CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)
CIVIL ENGINEERING DEPARTMENT

Vision and Mission of the Department

VISION

To strive for excellence in academics, research and consultancy in the field of Civil Engineering and contribute to the sustainable development of the country by producing quality Civil Engineers with professional and ethical values.

MISSION

- Maintaining high academic standards to develop analytical thinking and independent judgment among the students so that they are fit for industry and higher studies.
- Promoting skills and values among the students to prepare them as responsible global citizens who can solve complex problems.
- Preparing the students as good individuals and team members with professional attitude, ethics, concern for environment and zeal for lifelong learning who can contribute to society.

Program Educational Objectives(PEOs)

The PEOs are to facilitate the graduating students to

PEO1:Acquire basic knowledge and expertise necessary for professional practice in Civil Engineering for higher studies and research.
PEO2: Attain and practice technical skills to identify, analyze and solve complex problems and issues related to Civil Engineering.
PEO3: Possess a professional attitude as an individual or a team member to work for the betterment of the society and environment.
PEO4: Work with professional ethics as refined technocrats with a thirst for lifelong learning.

Program Specific Objectives (PSOs)

The graduates of this program will

1. Effectively apply engineering fundamentals for the development and management of eco-friendly Civil engineering systems which benefit the society at large.
2. Develop the ability to provide solutions to complex problems in civil engineering through individual and team work with a spirit for lifelong learning
3. Develop the competence to plan, build and maintain sustainable infrastructural facilities like housing, water management, transportation and geotechnical services.

R 18 Curriculum
(V – VIII Semesters)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Model Curriculum (with effect from 2020-2021)

B.E (CIVIL ENGINEERING)

SEMESTER – V

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1	18CE C13	Transportation Engineering	3	-	-	3	30	70	3
2	18CE C14	Geotechnical Engineering	3	-	-	3	30	70	3
3	18CE C15	Structural Analysis-II	3	-	-	3	30	70	3
4		Core Elective 1	3	-	-	3	30	70	3
5		Core Elective 2	3	-	-	3	30	70	3
6	18MB C01	Engineering Economics and Accountancy	3	-	-	3	30	70	3
	PRACTICALS								
7	18CE C16	Transportation Engineering Lab	-	-	2	2	15	35	1
8	18CE C17	Geotechnical Engineering Lab	-	-	2	2	15	35	1
9	18CE C18	Auto CAD Lab	-	-	2	2	15	35	1
Total			**18**	**-**	**06**		**225**	**515**	**21**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Core Elective 1:

1. 18CE E01 - Pre-stressed Concrete
2. 18CE E02 - Green Building Technologies
3. 18CE E03 - Principles of Geographic Information systems
4. 18CE E04 - Masonry Structures

Core Elective 2:

1. 18CE E05 - Solid and hazardous waste management
2. 18CE E06 - Mechanics of Materials
3. 18CE E07 - Repair and Rehabilitation of Structures
4. 18CE E08 - Concrete Technology

18CE C13

TRANSPORTATION ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. To understand the design concepts of the highways, the quality of the materials required for the construction of highways and different techniques used in construction of flexible and rigid pavements.
2. To know how to collect the field data for the evaluation of traffic patterns.
3. To get an idea about the concepts of designing flexible and rigid pavements.
4. To know the construction techniques of pavements
5. To Know about pavement failures and maintenance of pavements

Course Outcomes: At the end of the course, the students will be able to

1. Understand the types of highways, patterns, master plans, alignment finalization and components of highway projects.
2. Apply various IRC Standards for the Geometric design of highways.
3. Organize collection of traffic related data and analysing the data for different applications
4. Apply the design concepts to flexible and rigid pavements as per IRC standards.
5. Understand precautions required for the execution of construction of pavements as per IRC standards, pavement distress, pavement maintenance, evaluation of pavement condition and recommend suitable remedial measures.

UNIT- I:

Highway alignment: Objectives and phases of highway engineering, history of highway engineering, factors to be considered for highway alignment, engineering surveys current road project in India and concepts of master plan road pattern highway project preparation, classification as per IRC.

UNIT- II:

Geometric Design: Highway standards (IRC)- carriageway, shoulders, medians, right of way, footpaths, cycle tracks, service roads, frontage roads, sight distance, stopping sight distance, overtaking sight distance. Camber, horizontal curves, super-elevation, transition curve, extra widening, gradient, grade compensation and design of vertical curves with numerical examples.

UNIT- III:

Traffic Engineering: Objectives of traffic studies, traffic characteristics, volume, speed, density, headways and relationship among them. Traffic volume studies, speed and delay studies, parking and accident studies. Intersection delay studies, highway capacity and level of service concept as per HCM 2000, origin and destination studies, intersection improvement studies at grade, and types of grade separated intersections, channelization, rotary planning and design, concept of signal design.

UNIT- IV:

Pavement Design: Various properties of highway materials, pavement types, factors to be considered for pavement design, structural difference between flexible and rigid pavement design. Flexible pavement design - concept of layer theory, design wheel load, ESWL, EALF. IRC cumulative standard axles method (IRC - 37: 2018).

Rigid pavement design (IRC 58-2015): Concepts -radius of relative stiffness, Modulus of subgrade reaction and other characteristics of concrete, wheel load stresses analysis by Westergaards, temperature stresses and critical combination of stresses. Longitudinal and transverse joints, contraction joints, expansion joints, construction joints, design of dowel bars and tie bars.

UNIT- V:

Pavement Construction and Maintenance: Construction of WBM roads and WMM roads, types of bituminous construction- interface treatment, bituminous surface dressing, seal coat, penetration macadam, built up spray grout, pre-mix methods, bituminous macadam, bituminous pre-mix carpet, bituminous concrete, bituminous sheet asphalt, mastic asphalt. Construction procedures– surface dressing, penetration macadam, built- up spray grout, bituminous bound macadam and bituminous concrete. Construction of cement concrete pavements and construction of joints.Pavement distress, failures of flexible and rigid pavements, remedial measures including maintenance.

Text books:

1. S. K. Khanna, C. E. G. Justo, and A. Veeraraghavan, "*Highway Engineering*", revised 10th Edition, Nem Chand & Bros., 2017.
2. L. R. Kadiyali, '*Traffic Engineering and transport planning'*, Khanna Publishers.2011.
3. S.K. Sharma, "principles, Practice and Design of Highway engineering", S. Chand Publishers, 2015.
4. R.Srinivas Kumar, "*Transportation Engineering*", Universities Press, 2020

Suggested Reading:

1. Fred L. Mannering and Scott S. Washburn, "*Principles of Highway Engineering and Traffic Analysis*", 4th Edition, John Wiley, 2007
2. R. Srinivasa Kumar," *Pavement Evaluation, Maintenance and Management systems*", Universities Press, 2014.
3. L. A. Garber and N. J. Hoel, K. RamachandraRao, "*Traffic and Highway Engineering*, 5th Edition, 2017. Cengage learning India Pvt. Ltd., New Delhi
4. R. Srinivasa Kumar, "Textbook *of Highway Engineering*", Universities Press, 2011.
5. Dr. L.R. Kadiyali and Dr. N.B. Lal, "Principles and Practices of Highway Engineering", Khanna Publishers, 2018.
6. IRC 37:2018, "Flexible pavement design".
7. IRC 58:2015, "Rigid pavement design".

18CE C14

GEOTECHNICAL ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks CIE 30 Marks
Credits	3

Course Objectives: To enable the students

1. Understand the basic principles of soil mechanics, properties of soils and knowledge of identifying soil.
2. Understand the flow through soils and its behavior and gain a practical outlook of utilizing soil as construction materials.
3. Understand highly compressible soil settlements and estimate the strength of soil for different loading conditions.
4. Identify shear strength parameters of soil using different laboratory tests.
5. Interpret problem of earth pressures and slope stability under different field conditions.

Course Outcomes: At the end of the course, the student will be able to

1. identify various types of soils and determine their properties.
2. estimate coefficient of permeability, stresses in soils under various soil conditions and compute discharge in soil.
3. modify the properties of soil by using various compaction methods and compute the settlement of compressible soils.
4. estimate the shear strength of different soils under various loading conditions.
5. evaluate earth pressures and slope stability under different field conditions.

UNIT- I:

Physical and Index properties of soils: Introduction about origin and formation of soils, basic definitions from soil three phase diagram (weight ratios & volume ratio), Inter relationships of preliminary properties. Determination of laboratory tests for water content, field density, specific gravity by various methods, Index properties, sieve analysis, consistency limits, Indian soil classification IS-1498-1970.

UNIT- II:

Permeability of soils: Darcy's. law of seepage water through soils- Determination of co-efficient of permeability (constant head, variable head permeability tests) – Field tests (Pumping in and pumping out tests) – Equivalent permeability of stratified soils.

Stress in Soils: Total, effective and neutral stress for different soil conditions.

Seepage in Soil: Seepage flow, seepage pressure – Flow nets – Locating phreatic line in a homogeneous earthen dam using Kozeny's parabola – computation of seepage quantity.

Quick Sand Phenomena: Critical Hydraulic gradient.

UNIT- III:

Compaction: Compaction Mechanism, factors affecting compaction. Laboratory determination of compaction characteristics- standard and modified Proctor tests – IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.

Consolidation: Spring Analogy, Laboratory consolidation test, calculation of void ratio, compression characters and settlement equation, differential equation for one dimensional consolidation, co-efficient of consolidation - square root & logarithm time fitting method.

UNIT- IV:

Shear strength: Significance of Shear strength of soils – Mohr-Coulomb equation – shear parameters – Laboratory tests for determination of shear strength – Direct shear test, Tri-axial compression tests. (UU, CU and CD), Un-confined compression test, Vane shear test. Factors affecting shear strength of cohesionless and cohesive soils.

UNIT- V:

Earth pressure: States of earth pressure – Active, Passive and at rest condition; Rankine's theory; computation of active and passive earth pressure in cohesionless (ø)& Cohesive (c) soils and c-ø soils; Coulomb's Wedge theory; Rebhann's graphical solution.

Slope stability: Definition and classification of slopes – types of slope failures- Factors of safety with respect to cohesion, angle of shearing resistance, Height – Analysis of stability of slope using Swedish slip circle method and Taylor's stability number.

Text Books:

1. K. R. Arora, "Soil Mechanics and Foundation Engineering", Standard Publisher Dist.; 7th Edition, 2009
2. B. C. Punmia, A. K Jain, and A. K. Jain "Soil Mechanics and Foundations", Laxmi Publications; Sixteenth edition, 2017.

