 Springers publication
4.	Patrick Paultre "Dynamics of Structures", 1st edition 2011 Wiley publication
5.	Douglas Thorby "Structural Dynamics and Vibration in Practice", 1st edition 2008 Butterworth-Heinemann is an imprint of Elsevier

HR 602 CE	**AI ML APPLICATIONS IN CIVIL ENGINEERING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Introduction to concepts of Artificial networks, supervised learning, Support vector machines.
2.	Fundamental concepts of Machine learning.
3.	Understanding of AI- MI models for Civil Engg field

Course Outcomes	
On completion of this course, the student will be able to :	
CO-1	Ability to understand soft computing concepts, methods and technical terms their stages and procedures.
CO-2	Ability to understand the machine learning concepts and their applicability
CO-3	Ability to understand and formulate the fuzzy logic concepts.
CO-4	Ability to understand the Genetic Algorithm concepts
CO-5	Applications of AI-MI models to Civil Engineering problems

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	2	2	2	2	2	1	1			1		1	1	1
CO2	2	2	2	2	2	1	1			1		1	1	
CO3	2	2	2	2	2							1	1	
CO4	2	2	2	2	2	1	1					1		1
CO5	2	2	2	2	2	1	1					1	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Neural Networks: Fundamental concepts, Biological Neural networks, Basic Models in Neural networks, Comparison of Biological Neuron and artificial neuron, terminology of Neural networks. Supervised learning networks and calculation of error. Back propagation networks (algorithm and architectures). Self-organizing feature maps; Numerical examples. Support Vector Machines- Optimality conditions, Decision

Tree algorithms, Random forests

UNIT II

Machine Learning I: Unsupervised Learning and Generative - Nearest Neighbour: k-nearest neighbour, Curse of dimensionality - Clustering: Linkage-based clustering algorithms, k-means algorithm, Spectral clustering - Dimensionality reduction: Principal Component Analysis, Feature Selection and Generation: Feature selection, Feature transformations, Feature learning.

UNIT III

Fuzzy sets: Introduction to fuzzy sets and classical sets, fuzzy set operations and properties. Fuzzy relations, fuzzy membership functions, Fuzzy logic, fuzzy quantifiers and fuzzy inferences. fuzzy rule based methods and defuzzification methods. Application of fuzzy methods in water resources.

UNIT IV

Genetic Algorithms: Fundamentals of genetic algorithms, basic concepts, binary coding, fitness function, Reproduction, (Roulette wheel selection, Tournament selection). Cross over and mutation operations, convergence of algorithm. Simple applications in water resources.

UNIT V

Application and Case studies of AI & MI models to Structural Engineering, Water Resources Engineering, Transportation Engineering and Environmental Data -Assessment of Surface water quality parameters - Applications of Neural Networks in Civil Engineering including flood forecasting-

Suggested Reading:

1.	Applied Multivariate Statistical Analysis, Johnson, R. A. and Wichern, D. W.,Pearson Prentice Hall, Sixth Edition, 2007.
2.	Vedula S. and. Mujumdar P.P. 'Water resources Systems', McGraw-Hill Publishing Company, New Delhi. 2005
3.	Understanding Machine Learning: From Theory to Algorithms, Shalev-Shwartz,S., Ben-David,S., Cambridge University Press, 2014.
4.	Raja Sekharan S. and Vijaya Laxmi Pai G. A. , 'Neural Networks, Fuzzy Logic, and Genetic Algorithm', Prentice-Hall of India, New Delhi. 2003
5	Patterson, D.W, Introduction to Artificial Intelligence & Expert Systems, First edition, Pearson Education India, 2015

HR 701 CE	**TALL BUILDING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Demonstrate the influence of various design parameters and limitations in the design of tall structures
2.	Understand various loads acting on tall building structure including its combinations Demonstrate various methods of design of tall buildings
3.	Understand suitable form and configuration of structural systems
4.	Understand modeling of the structure and its behaviour
5	Understand the behavior of shear wall structures and its analysis

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Describe the development of tall building structure including loading and other serviceability parameters.
CO-2	Discuss about various types of loads, combinations and its influence on tall buildings.
CO-3	Demonstrate various types of structural forms and its applications.
CO-4	Modeling for analysis of Rigid frame building structure
CO-5	Analyse shear wall system, wall frame system of tall buildings.