Suggested Reading:

1. R. F. Scott, "Principles of Soil Mechanics", Wesley Educational Publishers Inc., 1st edition, 1963.
2. T. W. Lambe and R. V. Whitman, "Soil Mechanics", Wiley; 1 edition, 2012.
3. GopalRanjan, "Basic and Applied Soil Mechanics", New Age International Pvt Ltd; Third edition 2016.
4. C.Venkatramaiah, "Geotechnical Engineering", New Age Publications, revised Fifth edition, 2017.
5. B. M. Das and K. Sobhan, "Principles of Geotechnical Engineering", NPTEL study material.
6. IS 2720-11: Methods of test for soils, Part 11: Determination of the shear strength parameters of a specimen tested in unconsolidated undrainedtriaxial compression without the measurement of pore water pressure..

18CE C15

STRUCTURAL ANALYSIS – II

Instruction:	3L Hours per week	
Duration of Semester End Examination:	3 Hours	
Semester End Examination:	70 Marks	CIE: 30 Marks
Credits:	3	

Course Objectives: To enable the student

1. Understand the concept of drawing influence line diagrams (ILDs), for reactions, shear force and bending moment in determinate beams for various loads.
2. Grasp the procedure of constructing influence line diagrams for different truss girders under various types of loads and to find maximum forces in the members of trusses. Understand the concept of determining, deflections in determinate trusses and rigid jointed frames, by Castigliano's theorem –I and unit load method.
3. Gain the knowledge of analyzing three hinged arches for point loads and uniformly distributed loads. Know the concept and analysis of cables and suspension bridges with three hinged stiffening girder.
4. Know how to analyse continuous beams without and with sinking of supports by using slope displacement, moment distribution and Kani's method.
5. Know how to analyse rigid jointed plane frames without and with sway by using slope displacement, moment distribution and Kani's method.

Course Outcomes: At the end of the course, the student will be able to

1. develop the ILD's for reactions, shear force and bending moment at a section, determine the maximum SF and BM for various positions of the moving point loads and uniformly distributed loads.
2. construct the ILD's for forces in the members of trusses and evaluate the maximum forces for various positions of the moving point loads and uniformly distributed loads.
determine the deflections of determinate truss joints by Castigliano's theorem - I and unit load method.
3. analyze three hinged arches for point loads and uniformly distributed loads. analyze cables and suspension bridges with three hinged stiffened girder.
4. apply slope deflection, moment distribution, and Kani's methods for indeterminate beams with and without sinking of supports subjected to point loads and udl on the entire span.
5. analyze rigid jointed plane frames with and without lateral sway using slope deflection, moment distribution, and Kani's methods subjected to point loads and udl on the entire span.

UNIT– I:

Moving loads: Influence line diagrams for support reactions, shear force and bending moment for a simply supported beam/girder. Determination of maximum values of support reactions, shear force and bending moment at any section for various moving load systems on simply supported beam/ girder. Curves of maximum shear force and bending moment for simply supported girders traversed by (i) single point load, (ii) two point loads (iii) uniformly distributed load longer than the span, and (iv) uniformly distributed load shorter than the span. Focal length, enveloping parabola and EUDL

UNIT– II:

Moving loads on truss girders: Influence lines for forces in the members of statically determinate trusses like Warren truss, Pratt truss, and Curved flange trusses. Determination of maximum forces in truss members due to moving point loads and uniformly distributed loads. Counter bracing.

Deflections of Determinate trusses: Deflections of truss joints using Castigliano's theorem –I and Unit load method.

UNIT– III:

Three hinged arches: Three hinged parabolic and segmental arches, determination of support reactions. Bending moment, normal thrust and radial shear at a section subjected to point loads and uniformly distributed loads. Influence line diagrams for horizontal thrust, bending moment, normal thrust and radial shear.

Cables and Suspension bridges: Stresses in suspended cables due to point loads and uniformly distributed loads, equation of the cable, length of cable and general cable theorem. Suspension bridge with 3-hinged stiffening girders for static loading, determination of maximum tension in the cable, bending moment and shear force in the girder.

UNIT- IV:

Indeterminate beams: Analysis of Indeterminate beams with and without sinking of supports using slope deflection, moment distribution, and Kani's methods. Loading on each span may be point load(s) and uniformly distributed load on whole span. Shear force and bending moment diagrams.

UNIT- V:

Indeterminate rigid jointed plane frames: Analysis of rigid jointed plane frames with and without lateral sway using slope deflection, moment distribution, and Kani's methods. Loading on each span may be point load(s) and uniformly distributed load on whole span. Shear force, axial force and bending moment diagrams.

Text Books:

1. B.C Punmia, and A. K. Jain, "SMTS - II Theory of Structures", Laxmi Publications, New Delhi, 2017.
2. S. Ramamrutham, "Theory of Structures", Khanna Publishers, New Delhi, 2018.

Suggested Reading:

1. H. J. Shah, S. B. Junnarkar, "Mechanics of Structures Vol. II [Theory and analysis of structures]", 24th Edition, Charotar Publishing House Pvt. Ltd., 2015.
2. T. S. ThandavaMoorthy, "Structural Analysis", 2nd edition, Oxford University Press, 2012.
3. C. S. Reddy, "Basic Structural Analysis", 3rd Ed., Tata McGraw Hill, New Delhi, 2017.
4. D. S. PrakashRao, "Structural Analysis" - A Unified Approach, University Press, 2012

18CE E01

PRESTRESSED CONCRETE
(Core Elective –1)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to,

1. Understand the basic principles and structural behaviour of pre stressed concrete with reference to IS 1343 code
2. Equip the students with a thorough understanding of the behaviour and analysis of PSC beams.
3. Understand and apply the design principles of PSC beams in flexure and shear.
4. Understand the concepts of various stresses in anchorage zone.
5. Identify the advantages of continuous beams and can analyse for primary and secondary moments.

Course outcomes: At the end of the course, Students will be able to

1. understand the general mechanism of pre stressed concrete members, types of pre stressing
2. Analyze the behaviour of pre stressed concrete beams.
3. Identify and apply design concepts for the pre stressed concrete beams under flexure and shear.
4. analyze the stresses in anchorage zones and design the end anchorages.
5. understand the fundamental concepts of primary and secondary moments in continuous beams.

UNIT- I:General Principles of Pre Stressed Concrete:

Introduction: Basic concepts – Materials - Permissible stresses – Advantages – pre-tensing and post tensing – Pre Stressing by Straight Concentric, Eccentric bent and Parabolic Tendons – Different methods of Pre stressing – Hoyer System – Freyssinet system – Magnel-Blaton system – Lee Mecal system – Use of IS 1343 code, concepts of precast and post tensioned elements.

UNIT – II: Analysis, Losses and Deflection of PSC beams:

Analysis of sections for pre stress and flexure for Straight Concentric, Eccentric, Bent and Parabolic Tendons. Pressure Line – Cable Profile

Losses of Pre stress: Losses in P.S.C. members due to elastic shortening – Shrinkage – Creep in Concrete – Relaxation of Steel – Slip in anchorage – Frictional Loss – Computation of losses.

Deflections of P.S.C members: Importance of deflections - factors influencing deflections, short term and long term deflections – IS code requirements for Maximum deflections – Computation of short term deflections due to pre stressing force – Dead and Live loads.

UNIT – III:Design of Section for Flexure and Shear :

Allowable stresses – Elastic Design and Limit state method of Design of Rectangular – I Section beams for Flexure – Check for ultimate flexural strength as per – IS 1343 Codal Provisions. Design of Section for Shear: Shear and principal stresses – Cracked and uncracked sections – Codal provisions – Ultimate shear resistance – Design of shear reinforcement in beams.

UNIT – IV:Anchorage Zone stress in Post tensioned members:

Stress distribution in End block – Analysis by Magnel and Guyon'smethods – IS 1343 code provisions – Bursting Tensile force – Design of anchorage zone reinforcement.

UNIT – V:Continuous beams:

Advantage and Disadvantages - Primary and Secondary moment – P and C- lines – Liner transformation , Concordant and Non concordant cable profile - Analysis of Continuous beams.

Text Books:

1. N. Krishna Raju ,"Prestressed Concrete" , Tata McGraw Hill,2018
2. G.S. Pandit and S.P. Gupta, "Prestressed Concrete", CBS Pub., 2009.

Suggested Reading:

1. Arthur H. Nilson, by"Design of Prestressed Concrete", John Wiley 1987.
2. T.Y Lin and Burn," Design of prestressedConcrete",Wiley India Private Limited, 2010. 52 53 18CE

18CE E02

GREEN BUILDING TECHNOLOGIES
(CoreElective –1)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: To enable the student

1. To understand the basic concepts of green building technologies and their significance.
2. To understand the judicial use of energy and its management.
3. To know about the Sun-earth relationship and its effect on climate.
4. To enhance awareness of end-use energy requirements in the society.
5. To know about the suitable technologies for energy management and audit procedures.

Course Outcomes: At the end of the course, the student will be able to

1. relate the fundamentals concepts of green buildings, identify the energy use & its management and recall some prominent green buildings in india.
2. understand the indoor environmental requirement and choose appropriate materials and finishes.
3. apply the knowledge about sun-earth relationship vis-a-vis its effect on climate and understand the energy impact on the shape and orientation of buildings.
4. estimate lighting and heat energy requirements and evaluate their end use.
5. understand the various concepts of energy audit, judge the buildings for green certifications and develop a green building as per the standards.

UNIT- I:

Introduction to green buildings- Barriers and benefits of Green Building- Characteristics of energy use, energy process and its management - Macro aspect of energy use in dwellings and its implications- Site and landscape planning for Green Building Construction- Prominent Green Buildings in India and their features.

UNIT- II:

Indoor environmental requirement and management: Thermal comfort– Ventilation and air quality– Air-conditioning requirement- Visual perception– Illumination requirement- Auditory requirement- Green Building materials and finishes- emittance levels.

UNIT- III:

Climate, solar radiation and their influences: Sun- Earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature– Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT- IV:

Energy utilization and requirements: Lighting and day lighting– End use energy requirements- Status of energy use in buildings Estimation of energy use in a building- Heat gain and thermal performance of building envelope- Steady and non-steady heat transfer through the glazed window and the wall- Standards for thermal performance of building envelopes- Evaluation of the overall thermal transfer.

UNIT- V:

Energy management systems: Energy audit and energy targeting – Technological options for energy management. Certification- Study of LEED and TERI (GRIHA) parameters and certification of Green Buildings.

Text Books:

1. Charles J. Kibert,"Sustainable Construction - Green Building Design and Delivery", John Wiley & Sons, New York, 2008

2. Norbert Lechner,"Heating, Cooling, Lighting - Sustainable Design Methods for Architects", Wiley, New York, 2015.
3. James Kachadorian, "The Passive Solar House: Using Solar Design to Heat and Cool Your Home", Chelsea Green Publishing Co., USA, 1997.

Suggested Reading:

1. Michael Bauer, Peter Mosel and Michael Schwarz, "Green Building– Guidebook for Sustainable Architecture", Springer, Heidelberg, Germany, 2010.
2. Mike Montoya,"Green Building Fundamentals", Pearson, USA, 2010.
3. Regina Leffers, "Sustainable Construction and Design", Pearson / Prentice Hall, USA, 2009.

18CE E03

PRINCIPLES OF GEOGRAPHICAL INFORMATION SYSTEMS
(Core Elective –1)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: The student is able to

1. Know the basics of GIS and its application in decision making
2. Know about various data types used in GIS
3. Realize the importance of data quality and building of GIS data base
4. Carry analysis on GIS data
5. Develop maps based on queries using GIS software's

Course outcomes: At the end of the course, the students will be able to

1. Understand the concepts and components of GIS.
2. Identify the data required to create data structure for implementation of GIS.
3. Apply the spatial and non-spatial functions for creating and editing of GIS data.
4. Choose an appropriate sequence of GIS functions for developing cartographic models.
5. Apply the knowledge of GIS in decision making by evaluation of data and find appropriate solutions to complex problems.

UNIT- I:

GIS-Introduction, definitions, components, software scenario, applications, Map- definition, elements, Projections-Definition, types, UTM, Datum - types, Coordinate system, coordinate transformations, Geoid and Ellipsoidal models.

UNIT- II:

Database management - introduction, records, fields and keys, data file and data access, database structure, database models-Hierarchical, Network, Relational database and object oriented models, Geographical data - spatial and non-spatial data, Spatial data models-Raster data-Run length coding, Block coding and Quadtree , Vector data- spaghetti data model, topological model, triangular irregular Network (TIN) data.

UNIT- III:

Development of GIS data - data input - keyboard, scanners, digitizers and images, existing data- source, concepts of Geo-referencing and selection of projections, data quality -components - positional accuracy, attribute accuracy, logical consistency, resolution, completeness, time , sources of errors- accuracy- definition, test and assumptions.

UNIT- IV:

GIS functions - organizing data for GIS analysis- Data Layers, Classification - Maintenance and analysis of spatial data-Format transformation, Geometric transformations, Geometric projections, Conflation, Edge matching, Editing and Line coordinate thinning. Maintenance and analysis of attribute- Editing and analysis functions.

UNIT- V:

Integrated analysis of Spatial and Non spatial data- Retrieval measurement and classification, Overlay, Neighborhood operations -search, Line in polygon, point in polygon, topographic functions, interpolation contour generation, Connectivity functions- contiguity, Proximity, Spread, Seek , indivisibility, Illumination, GIS output - Map Annotation, Text Labels, texture, and lines patterns. Cartographic modelling- watershed management, water resource management etc.

Text books:

1. Chor Pang Lo and Albert K.W. Yeung, "*Concepts and Techniques of Geographic Information systems*" Pearson, 2016.
2. Peter A. Burrough and Rachael A. McDowell, "*Principle of Geographical Information Systems*", Oxford University press, 1998.

Suggested Reading:

1. Michael N. Demers, "*Fundamentals of Geographic Information systems*", John Willey Publishers, 2012.
2. Stan Aronoff, "*Geographic information systems-A Management Perspective*" Environmental Systems Research Institute Inc.,U.S., 2005.
3. Kang-Tsung Chang "*Introduction to Geographic information systems*", Tata McGraw-Hill, 2015.
4. Ian Heywood, Sarah Cornelius, Steve carver, "*An introduction to Geographical information systems"*, Addison Wesley Longman, 2009.

18CE E04

MASONRY STRUCTURES
(Core Elective –1)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to understand the fundamental concepts of

1. Masonry materials and its mechanical properties.
2. Analysis and the behaviour of structural masonry
3. Shear and flexural behaviour of Reinforced and unreinforced masonry
4. Summarize construction practices, seismic behaviour, specifications ,for Design of masonry
5. Seismic evaluation and Retrofit of Masonry

Course Outcomes: At the end of the course, students will be able to

1. select an appropriate masonry unit and mortar mix for masonry construction.
2. distinguish in plane and out of plane loads and analyse for lateral forces.
3. analyse reinforced and unreinforced masonry structural elements for flexural and shear behaviour.
4. design masonry elements using working and ultimate strength design
5. understand the repairing techniques and strengthen the existing masonry structures for seismic loads

UNIT- I:
Introduction - Masonry construction - National and International perspective – Historical development, Modern masonry, Principles of masonry design, Masonry standards: IS 1905 and others.
Material Properties - Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT- II:
Masonry in Compression - Prism strength, Eccentric loading, Kern distance. Masonry under Lateral loads - In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms.

UNIT- III:
Behaviour of Masonry - Shear and flexure - Combined bending and axial loads - Reinforced and unreinforced masonry - Cyclic loading and ductility of shear walls for seismic design – Infill masonry.

UNIT- IV:
Structural design of Masonry - Working and Ultimate strength design - In-plane and out-of-plane design criteria for load-bearing and in fills, connecting elements and ties - Consideration of seismic loads - Code provisions.

UNIT- V:
Seismic evaluation and Retrofit of Masonry - In-situ and non-destructive tests for masonry - properties - Repair and strengthening of existing masonry - structures for seismic loads.

Text Books:

1. P. Dayaratnam, "*Brick and Reinforced Brick Structures*", Oxford & IBH Publishing Co, 2017.
2. R. G. Drysdale, A. H. Hamid, and L. R. Baker, "*Masonry Structures: Behaviour& Design*", Prentice Hall Hendry, 1993.

Suggested Reading:

1. A.W. Hendry, B.P. Sinha and Davis, S. R, "*Design of Masonry Structures*", E & FN Spon, UK, 1997.
2. S. Sahlin, "*Structural Masonry*", Prentice Hall, Englewood Cliffs, NJ, 1971.
3. R.S. Schneider and W.L. Dickey, "*Reinforced Masonry Design*", Prentice Hall, 3rd edition, 1994.

18CE E05

SOLID AND HAZARDOUS WASTE MANAGEMENT
(Core Elective –2)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student
1. Understand characteristics of solid waste and legislations of solid waste management.
2. Gain insight into the transfer, transport and energy recovery from municipal solid waste.
3. Understand characteristics, handling and storage of hazardous wastes.
4. Grasp the fundamentals of site selection, remediation measures for disposal sites; contrast between hazardous waste treatment techniques.
5. Understand the concepts of Environmental Audit, Hazardous waste management legislations and toxicology principles.

Course Outcomes: At the end of the course, student is able to
1. Identify characteristics of solid waste, collection systems as per legislations.
2. List out waste reduction methods, collection techniques, resource recovery/recycling, energy recovery, transport & disposal options and select appropriate waste management facility.
3. Identify sources of hazardous waste; assess handling & storage methods based on regulations.
4. Select the site for disposal of hazardous waste; suggest treatment technologies and remediation measures for disposal sites.
5. Understand the concepts of Environmental Audit, toxicology principles; apply legislations of hazardous waste management.

UNIT- I:
Solid wastes: Solid waste generation in a technological society, sources and types of solid waste, legislations on management and handling of municipal solid wastes, monitoring responsibilities; Collection of Solid Waste: type of waste collection systems, analysis of collection system, alternative techniques for collection system.

UNIT- II:
Management of Solid waste: Separation, Processing and Transformation of Solid Waste: unit operations used for separation and processing, materials recovery facilities, waste transformation through combustion and anaerobic composting, anaerobic methods for materials recovery and treatment; Energy recovery - Incinerators. Transfer and Transport: need for transfer operation, well injections; Landfills: Site selection, drainage and leachate collection systems, requirements and technical solutions, integrated waste management facilities.

UNIT- III:
Hazardous waste: Definition and identification of hazardous wastes, sources and characteristics, hazardous wastes in Municipal Waste, Hazardous waste regulations, minimization of Hazardous Waste, compatibility, handling and storage of hazardous waste, collection and transport.

UNIT –IV:
Hazardous waste management: Treatment technologies, physical, chemical and biological treatment, Hazardous waste landfills: Site selection, remediation of hazardous waste disposal sites, quantitative risk assessment, containment, remedial alternatives.

UNIT –V:
Environmental regulations: Environmental audit, pollution prevention, facility development and operation. Hazardous waste legislations, RCRA process, superfund process; toxicological principles, dose response, toxic effects, toxic response.

Text books:

1. P. A. Vesilind, Worrell W and Reinhart, "*Solid Waste Engineering*", 2nd Edition (2016), Cengage Learning India Pvt. Ltd.
2. Tchobanoglous,"*Integrated Solid Waste Management"*, Mc-Graw Hill International 1st Edition, New York, 2014."
3. Charles A. Wentz; "*Hazardous Waste Management*", McGraw Hill Publication, 1995.

Suggested Reading:

1. CPHEEO, "*Manual on Municipal Solid waste management"*, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans, "*Hazardous waste Management*", Waveland Pr. Inc, 2010
3. C. A. Wentz, "*Hazardous Waste Management*", McGraw-Hill Publication, 1995.
4. A. D. Bhide and B. B. Sundaresan, "*Solid Waste Management, Collection, Processing and Disposal*", Nagpur.
5. S.C. Bhatia, "*Solid and Hazardous waste management*", Atlantic publishers, 2007.

18CE E06

MECHANICS OF MATERIALS
(Core Elective –2)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the students

1. Understand the flexural behaviour of curved bars and determining the stresses in various cross sections.
2. Understand the behaviour of beams curved in plan, subjected to different types of loads.
3. Learn the determination of stresses in rotating discs & cylinders.
4. Realize the significance of experimental techniques in stress analysis & understand the stress analysis using brittle coating technique.
5. Comprehend the failure criteria of materials and corresponding theories of elastic failure.