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	1	1	1	1	-	2	1	1
CO2	3	2	2	2	2	1	1	1	1	1	-	2	1	1
CO3	3	2	2	2	2	1	1	1	1	1	-	2	1	1
CO4	3	2	2	2	2	1	1	1	1	1	-	2	1	1
CO5	3	2	2	2	2	1	1	1	1	1	-	2	1	1

Correlation rating: Low/ Medium/ High:1/2 /3 Respectively.

UNIT - I

Introduction – Factors affecting growth, Height and structural form – Tall building structure – Philosophy – Design criteria– Design process– Design philosophy – Loading – Strength and Stability – Stiffness and Drift limitations – Human comfort criteria – Creep, shrinkage and temperature effects

– Fire – Foundation settlement and soil-structure interaction.

UNIT - II

LOADING ON TALL BUILDINGS Introduction – Gravity loading including live load and its reduction – Impact load due to elevators – Construction loads. Wind loading- Load Combinations as per BIS-Methods of Design.

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UNIT - III

STRUCTURAL FORM Introduction – Braced frame structures – Rigid frame structures –

In-filled frame Structures – Flat plate and Flat slab structures – Shear wall structures including coupled walls– Dual structures(wall frame structures)– Framed-Tube structures –Outrigger-Braced Structures – Suspended structures – Core structures – Space Structures – Hybrid Structures Different R.C. floor systems.

UNIT – IV

MODELING FOR ANALYSIS: Introduction – Approaches to analysis – Assumptions – High-Rise Behavior – Modeling for Approximate analysis – Modeling for Accurate Analysis – P-Delta effects – Wide Column Deep beam analogies etc.

UNIT - V

SHEAR WALL STRUCTURES Introduction – Behavior of shear wall structures – Analysis of proportionate wall systems - and Non proportionate structures and its behavior - Effects of Discontinuities at Base – coupled shear wall structure –Behaviour – Methods of Analysis (limited to theory only – Computer analysis.) (Only for practice and not included in the exam)

Suggested Reading:

1.	.John D Holmes, Wind Loading of Structures,Spon Press, 2003
2.	PankajAgarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, 9th edition, PHI Learning Private Limited,New Delhi, 2011
3.	IS 456 : 2000 or latest. 4.IS 1893 (Part 1) : 2016 or latest 5.IS 13920: 2016 or latest 6.IS 875 (Part 1 to Part 5) latest. 7.IS 16700 : 2017 : Criteria for structural safety of Tall Concrete Buildings.
4.	*Bungale S. Taranath Wind and Earthquake Resistant Buildings CRC press Taylor and Francis group 2019*
5.	*Bungale S. Taranath Reinforced Concrete Design of Tall Buildings CRC press Taylor and Francis group 2010*

HR 702CE	INTELLIGENT TRANSPORTATION SYSTEM					
Pre-requisites	**Transportation Engineering**		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60Marks	**CIE**		40Marks	

Course Objectives

1. To understand theory of problems of traffic flow and definitions of ITS
2. To learn traffic data acquisition techniques, technologies, deployment plans and their usage
3. To learn various applications of ITS
4. Study on ITS architecture and its planning
5. Learn various applications of ITS for solving traffic flow problems

Course Outcomes

1. Understand of the basic definitions and historical developments of ITS
2. Ability of understand various data collection techniques using various technologies applicable to ITS
3. Functional areas of ITS and their conceptual uses
4. Gain knowledge on ITS architecture and its planning
5. Ability to understand various applications of ITS for solving traffic flow problems

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	2								2	
CO2	2	2	2	2	2								2	1
CO3	2	2	3	1	1		1					1	2	2
CO4	2	2		1	2		1				2		2	2
CO5	2	2	2	1	2		1				2	1	1	1

Correlation rating: Low/ Medium/High:1/2/3 respectively

UNIT-1

Fundamentals of Intelligent Transportation System (ITS): Introduction to ITS, Traffic Problems,Definition of ITS, Objectives of ITS, Benefits of ITS, The historical Context of ITS and Types of ITS.