Course Outcomes: At the end of the course, student will be able to

1. analyze curved bars of rectangular, circular and trapezoidal cross sections in crane hooks and chain links.
2. determine the stresses in beams curved in plan, for simply supported and fixed end conditions.
3. evaluate the stresses in rotating discs, rings and cylinders.
4. recall various brittle coating techniques, estimate the coating stresses and detect cracks.
5. apply an appropriate elastic theory of failure for the materials.

UNIT – I:

Bending of curved bars: Introduction, Bending of curved bars, stresses in curved bars with large curvature (Winkler-Bach Theory), calculation of stresses in curved bars of different sections-rectangular, circular and trapezoidal in crane hooks, and chain links.

UNIT-II:

Beams curved in plan: Introduction, circular beam loaded uniformly and symmetrically supported on columns, Semi-Circular beam simply supported on 3 equally spaced supports, cantilever quarter circular beam with a point load at free end, A fixed ended segmented curved beam.

UNIT-III:

Rotating Rings, Discs & Cylinder: Introduction, thin rotating ring or cylinder, rotating solid thin disc, rotating disc with a central hole, rotating disc of uniform strength, and rotating long cylinder.

UNIT-IV:

Stress analysis by brittle coating Technique: Introduction, Brittle Lacquers - Brittle coating techniques, Coating stresses, Theory of failure for Brittle coatings, crack patterns in brittle coating, crack detection, types of Brittle coating, Resin based brittle coating, equipment for Stress analysis by brittle coating method, specimen preparation, Testing & calibration of brittle coating .

UNIT-V:

Elastic theories of failure: Introduction - Failure by Yielding-Failure by Fracture - Yield and Fracture Criteria-Maximum Shearing Stress Theory-Maximum Distortion Energy Theory-Octahedral Shearing Stress Theory-Comparison of Yielding Theories-Maximum Principal Stress Theory- Mohr's Theory-Coulomb-Mohr Theory

Text Books:

1. V. N. Vazirani and M. M Ratwani, “Analysis of Structures Vol. 1: Analysis, Design And Details Of Structures”, Khan Publications, 2003.
2. U.C. Jindal, “Advanced Topics of Strength of Materials (PART-II)”, Galgotia Publications Pvt..Ltd. 2001.

Suggested Reading:

1. Heinemann, “Mechanics of Materials” Butterworth, 3rd edition, 1997. 2. J. O. Seely and F. B. Smith, “Advanced Mechanics of Materials”, 1967.
3. R. Subramanian, “Strength of Materials”, Oxford University press, 2016. 4. U. C. Jindal, “Strength of Materials”, Pearson Education; 2nd edition, 2017.

18CE E07

REPAIR AND REHABILITATION OF STRUCTURES
(Core Elective –2)

Instruction	3L Hours per week
Duration of Semester End	Examination 3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student to understand the fundamental concepts of
1. Maintenance and causes for distress.
2. Serviceability and durability limits.
3. Importance of structural audit and different NDT techniques.
4. Different repair materials & their suitability.
5. Various repair techniques and rehabilitation methods.

Course Outcomes: At the end of the course, the student will be able to
1. Understand the importance of maintenance & inspection and analyze the damage.
2. Find the causes of cracking & durability problems and examine the remedial measures.
3. Understand the principles of condition assessment and apply various techniques to evaluate them.
4. Choose a suitable material for a specific type of repair.
5. Identify a suitable technique for repair & rehabilitation of a structure and develop a practical solution for the problem.

UNIT – I:
Maintenance and inspection: Basic definitions of repair, retrofit, rehabilitation, strengthening and upgradation; Facets of maintenance; Planning for maintenance; Importance of maintenance, various aspects of inspection, introduction to structural auditing, NDT and NDE, structural stability and certification.
Introduction to damage mechanics: Causes of distress and damage assessment in concrete structures, Construction and design failures; Damage mechanics.

UNIT – II:
Serviceability and durability of concrete:
Deflections and deflection control, Cracks and cracks control in concrete structures, Vibrations in concrete structures. Thermal properties and cracking; Effects due to climate- Temperature, Chemical attack, Corrosion; Design and construction errors; Permeability; Effects of cover thickness and cracking.

UNIT – III:
Condition survey and NDT:
Definition and objective of condition survey, stages of conditions survey – planning, inspections and testing stages, possible defects in concrete structures; NDT techniques- rebound hammer, infra-red thermography, ground penetration technique, ultra-sonic pulse velocity test, half cell potential method and Windsor probe test, safety audit-principles and objectives, semi destructive testing– core cuttings methods.

UNIT – IV:
Materials for repair:
Special concretes and mortar- Concrete chemicals, Special elements for accelerated strength gain, Expansive cement, Polymer concrete, Sulphur infiltrated concrete, Ferro cement, Fiber reinforced concrete, Bacterial concrete,

Rust eliminators and polymers coating for rebars during repair, Foamed concrete, Mortar and dry pack, Vacuum concrete; Carbon composites.

UNIT – V:

Techniques for repair and rehabilitation:

Guniting, shotcreting; Epoxy injection, Mortar repair for cracks, Shoring and underpinning; Methods of corrosion protection, Corrosion inhibitors, Corrosion resistant steels, Coating and cathodic protection.

Techniques for column strengthening, beam strengthening, beam to column joint strengthening using concrete, steel, FRP and carbon fibre jacketing; Addition of infill walls, shear walls and steel braces**.**

Text Books:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.

2. Allen R.T. & Edwards S.C, Repair of Concrete Structures, Blakie and Sons, UK, 1987.

3. B.L. Gupta and Amit Gupta, 'Maintenance and Repair of Civil Structures", Standard Publications, New Delhi, 2010.

Suggested Reading:

1. S. C. Millard and J. H. Bungey, "Testing of Concrete in Structures", Chapman and Hall, New York, 1989.

2. Barry A. Richardson, "Defects and Deterioration in Buildings", E & FN Spon Press, London, 1991.

3. A.R. Santhakumar, "Concrete Technology", Oxford University Press, New Delhi, 2006.

4. Peter H. Emmons, "Concrete Repair and Maintenance Illustrated", RS Means, John Wiley & Sons, New York, 1981.

5. W.H. Ransom, "Building Failures: Diagnosis and Avoidance", E & FN Spon Press, London, 1992.

6. P.K. Mehta and P.J.M. Monteiro, "Concrete- Microstructure, Properties and Materials", McGraw-Hill, New York, 2014.

7. N. Jackson and R.K, Dhir, "Civil Engineering Materials", Basingstoke, Macmillan, London, 1988.

8. Defects and Deterioration in Buildings, EF & N Spon, London.

9. Non-Destructive Evaluation of Concrete Structures by Bungey – Surrey University Press.

10. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W.H. Ranso, (1981).

11. Ravishankar.K., Krishnamoorthy.T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004.

12. CPWD and Indian Buildings Congress, Hand book on Seismic Retrofit of Buildings, Narosa Publishers, 2008.

18CE E08

CONCRETE TECHNOLOGY
(Core Elective –2)

Instruction	3L Hours per week	Duration of Semester End	
Examination	3 Hours	Semester End Examination	
	70 Marks	CIE	
	30 Marks	Credits	
	3		

Course objectives: To enable the students to
1. Learn the properties & conduct tests on various ingredients of concrete.
2. Understand the behavior of concrete in fresh and hardened states.
3. Understand the Mix design of concrete using various design methods.
4. To learn the durability of concrete & acquire knowledge on the properties and effective usage of various admixtures.
5. Gain knowledge of various special concretes and their applications.

Course outcomes: At the end of the course, the student will be able to
1. understand the properties of concrete making materials and production of concrete.
2. analyze the properties of fresh and hardened concretes.
3. design the concrete mix using various methods for a specified grade.
4. evaluate durability of concrete and apply suitable admixtures in concrete making.
5. evaluate and choose appropriate concrete for field application.

UNIT- I:
Concrete Materials & Production of Concrete: Manufacturing process of cement, Types of cements, Properties of cement and aggregate (fine & coarse), tests conducted on cement and aggregate (fine & coarse). Production of concrete – Various methods of batching, mixing, compaction and curing. Hot weather and cold weather concreting. Water cement ratio, gel space ratio, Segregation and bleeding of concrete.

UNIT- II:
Fresh concrete: Workability, factors affecting workability, measurement of workability using slump cone, compaction factor and Vee-Bee Consistometer tests.
Hardened concrete: Behavior of concrete under various types of loading - compression, Tension and flexure. Non - destructive testing methods. Time dependent behavior of concrete –Maturity, shrinkage & creep.Stress-Strain behavior of concrete.

UNIT- III:
Concrete Mix Design: Basic considerations, Factor to be considered in choice of mix design, Different mix design methods – I.S. code method, British and ACI methods. Quality control of Concrete.

UNIT- IV:
Durability of concrete: Durability –Factors affecting Durability, Cracking of Concrete - types of cracks, causes, remedies and tests on concrete cracks. Deterioration of concrete and its prevention.Behavior of concrete under various types of extreme environments, Freezing and Thawing, Acid attack on concrete, Efflorescence, fire resistance.
Concrete Admixtures: Classification of admixtures, Mineral and Chemical admixtures, Influence of various admixtures on properties of concrete.

UNIT- V:

Special Concretes: Properties & applications of High Strength Concrete, High Performance Concrete, Polymer Concrete, High Density Concrete, Light Weight Concrete, and Ferro cement, Recycled Aggregate Concrete, Self Compacting Concrete (SCC) and Fly Ash Concrete. Ready Mix Concrete (RMC).

Fiber Reinforced Concrete(FRC): Mechanism, Types of fibers, Steel Fiber Reinforced Concrete – Properties & Applications, Geopolymer concrete – Constituent materials, properties and applications, Bacterial Concrete – principles of self healing, materials and applications

Text Books:

1. A.M Neville., "Properties of Concrete", Pearson Education. 2012.
2. M.S. Shetty, and A. K. Jain, "Concrete Technology: Theory and Practice", S. Chand & Company, 2018.
3. R. Santhakumar, "Concrete Technology", Oxford University, Press 2018.

Suggested Reading:

1. A.M. Neville and J.J. Brooks, "Concrete Technology", Dorling and Kindersley Publications, 2002.
2. P. K. Mehta, and J. M. M. Paulo, "Concrete- Microstructure – properties and Material", Mc. Graw Hill Publishers, 2017.
3. N. Krishnaraju, "Design of Concrete Mixes", CBS Publishers and Distributors, 2010.

18CE C16

TRANSPORTATION ENGINEERING LAB

Instruction	3P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: To enable the student

1. Assess the quality of the material used in pavement construction and compare with IRC specifications.
2. Identify the field data required for assessing the traffic parameters.

Course Outcomes: The student will be able to

3. Conduct various tests on bitumen and aggregates, evaluate the quality of material to be used in pavements.
4. Organize various traffic studies and analyze the data by applying statistical tools.
5. Conduct the CBR test, Marshall Stability tests and interpret the results for design purpose.
6. Prepare representative samples for various tests on aggregates.
7. Develop skill of generating technical report based on the studies carried in the laboratory and field studies.

A) Tests on bitumen

1. Penetration test
2. Ductility test
3. Softening point test
4. Specific gravity test
5. Viscosity test
6. Flash and fire point test

B) Tests on road aggregates

7. Aggregate crushing value test
8. Los Angeles abrasion test
9. Aggregate impact value test
10. Aggregate shape test (flakiness & elongation)
11. Water Absorption
12. Soundness

C) Traffic Studies

13. Traffic volume study
14. Spot Speed study
15. O & D study concepts
16. Speed and delay studies

D) Miscellaneous Tests (demonstration only)

17. Determination of CBR.
18. Preparation of representative sample by coning and quartering.
19. Bitumen extraction test
20. Marshall stability concepts and tests.

Suggested Reading:

1. Khanna and Justo, "*Highway materials and Pavement Testing*", Nem Chand & Bros. 2013.
2. R. Srinivasa Kumar, "*Highway Engineering*", Universities Press, 2011
3. IRC codes and specifications

18CE C17

GEOTECHNICAL ENGINEERING LAB

Instruction	3L Hours per week	
Duration of Semester End Examination	3 Hours	
Semester End Examination	35 Marks	CIE
	15 Marks	Credits
	1	

Course Objectives: Students will able to
1. Identify physical and mechanical properties of soil in the field and laboratory.
2. Develop an understand the relationships between physical characteristics and mechanical properties of soils;
3. Understand techniques used in soil mechanics for Darcy's Law
4. Understand Mohr-Coulomb theory for shear strength behavior of soils.
5. Choose different tests for soils according to IS standards.

Course Outcomes: Upon successful completion of this course, students will be able to
1. Identify soils with reference to their characteristics.
2. Evaluate and classify soils according to IS classification.
3. Calculate seepage volume for different soils.
4. Examine methods to improve soil stability of soils.
5. Conduct tests according to IS laboratory standards and procedures.

List of Experiments:
1. Grain size distribution by Sieve Analysis.
2. Consistency limits - Liquid limit and Plastic limit using Casagrande's method.
3. Compaction test: Standard Proctor test.
4. Field Density using Sand Replacement method.
5. Field Density using Core Cutter method.
6. Specific gravity of soils.
7. Natural Moisture Content using Pycnometer method.
8. Direct Shear test.
9. Permeability test using Falling-head method.
10. Relative density

Demo Experiments:
1. Consolidation test
2. Triaxial test (UU)
3. Vane Shear test

Suggested Reading:
1. B. C. Punmia, "Soil Mechanics and Foundation Engg", (2005), 16th Edition Laxmi Publications Co. , New Delhi.
2. IS : 2720(part-3 1964) for specific gravity, (IS : 2720 (Part 17), 1966) for Sieve analysis IS : 2720 (Part-IV), 1965) for Grain size analysis, IS: 2720 (Part 1) - 1983 for shear strength tests and compaction.
3. T. W. Lambe," Soil Testing for Engineers"-., Wiley Eastern Ltd., New Delhi.
4. K. H. Head K.H."Manual of Soil Laboratory Testing"-., (1986)- Vol. I, II, III, Princeton Press, London.
5. J. E. Bowles J.E", Properties of Soil and Their Measurements",. (1988), - McGraw Hill Book Co. New York.
6. http://smfe-iiith.vlabs.ac.in/List%20of %20experiments.html?domain=Civil%20Engineering
7. http://home.iitk.ac.in/~madhav/geolab.html

18CE C18

AUTO CAD LAB

Instruction	3P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Outcomes: The student will be able to
1. Select and apply appropriate settings for coordinates, units and scale to the drawing.
2. Create 2D objects and use display commands.
3. Select and apply appropriate editing tools in the drawing and manage object properties.
4. Create text, blocks and insert them in the drawing.
5. Apply appropriate hatching and dimensioning to the drawing.

LIST OF EXPERIMENTS

1. Introduction to Computer Aided Drafting (AutoCAD) - features and environment.
2. Coordinates and Basic Drafting Tools: Exercises pertaining to basic building elements to illustrate use of absolute coordinates and relative Cartesian coordinates. Object tools, such as SNAP, GRID and initial settings of a drawing file.
3. Display commands: Drawing Scale & View magnification, zooming and panning Commands.
4. Creating 2D geometry: Creating LINE objects, creating CIRCLE, ARC, ELLIPSE, various POLYGONS and using POLYLINE.
5. Editing and construction techniques: Tools to assist drafting – Creating Offsets, Trimming and extending of lines, Filtering of corners, creating multiple objects through Mirroring and Array Generation.
6. Managing Object Properties: Concept and significance of Layers and its applications in building drawing - Use of different types of lines and line weights.
7. Creating Text and Defining Styles: Exercises in adding text to the drawing and management of text styles.
8. Introduction to Blocks: Significance of blocks in drawing – creating blocks of common building elements and their insertion.
9. Dimensions, Hatching and Plotting: Addition of dimensions to the drawing - Dimension style management - Hatching of sections - styles of hatch, Plotting.
10. Drawing 2-D Single story building plan with section and elevation.

Suggested Reading:
1. Shah M. G., Kale C. M and Patki S. Y, "*Building Drawing*", Tata McGraw-Hill Book Co., 2002.
2.George Omura , Brian C. Benton," *Mastering AutoCAD 2019 and AutoCAD LT 2019*", Wiley, 2018.
3. Balagopal A and Prabhu T. S., "*Building Drawing and Detailing",* Spades publishers, Calicut, 1987.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Model Curriculum (with effect from 2020-2021)

B.E (CIVIL ENGINEERING)

SEMESTER – VI

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1	18CE C19	Design of Steel Structures -I	3	-	-	3	30	70	3
2	18CE C20	Environmental Engineering	3	-	-	3	30	70	3
3	18CE C21	Engineering Geology	3	-	-	3	30	70	3
4		Core Elective 3	3	-	-	3	30	70	3
5		Core Elective 4	3	-	-	3	30	70	3
6		Open Elective 1	3	-	-	3	30	70	3
	PRACTICALS								
7	18CE C22	Environmental Engineering Lab	-	-	2	2	15	35	1
8	18CE C23	Engineering Geology lab	-	-	2	2	15	35	1
		Total	**18**	**-**	**04**		**210**	**490**	**20**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE - Semester End Examination

Core Elective 3:

1. 18CE E09 - Structural Analysis-III
2. 18CE E10 - Foundation Engineering
3. 18CE E11 – Water Shed Management
4. 18CE E12 - Urban Transportation Planning

Core Elective 4:

1. 18CE E13 - Finite Element Methods
2. 18CE E14 - Reinforced Concrete Design-II
3. 18CE E15 - Railway Engineering
4. 18CE E16 - Groundwater Engineering
5. 18CE E17 -Applications of Artificial Intelligence in Civil Engineering

Open Elective 1:

1. 18CS O06 – Fundamentals of DBMS
2. 18ME O04 – Entrepreneurship
3. 18EG O01 – Technical Writing Skills
4. 18EE O04 – Energy Management Systems

18CE C19

DESIGN OF STEEL STRUCTURES - I

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Codes required: IS 800 – 2007, IS 875 Part II & Part III and Steel Tables.

Course Objectives: To enable the students

1. Learn and apply the design philosophies(working stress method andlimit state method) for various steel structural components and their connections, as per the relevant standard
2. To understand the behavior of compression members.
3. To understand the modes of failure of tension members.
4. To understand the behavior of flexural members in the industry
5. Learn the behavior of trusses and design of purlins.

Course Outcomes: At the end of the course, the student will be able to

1. understand the material properties, loads and design philosophies, design bolted and welded connections.
2. know, how yielding & buckling takes place, design simple and built-up compression members and column bases
3. understand the modes of failure of tension members ,design tension members using limit state method ,design tension and compression members using working stress method as per IS: 800-2007
4. classify structural steel sections, distinguish between laterally supported and laterally unsupported beams, design simple flexural members including secondary considerations
5. estimate the loads on roof trusses and design purlins and members of trusses

UNIT – I:

Materials and Specifications: Chemical composition of steel, types of Structural Steel, classification of Rolled Steel Sections.

Design Philosophies: Working Stress Method, Limit State Method, Loads and Load Combinations,Partial safety factors for materials and loads.

Bolted Connections (Limit State Method):

Bolted Joints -Modes of failure - Design of Bolted joints using ordinary Black Bolts - Lap & Butt joints - Concentric Connections and Eccentric Connections, Introduction to High Strength Friction Grip Bolted connections.

Welded Connections (Limit State Method): Types of Welds, Lap and Butt Joints- strength of welded joints -design of welded joints - Concentric Connections and Eccentric Connections.

UNIT – II

Design of Compression Members (Limit State Method): Introduction, yielding & Buckling phenomena, Sections used for compression Members. Effective Length of Compression Members, Design of Compression Members with single section and Built-up Sections, Lacing and Battening, Column Splices.

Design of Column Bases: Design of Slab and Gusset Bases.

UNIT – III

Design of tension members (Limit State Method): Introduction to tension members - Applications of tension members, Modes of Failure, Design of Tension Members –Staggered bolting ,Design of Lug Angles.

Working Stress Method as per IS 800-2007: Permissible Stresses, Slenderness Ratio, Design of tension members, Design of Simple Compression Members.

UNIT – IV

Design of Beams (Limit State Method) : Introduction to Plastic Analysis –Plastic Hinge, Plastic moment, Shape factor; Classification of Cross Sections, Phenomenon of Lateral Torsional Buckling; Design of Laterally Supported beams and laterally Unsupported Beams, Secondary considerations - Check for Web crippling, web buckling & deflection.

UNIT – V

Design of Roof trusses (Limit State Method): Types of trusses, Estimation of loads- dead load, live load and wind load, Design of purlins, Analysis of roof trusses and design of its members with angle sections.