UNIT-2

Data Requirements for ITS: ITS data collection Techniques and technologies used- types of Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Virtual, WIM Station, GIS, data collection using Videos. Importance of telecommunications in the ITS system. Information Management, Traffic Management Centres (TMC). Application of sensors to Traffic management.

UNIT-3

Functional Areas of ITS: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation System (APTS), Advanced Rural Transportation Systems (ARTS), ITS User Needs and Services – Travel and Traffic Management, Emergency Management.

UNIT-4

ITS Architecture: Regional and Project ITS architecture; Concepts of operations; ITS and safety; and ITS security. ITS as a technology deployment program, research, development and business models/modules, ITS Planning.

UNIT-5

ITS Applications: Traffic and Incident Management Systems; electronic toll collection, ITS and Road-pricing, Automated highway systems-Vehicle in platoons-Integration of Automated Highway System, ITS Programs in the world- Overviews of ITS implementation in developed countries, ITS in developing countries.

Suggested Readings:

1. Srinivasa Kumar R, Intelligent Transportation Systems, Universities Press, 2021.
2. Joseph S.S**.,** Perspectives on Intelligent Transportation Systems, Springer, 2017.
3. Chowdhury MA and Sadek A., Fundamentals of Intelligent Transportation Systems Planning, Artech House, USA, 2003.
4. Kan Paul Chen and Jhon Miles, Intelligent Transportation Systems- Hand Book, Recommendations for World Road Association (PIARC), 2000.
5. Paolo Pagano (Editor), Intelligent Transportation Systems from Good Practices to Standards, CRC Press, 2016.

LABORATORIES

HR 551 CE	ADVANCED STRUCTURAL ENGINEERING LABORATORY					
Pre-requisites	**Concrete Technology lab**		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	To study the concrete mix design of High strength concrete and investigate variousmix proportions.
2.	Learn to determine various properties of HYSD bars.
3.	Carry out Strength tests and Nondestructive tests on concrete.
4.	Understand structural behaviour of RC beams.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Design the mix proportion for High strength concrete.
CO-2	Evaluate the mechanical properties of High strength concrete and correlate its various properties.
CO-3	Evaluate the properties of HYSD bars and understand the effect of cyclic loadingon steel.
CO-4	Perform Nondestructive tests on concrete structures
CO-5	Assess the behaviour of beams under flexural and shear.

Articulation matrix of Course outcomes with PO"s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	1	2	1	1	1	1	1	1	-	2	1	-
CO2	3	3	1	2	1	1	1	1	1	1	-	2	1	-
CO3	3	3	1	2	1	1	1	1	1	1	-	2	1	-
CO4	3	3	1	2	1	1	1	1	1	1	-	2	1	-
CO5	3	3	1	2	1	1	1	1	1	1	-	2	1	-

Correlation rating: Low/ Medium/ High:1/2 /3respectively

LIST OF EXPERIMENTS

1. To investigate the basic properties of ingredients used in proportioning of concrete.
2. To design the mix and determine fresh properties for High Strength Concrete.
3. Study of stress-strain curve of high strength concrete, correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
4. To carry out tests on HYSD bars and study the effect of cyclic loading on steel.
5. Non Destructive tests on existing concrete structures.
6. To investigate the structural behaviour of RC beams and measure strains.

HR 651 CE	**Advanced Water Resources Engineering Laboratory**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Learning of MATALB
2.	Understanding and Usage of Softwares related to WRE
3.	Expose students to various softwares

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Ability to Write, compile and debug MATLAB programs in Water Resources Engineering related Problems.
CO-2	Ability to solve complex problems using Advanced Approaches and softwares such SDSM and HEC-HMS
CO-3	Ability to use and apply Softwares to WRE problems especially CFD, GIS & EPANET

Articulation matrix of Course outcomes with PO's:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	2	2	3	1	2	1	2	2		1	3	1
CO2	3	2	2	2	3	1	2	1	2	2		1	3	1
CO3	3	2	2	2	3	1	2	1	2	2		1	3	1

Correlation rating: Low/ Medium/High:1/2/3respectively.