Text Books:

1. S. K. Duggal, "Limit State Design of Steel Structures", 3rd Edition, McGraw Hill HED, 2019.
2. N. Subramanian, "Design of Steel Structures, Limit States Method", 2nd Edition, Oxford University Press, 2016

Suggested Reading:

1. M.R. Shiyekar, "Design of Steel Structures, (Limit State Method", Second Edition, PHI Learning Pvt Ltd. 2013.
2. S. S. Bhavikatti, "Design of steel Structures", 3rd Edition, I.K.International Publishing House Pvt. Ltd. 2012.

18CE C20

ENVIRONMENTAL ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student

1. Understand methods of population forecasting, estimate water quantity to be supplied in towns and design water distribution network.
2. Understand and design various units of a water treatment plant.
3. Calculate sewage produced in residential areas and design conveyance components.
4. Learn about design components of waste water treatment plants, low cost treatment techniques and sludge digestion systems.
5. Address issues of air pollution and noise pollution with the aid of appropriate control methods.

Course Outcomes: At the end of the course, the student will be able to

1. identify an appropriate population forecasting method and estimate quantity of water to be supplied and plan & design conveyance components.
2. design water treatment units for a water treatment plant.
3. estimate quantity of sewage and storm water & characteristics of sewage, design sewers and plan sewer appurtenances.
4. design components of waste water treatment plant and sludge digestion systems.
5. understand and judge methods for control of particulate matter and gaseous pollutants in the atmosphere, outline noise pollution control methods.

UNIT – I:

Introduction: Protected water supply, population forecasting methods, design period, types of water demand, factors affecting, fluctuations, fire demand, drinking water standards; sources of water, comparison from quality and quantity and other considerations; intakes, infiltration galleries; Design of distribution systems, pipe appurtenances.

UNIT – II:

Water treatment: Sedimentation principles, design factors, coagulation, flocculation, clarifier design, coagulants, feeding arrangements. Filtration theory, working of slow and rapid gravity filters, multimedia filters, design of filters, troubles in operation, comparison of filters, disinfection, theory of chlorination, chlorine demand, other disinfection practices.

UNIT - III:

Characteristics of sewage: Waste water collection, estimation of waste water and storm water, decomposition of sewage, self purification of rivers, examination of sewage, B.O.D. Equation, C.O.D. Design of sewers, shapes and materials, sewer appurtenances, house drainage, plumbing requirements, sanitary fittings, traps, one pipe and two pipe systems of plumbing.

UNIT – IV:

Waste water treatment: Primary treatment: screens, grit chambers, skimming tanks, sedimentation tanks, principles of design, Biological treatment: Design of trickling filters, Activated Sludge Treatment and oxidation ponds. Sludge digestion: factors affecting, design of digestion tank, septic tanks: working principles and design, soak pits, ultimate disposal of sewage.

UNIT – V:

Air pollution: Meteorological parameters affecting air pollution, atmospheric stability, plume behaviour, control of particulates, gravity settlers, cyclone filters, Electrostatic precipitators; Control of gaseous pollutants.
Noise – Basic concept, measurement and various control methods.

Text Books:

1. B.C Punmia, Ashok.K.Jain, Arun K .Jain "*Environmental Engineering I",* Laxmi Publications; 2016.
2. B.C Punmia, Ashok.K.Jain, Arun K .Jain "*Environmental Engineering II*", Laxmi Publications; 2016.
3. Santosh Kumar Garg, "*Water Supply Engineering*", Khanna Publications, 2017.
4. Santosh Kumar Garg, "*Sewage Disposal and Air Pollution Engineering*", Khanna Publications, 2018.

Suggested Reading:

1. H.S Peavy, D. R. Rowe," *Environmental Engineering*", McGraw Hill Education (India) Pvt. Ltd, 2017.
2. Metcalf and Eddy, "*Waste Water engineering*", McGraw Hill, 2015.
3. Mark J Hammar and Mark J. HammarJr," *Water and Waste Water Technology*".Wiley, 2007.
4. "*Manual on Water Supply and Treatment*", Ministry of Urban Development, New Delhi.
5. "*Manual on Sewerage and Sewage Treatment Systems, Part A, B and C*", Central Public Health and Environmental Engineering Organization, Ministry of Urban Development.

18CE C21

ENGINEERING GEOLOGY

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:-The Students Will able to
1. Describe the various properties of minerals, distinguishing features of rocks.
2. Describe the geological structures, processes of weathering and classification of soils.
3. Explain the process of ground water exploration
4. Illustrate the knowledge of geological studies for dams and reservoirs.
5. Illustrate the knowledge of geological studies for tunnels; list the causes and effects of earth quakes, tsunamis and landslides with their mitigation measures.

Course Outcomes: Upon the completion of course, students will be able to
1. identify different minerals and distinguish features exhibited by the rocks.
2. identify the geological structures like folds, faults, joints and unconformities present in rock and describe the processes of weathering.
3. assess the occurrence of ground water in various litho logical formations and location of bore wells.
4. evaluate the suitability of site for the dam construction.
5. evaluate the suitability of site for the tunnel construction; recognize the causes and effects of earthquakes, tsunamis and landslides in geological aspects.

UNIT- I:
Introduction: Branches of Geology useful to civil engineering scope of geological studies in various civil engineering projects.
Mineralogy: Definition of Mineral and crystal. Physical properties used in the identification of minerals. Physical properties of quartz, Orthoclase, Hornblende, Biotitic, Muscovite, Talc, Barite, Calcite, Kyanite and corundum.
Rocks:- Geological classification of Rocks, Textures and structures Geological description and Indian occurrence of granite, Basalt, Dolerite, Gabbro, Laterite, Sand stone, Shale, Limestone slate, Gneiss, Schist, Quartzite, Marble, and Khondalite.

UNIT- II:
Geological Structures: Classification mode of origin and engineering consideration of Folds, Faults, Joints and unconformities.
Rock Weathering: Definition of Rock weathering, classification of weathering Engineering consideration of Rock Weathering.
Geology of Soils: Formation of soil, Soil Profile important clay minerals, Geological classification of soils, Types of Indian Soils.

UNIT- III:
Hydro Geology: Hydrological cycle, Zones of Ground water Aquifers, Aquifuge, Aquiclude and Aquitards. Springs, ground water exploration, ground water provinces of India.

UNIT- IV:
DAMS: Terminology of Dam, types of dams, Geological investigation for selection of a good dam site. Analysis of Dam failures in the past .Engineering geology of major dam sites and Reservoirs of India.

UNIT-V:
Tunnels: Geological investigations of tunnels problems of tunneling, over break, logging of tunnels geology of some well known tunnels.
Geological Hazards: Geological aspects of earthquakes, tsunamis and landslides.

Text Books:

1. Parbinsingh, "*Engineering and general Geology*", S.K.Kataria& sons, New Delhi 2010.
2. Chennakesavulu, "*Text book of Engineering Geology*", Macmillan India Ltd, 2009.
3. D. Venkata Reddy, "*Engineering Geology*", Vikas Publishers House Pvt. Ltd 2010.

Suggested Reading:

1. F. G. Bell, "*Fundamentals of Engineering Geology*", Aditya Books Pvt. Ltd., New Delhi 2007
2. D. P. Krynine and W. R. Judd, "*Principles of Engineering Geology and Geotechnics",* CBS publishers Distribution First India Edition 1998.
3. SubinoyGangopadhyay, "*Engineering Geology*", Oxford University press 2013.
4. "*Seismo Tectonic Map of India*", Geological Survey of India 2005.

18CE E09

STRUCTURAL ANALYSIS -III
(Core Elective-3)

Instruction	3L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
CIE:	30 Marks
Credits:	3

Course Objectives: To enable the student to
1. Understand the concept of analyzing two hinged arches and the redundant trusses.
2. Use the approximate methods to analyze the multi-storey frames for gravity and lateral loads.
3. Apply the Flexibility method and to analyze the indeterminate beams, plane frames and trusses.
4. Comprehend the Stiffness method and analyze the indeterminate beams, plane frames and trusses.
5. Get exposed to basic concepts of finite element method and solve simple numerical problems.

Course Outcomes: At the end of the course, the student will be able to
1. determine the support reactions and bending moment, normal thrust and radial shear at a section for point loads and udl, apply Castigliano's theorem –II and Unit load method to determine the forces in the members of the redundant pin-jointed plane frames.
2. analyze the multi-story frames for gravity and lateral loads by using approximate methods
3. analyze the indeterminate beams, rigid jointed plane frames and trusses using flexibility matrix method for different load conditions.
4. apply Stiffness matrix method to analyze the indeterminate beams, rigid jointed plane frames and trusses, for different load conditions.
5. formulate stiffness matrix for bar, truss and beam element and apply to analyze axially loaded members, trusses and beams.

UNIT – I:
Two hinged arches: Parabolic and segmental arches, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading, temperature effects.
Redundant pin-jointed plane frames (trusses): Analysis of pin-jointed plane frames using Castiglione's theorem – II and Unit load method, with one degree of redundancy (internal / external), Assembly and temperature effects.

UNIT-II:
Approximate Methods of Analysis: Introduction – Analysis of multi-storey frames by Portal and Cantilever methods for lateral loads and Substitute Frame method for gravity loads.

UNIT– III:
Flexibility method of Analysis: Introduction, Analysis of continuous beams, and rigid jointed plane frames with static indeterminacy not exceeding three. Analysis pin jointed plane frames with static indeterminacy not exceeding two.

UNIT-IV:
Stiffness method of Analysis: Introduction, Analysis of continuous beams, and rigid jointed plane frames with kinematic indeterminacy not exceeding three. Analysis pin jointed plane frames with kinematic indeterminacy not exceeding two.

UNIT-V:
Basics of Finite Element Method: Introduction, Discretization of a structure, Types of Elements. Formulation of stiffness matrix for bar element, Truss element and Beam element. Numerical Problems with degree of freedom not exceeding three.

Text Books:

1. T. S. ThandavaMoorthy, "*Structural Analysis*", Oxford University Press, 2nd Edition, 2012.
2. C. S. Reddy, "*Basic Structural Analysis*", Tata McGraw Hill, 3rd Edition 2017.

Suggested Reading:

1. B.C. Punmia, and A. K. Jain, "*SMTS - II Theory of Structures*", Laxmi Publications, 2017.
2. S. Ramamrutham, "*Theory of Structures*", Khanna Publishers, 2018.
3. D. S. PrakashRao, "*Structural Analysis" - A Unified Approach"*, University Press, 2012.
4. W. Weaver, JR. and J. M. Gere., "*Matrix Analysis of Framed Structures*", CBS Publishers, 2nd edition, 2004

18CE E10

FOUNDATION ENGINEERING
(Core Elective-3)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To enable the students
1. Understand the stress distribution in the soils for different loading conditions
2. Understand the principle of bearing capacity and settlement analysis.
3. Understand the principles of single and group piles.
4. Select suitable methods for construction of coffer dams and caissons.
5. Understand the principles of site investigation techniques and timbering of excavations.

Course outcomes: At the end of the course the students will be able to
1. compute the stress distribution in the soil under different loading conditions.
2. estimate the bearing capacity and compute settlements for different soils in shallow foundation.
3. estimate the load carrying capacity of single and group of piles.
4. understand the construction techniques and performance of cofferdams and caissons.
5. identify suitable investigation techniques for soil exploration and compute the loads in timbering of excavations.

UNIT- I:
Stress distribution in Soils: Boussinesq's and Westergaards equations for point load. Application of point load formulae for uniformly distributed load on circular area, Line load, Strip Load, rectangular area. Use of Newmark's chart for different areas using Boussinesq's equation, Contact pressure distribution.

UNIT- II:
Bearing capacity of soils: Terzaghi's equation for bearing capacity in soils –for continuous, square, rectangular and circular footings, general and local shear failure conditions. Plate load test as per IS specification. Allowable bearing capacity.Standard penetration test and use of N values for estimating soil conditions and bearing capacity.

Settlement Analysis: Computation of pressures before loading and after loading. Estimation of settlement – ultimate settlementand after any given period.

UNIT- III:
Pile Foundations: Types of piles–Timber, steel, concrete, cast-in situ, precast piles, bearing piles, friction piles, compaction piles, large diameter piles. Pile capacity – Static formulae, dynamic formulae, pile load test, determination of point resistance and skin friction as per IS code. Bearing capacity of pile groups, negative skin friction.

UNIT- IV:
Coffer dams: General description and construction methodsEarth embankments, cantilever sheet piles, braced coffer dams. Double wall cofferdams, cellular coffer dams – circular, diaphragm type.

Caissons: types of caissons–Open caissons, pneumatic caissons, box caissons (floating caissons). General description and construction methods.Dewatering techniques: sumps, ditches. Well points, deep walls. Geotextile methods: Types and uses.

UNIT- V:
Site investigation: Principles of exploration, sampling methods, transportation and storage of samples, boring and drilling methods, log of bore holes, sampling tubes and samplers. Sampling records.
Timbering of excavation: Bracing for shallow and deep excavations. Computation of lateral earth pressure.Reaction of struts.

Text Books:

1. K. R. Arora, “Soil Mechanics and Foundation Engineering”, 7th Edition, Standard Publishers, 2009.
2. GopalRanjan, “Basic and Applied Soil Mechanics”, 3rd Edition, New Age International, 2016.

Suggested Reading:

1. B.C. Punmia and Ashok Kumar Jain and Arun Kumar Jain, “Soil Mechanics and Foundations”, Laxmi Publications, 16th Edition, 2017.
2. E. J. Bowles, “Foundation Analysis and Design”, Tata McGraw Hill, 2017.
3. IS: 2911 – (part-IV) – Codes of practice for design and Construction of Pile Foundations – Load test on piles.
4. IS 1888 - 1982: Method of load test on soils.

18CE E11

WATER SHED MANAGEMENT
(Core Elective-3)

Instruction	3LHoursperweek
DurationofSemesterEndExamination	3Hours
SemesterEndExamination	70Marks
CIE	30Marks
Credits	3

Course Objectives: To enable the student

1. Understandtheconceptsofwatershedmanagement,socioeconomic aspects related to watersheddevelopment.
2. Understandcharacteristicsofwatershed,soilerosionanditscontrol.
3. Familiarize with various water harvesting techniques and land use managementpractices.
4. Understand social aspects of watershedmanagement
5. Understand the concept of integrated watershed management and ecosystemmanagement.

Course outcomes: At the end of the course, the student will be able to

1. identify relevance and scope of watershed management.
2. identify causes of soil erosion and understand its control measures.
3. understand waterharvesting structures and land management practices.
4. understand the participation of stake holders in watershed management.
5. understand soil and agricultural ecosystem and identify integrated approach of watershed management.

UNIT – I:

Definition and concept of Watershed: Concept of watershed development, History of Watershed management and its relevance to India, objectives of watersheddevelopment,differentstakeholdersandtheirrelativeimportance,need for watershed development in India, selection of watershed, watershed policy issues, Integrated and multidisciplinary approach for watershedmanagement.

UNIT – II:

Characteristics of Watershed: Size, shape, physiographic, slope, climate, drainage,landuse,vegetation,geologyandsoils,hydrologyandhydrogeology, socioeconomiccharacteristics.

Principles of Erosion: Types of erosion, factors affecting erosion, effects of erosiononlandfertilityandlandcapability,estimationofsoillossduetoerosion. **Measures to Control Erosion**: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rock fill dams, brushwood dam, Gabion.

UNIT – III:

Water Harvesting: Rainwater harvesting, catchment harvesting, harvesting structures& Design of harvesting structures,soilmoistureconservation,checkdams,artificialrecharge,farmponds and percolation tanks. Roof top waterharvesting.

LandManagement:Landuseandlandcapabilityclassification,managementof forest,agricultural,grassland andwildland,reclamationofsalineandalkaline soils.

UNIT – IV:

SocialAspectsofWatershedManagement:PlanningofWatershedmanagement activities, community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Casestudies.

UNIT – V:

Integrated Watershed Management: Introduction to integrated approach, Integrated water resources management, conjunctive use of water resources.

EcosystemManagement:RoleofEcosystem,crophusbandry,soilenrichment, inter mixed and strip cropping, cropping pattern, sustainable agriculture, bio- mass management, dry land agriculture, horticulture, social forestry and a forestation.

Text Books:

1. Murthy,J.V.S.,"*WatershedManagement*",NewAgeInternational(P), Ltd., NewDelhi,1988.
2. Majumdar,D.K.,"*IrrigationandWaterManagement*",PrenticeHall, NewDelhi, 2000.

Suggested Reading:

1. Mohan Das, M. and Das Saikia, "*Watershed Management*." PHI Learning(P).,Ltd.,NewDelhi,2013.
2. Goswami, M.D.,"*Watershed Management: Theroy and Practices*." RitwikandGargee(P).,Guwahati,Assam,2004.
3. Haan, C.T., Johnson, C.T., AND Brakensiek, D.L,.*"Hydrologic ModelingofSmallWatersheds*."ASAE,Michigan,1982.
4. SrinivasaRajuK.andNageshKumarD,"*MulticriterionAnalysisin EngineeringandManagement*",PrenticeHallofIndia(PHI)Learning Pvt.Ltd,NewDelhi,2014.

18CE E12

URBAN TRANSPORTATION PLANNING
(Core Elective-3)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives:

1. To understand the importance and the steps involved of transportation planning.
2. To identify the data required for creating and improving transportation infrastructure
3. To get knowledge about the traffic data acquisition process and analysing for understanding traffic growth pattern.
4. To understand the concepts of modelling techniques applied in transportation planning.
5. To know the ways to apply economic evaluation criteria to transportation project.

Course outcomes: At the end of the course, the student will be able to

1. apply the fundamental knowledge for forecasting and creating the transportation infrastructure facilities scientifically and ethically by collecting the appropriate sample data.
2. identify the procedures for collecting the traffic related data for generating and validating transport demand models.
3. apply four stage transportation demand modelling by creating mathematical models to understand the travel pattern and behavior of road users.
4. apply the mathematical knowledge in solving the transportation planning related problems by analyzing transportation data.
5. evaluate highway projects by using different economic methods and understand the role of computer applications in transportation planning.

UNIT - I:

Introduction of concepts of Transportation planning process, Interdependence of the land use and traffic, systems approach to transportation planning, stages in transportation planning, survey and analysis of existing conditions, forecast analysis of future conditions and plan synthesis, evaluation, program adoption and implementation.

UNIT - II:

Transportation Surveys – Introduction, definition of the study area, zoning, types of surveys, home interview, commercial vehicle, taxis, roadside interview, postcard questionnaire, registration number of vehicle plate, tags on vehicles, mass transport, analyzing the data from samples.

UNIT - III:

Trip Generation – Introduction and definition, trip purpose, factors governing trip production and attraction rates, regression methods – multiple linear regression analysis. Trip Distribution – concepts of trip distribution, methods of trip distribution, uniform (constant) factor method, average factor method, Fratar method, Furness method, advantages and disadvantages of growth factor methods, the gravity model.

UNIT - IV:

Modal split – General considerations, factors affecting modal split, modal split in the transportation planning process. Traffic Assignment – purpose of traffic assignment, general principles, assignment techniques, all or nothing assignment, multiple route assignment, capacity restraint assignment, diversion curves.

UNIT - V:

Economic evaluation of highway projects – need, basics principles, methods - benefit cost ratio, net present value, First year rate of return and internal rate of return - comparison. Computer applications in Transportation planning.

Text books:

1. B. G. Hutchinson, "*Principles of Urban Transport Systems Planning*", McGraw –Hill, Newyork, 1974.
2. C. S. PapacostasandP. D. Prevedouros, "*Transportation Engineering and Planning*", Pearson education India, 2015.

Suggested Reading:

1. L.R. Kadiyali "*Traffic Engineering and Transportation Planning*" Khanna Publishers, 2011.
2. Sarkar, Pradip Kumar, Maitri, Vinay, Joshi, G.J. "*Transport Planning: Principles, Practice and Policies*" PHI Learning, 2017.