List of Experiments:

1. Flood routing by Muskinghum Method by MATALB
2. FITTING DISTRIBUTION for DATA
3. Application of ANN models for hydrology especially for Rainfall Runoff studies.
4. Design of Irrigation channel
5. Determination of Phi-Index

6. Development of Unit Hydrograph.
7. Assessment of SPI index.
8. Climate change applications using SDSM software
9. Application of EPANET software for Network of Pipe design
10. Application of HEC-HMS to simulate precipitation and Runoff Process in a watershed
11. Applications of Computational Fluid Dynamics (CFD)
12. To study various application of GIS in water resources.

HR 751 CE	**Advanced Transportation Engineering Laboratory**					
Pre-requisites	Transportation Engineering		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	Learn conduct of traffic Engineering and conduct of Traffic surveys
2.	Understand to conduct of spot speed under different conditions
3.	Expose students to Traffic Signal design Webster's method under different conditions

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Ability to conduct and perform traffic surveys under different situations
CO-2	Ability to conduct the spot speed survey under different conditions
CO-3	Ability to design Traffic Signal design by

Articulation matrix of Course outcomes with PO's:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	2	2	2	2	2	1		2	1			2	2
CO2	2	2	2	2	2	2	1		2	1			2	2
CO3	2	2	2	2	2	2	1		2	1			2	2

Correlation rating: Low/ Medium/High: 1/2/3respectively.

List of Experiments:

1. Introduction to traffic engineering and the surveys
2. Traffic volume count survey at a mid-block section of a two-way road
3. Traffic flow directional distribution survey at four-legged road intersection
4. Traffic flow directional distribution survey at three-legged road intersection
5. Traffic flow directional distribution survey at a Roundabout intersection
6. Spot speed survey
7. Speed and delay study by moving observer method
8. Speed and delay study at signalised intersection

9. Traffic Signal design by Webster's method for a Three-legged intersection
10. Traffic Signal design by Webster's method for a Four-legged intersection
11. Study on capacity determination of weaving sections of a Roundabout Intersection
12. Parking surveys

HR 851 CE	**HR-PROJECT WORK**					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	6	3
Evaluation	**SEE**	150 Marks	**CIE**		75 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	To enhance practical and professional skills.
2.	To familiarize tools and techniques of systematic literature survey and prepare documentation
3.	To expose the students to industry practices and ability to work as team.
4	To encourage students to work with innovative and entrepreneurial ideas

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Demonstrate the ability to synthesize and apply the knowledge and skills acquired in the Academic program to real-world problems
CO-2	Ability to collect the relevant literature and information in an organized manner
CO-3	Evaluate different solutions based on economic and technical feasibility
CO-4	Effectively plan a project and confidently perform all aspects of project management
CO-5	Demonstrate effective technical write up and oral communication skills

Articulation matrix of Course outcomes with PO's:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	3	3	2	3	2	2	1	2	3	1	1	2	2
CO2	3	3	3	2	2	2	1	1	2	3	1	1	2	2
CO3	3	3	3	2	2	2	1	1	2	3	1	1	2	2
CO4	3	3	3	2	3	2	1	1	2	3	2	1	2	1
CO5	3	3	3	2	3	2	1	1	2	3			2	1

Correlation rating: Low/ Medium/High:1/2/3respectively.

The Department will initiate the project allotment to the students depending upon their choice and merit. The department will appoint a project coordinator who will coordinate the following: Collection of project topics/ descriptions from faculty members (Problems can also be invited from the industries) Grouping of students and Allotment of project guides

The aim of project work is to develop solutions to realistic problems applying the knowledge and skills obtained in different courses, new technologies and current industry practices. This requires students to

understand current problems in their domain and methodologies to solve these problems. After completion of these seminars each group has to formalize the project proposal based on their own ideas or as suggested by the project guide. Seminar schedule will be prepared by the coordinator for all the students from the 5thweek to the last week of the semester which should be strictly adhered to. Each group will be required to: 1. Submit a one-page synopsis before the seminar for display on notice board. 2. Give a 30 minutes presentation followed by 10 minutes discussion. 3. Submit a technical write-up on the talk. At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3items stated above. The seminar presentation should include the following components of the project:

a. Problem definition and objectives
b. Literature survey
c. Broad knowledge of available techniques to solve a particular problem.
d. Planning of the work, preparation of bar (activity) charts
e. Presentation- oral and written.