18CE E13

FINITE ELEMENT METHODS
(Core Elective-4)

Instruction:	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination:	70 Marks
CIE:	30 Marks
Credits:	3

Course Objectives: To enable the student
1. Learn the fundamentals of Finite element method (FEM) and derive elasticity matrices for 2-D, 3-D and axisymmetric elasticity problems.
2. Understand basic principles of minimum potential energy methods, Principle of virtual work and various coordinate systems
3. Understand the FEM formulation for bar, truss elements and analyze simple problems with kinematic indeterminacy not greater than three.
4. Understand the FEM formulation for beam element and rigid jointed plane frame element and analyze simple problems with kinematic indeterminacy not exceeding than three.
5. Get familiarized with displacement models, Iso-parametric elements, 2D CST elements and rectangular elements and know the formulation of global stiffness matrices and load matrices and Gauss Quadrature rule

Course Outcomes: At the end of the course, student will be able to
1. apply the fundamentals of FEM, elements of theory of elasticity for 2D, 3D and axisymmetric problems.
2. apply Principle of minimum potential energy and Principle of Virtual work; analyze simple problems using Rayleigh Ritz Method and Galerkin's method.
3. formulate the local and global stiffness matrix, load matrix for 1D bar elements and 2D truss elements and analyse simple problems.
4. develop the stiffness matrix for beams and rigid jointed plane frames and solve problems with degree of freedom not exceeding three.
5. select displacement functions, formulate the stiffness matrix, load matrix for CST elements. Use Iso-parametric elements and quadrilateral elements, and evaluate definite integral by Gauss Quadrature.

UNIT- I:
Introduction to FEM: General description of the method, brief history of the method, applications of the method, advantages of the finite element method, steps in the finite element method. Types of elements, Types of forces, and Boundary conditions. Strain displacement, and stress- strain relations for 2-D, 3-D problems & Axisymmetric elements. Equations of equilibrium and compatibility conditions for 2-D and 3-D problems. Plane stress and plane strain situations and derivation of elasticity matrices.

UNIT- II:
Finite Element Formulation: Principle of minimum potential energy, Principle of virtual displacement, Raleigh Ritz method, Weighted Residual method- Galerkin's method. Coordinate system - Global coordinate, local coordinate and natural coordinate system.

UNIT- III:
Bar Elements: Shape functions, stiffness matrix for a 2- noded bar element, axial bar subjected to point loads, surface forces and body forces - constant cross section and varying cross section bar.
Truss Elements: Transformation matrix, Stiffness matrix of truss member in local and global coordinate, analysis of trusses with kinematic indeterminacy not exceeding three.

UNIT- IV:

Beam Elements: Shape functions, beam element stiffness matrix, element load vector, and analysis of continuous beams with kinematic indeterminacy not exceeding three.
Plane Frame elements: Element stiffness matrix in local coordinates,
Transformation or Rotation matrix, and stiffness matrix and load vector in global coordinates.

UNIT-V:
Displacement models: Selection of displacement models, geometric invariance, conforming and non-conforming elements.
2-D Triangular Elements (CST) and Rectangular Elements: Determination of strain-displacement matrix, shape functions, determination of element stiffness and load matrices, assembling global stiffness and load matrices.
Iso-parametric elements: Iso-parametric concept, Iso-parametric, Sub parametric and Super parametric elements. Gauss Quadrature of numerical integration.

Text Books:
1. David V. Hutton, "*Fundamentals of Finite Element Analysis*", McGraw Hill Education (India) Private Limited, Delhi, 2014.
2. P. N. Godbole," *Introduction to Finite Element Method*", I. K. International Publishing House Pvt. Ltd. New Delhi, 2013.
3. P. Seshu, "*Finite Element Analysis*", Prentice Hall of India Private Limited, New Delhi, 2010.

Suggested Reading:
1. T. R. Chandrupatla and A. D Belegundu, "*Introduction to Finite Elements in Engineering*", Prentice –Hall of India Private Limited, New Delhi, 2009
2. Daryl L, Logan, "*A first course in the Finite Element Method*", Third Edition, Thomson Brook, Canada Limited, 2007.
3. R. D. Cook, "*Concepts and Applications of Finite Element Analysis"*, John Wiley and sons, 1981.
4. O. C. Zienkiewicz and R. Taylor, "*The Finite Element Method"*, Vol.1, McGraw Hill Company Limited, London, 1989.

18CE E14

REINFORCED CONCRETE DESIGN-II
(Core Elective-4)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: The student shall be able to
1. Comprehend the concepts of design and detailing of combined rectangular and trapezoidal footings.
2. Understand the design and detailing of cantilever and counterfort type of retaining walls.
3. Learn the concepts of design and detailing of various water tanks.
4. Grasp the knowledge from relevant IRC codes, design and detailing of RC solid slab bridge.
5. Know the procedures for design and detailing of T-beam bridges.

Course Outcomes: At the end of the course the student will be able to
1. develop the plan layout, design and detail rectangular & trapezoidal combined footings and beam-slab type raft footing.
2. analyse for stability, design, the various components and detail cantilever and counterfort type retaining walls.
3. interpret the specifications from relevant codes, determine the design forces, design various components and detail rectangular and circular water tanks including Intze tanks.
4. understand the clauses from relevant IRC codes, design and detail the various components of Solid slab bridge.
5. analyse the slab panels using effective width method/ Pigeaud's curves, girders using Courbon's method and design & detail the various components of T-Beam bridges.

UNIT – I:
Combined Footings: Limit state design & detailing of combined rectangular and trapezoidal footings – Design of raft footings (Beam Slab type up to 3 x 2 grid)
UNIT – II:
Retaining walls: Limit state design and detailing of cantilever and counterfort type of retaining walls under various conditions of backfill.
UNIT – III:
Water tanks: Elastic Design & Detailing of circular and rectangular ground level and over-head tanks, Design principles of Intze tank - Design of staging for wind loads.
UNIT – IV:
Bridges: Basic components- Types of bridges -Loads on bridges- IRC standards; Elastic design and detailing of two lanes, simply supported RC Solid Slab Bridge including Kerb.
UNIT- V:
T-beam bridges: Components of a T-beam bridge- Elastic design and detailing of two lane, Simply Supported, Three girder T-beam bridge- Use of effective width method- Pigeaud's curves and Courbon's method.

Text Books:
1. N. Krishna Raju, "*Advanced Reinforced Concrete Design (IS: 456-2000)* ", CBS Publications 2nd Edition,2010.
2. Vazirani and Ratwani," *Design Of Concrete Bridges*", Khanna Publishers, 1998.

Suggested Reading:
1. D. S. PrakashRao, "*Design Principles and Detailing of Concrete Structures*", Tata McGraw-Hill Publishing Co. Ltd., 1998.
2. D. Johnson Victor, "*Essentials of Bridge Engineering"*, paperback, Oxford & IBH, Publishing Co., New Delhi, 6th Edition, 2015.

3. S. Ponnuswamy, "*Bridge Engineering*", Tata McGraw Hill, Third Edition, 2017.4. N. Krishna Raju, "Design of Bridges", Oxford &IBHPubs Company New Delhi, Fourth Edition, 2008.

18CE E15

RAILWAY ENGINEERING
(Core Elective-4)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student
1. To understand about permanent way and its components and their functions
2. To know about the geometric standards of railway track.
3. To know the role and the construction of Points and constructions
4. To know the importance of maintenance of railway track
5. To know the role of signals and their components and the requirements of drainage system

Course Outcomes: At the end of the course, the students will be able to
1. understand the role played by various components of permanent way.
2. apply engineering knowledge to geometric design of a railway track as per the standards.
3. understand the importance and components of points and crossings.
4. create facilities for railway passengers and goods, identify procedures to be followed for maintenance of track.
5. understand various types of railway signals and their functions, need and requirements of drainage system in railway tracks.

UNIT- I:
Introduction to Railway Engineering: History of development of railway engineering, brief introduction of railway zones, classification of Indian railway, Permanent way- rail gauges- types, uni-gauge policy, ideal requirements, Rails, types of rails, rail fastenings, rail joints, creep - causes, measurement, remedial measures for rectification of creep, Adzing of rails, Sleepers- function of sleepers, requirements of sleepers, sleeper density, types of sleepers, Ballast- functions of ballasts, requirements of ballasts, screening of ballasts, size and quantity of rail ballasts.

UNIT– II:
Geometric Design of Track: Curvature of track, designation of curves, types of curves, design of transition curves, cant concept, cant deficiency, cant excess, speeds of trains on curves, types of gradients, and grade compensation.

UNIT– III:
Points and Crossings: Introduction of right and left hand turn outs, terms used in points and crossings, components, length of stock rail, tongue rail, heel clearance, Crossings- types of crossings- ordinary and double crossings, theoretical and actual nose of crossing, crossing angle, types of leads calculations, Design and maintenance of points and crossings.

UNIT– IV:
Track Maintenance, Stations and Yards: Necessity for maintenance of track, maintenance of track proper, maintenance of railway bridges, maintenance of rolling stock, signaling during maintenance, tools required during maintenance, rail inspection, track inspection, modern methods of track maintenance. Definition of station, selection of site for railway station, features of railway station, types of railway stations definition platform types, Dimensions of platform, definition of a yard, types of yard,

UNIT– V:

Signals and Track Drainage Systems: Objectives of signaling, types of signals, classification based on function, classification based on location, and special signals, typical layouts, control of movement of trains, Interlocking – principles of interlocking and methods of interlocking. Drainage system - significance of drainage system, requirements of drainage system.

Text Books:

1. S.P.Arora, Prof. S.C. Saxena," *Railway Engineering*", DhanpatRai Publications Pvt. Ltd., New Delhi, 2010.
2. S.C. Rangwala , "*Railway Engineering* " , Charotar Publishing House Pvt. Ltd. (2017)

Suggested Reading:

1. Satish Chandra, M. M. Agarwal," *Railway Engineering*", Oxford, second edition, 2013.
2. K. P. Subramanian, "*Highway, Railway, Airport and Harbour Engineering*", 2015. Scitech Publications (India) Pvt. Ltd.,

R. Srinivasa Kumar, "*Airport, Railway, Docks &Harbors*", Universities Press, 2014.

18CE E16

GROUND WATER ENGINEERING
(Core Elective –4)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: The student should able to understand,

1. Basics of groundwater hydrology, familiar with aquifer parameters.
2. Unsteady flow and its flow computation.
3. Exploring groundwater through surface and subsurface methods.
4. Artificial recharge and causes, methods of recharge.
5. Various models in groundwater, quality of groundwater, pollutant transport.

Course outcomes: At the end of the course, students will be able to

1. understand the concepts of groundwater flow and basic equations.
2. distinguish between steady and unsteady flow and solve the relevant problems.
3. explore and estimate groundwater potential.
4. understand the artificial recharge, sea water intrusion and control measures.
5. identify and define groundwater contamination and construct groundwater models.

UNIT- I:

Introduction: Occurrence of groundwater, problems and perspectives regarding groundwater in India, rock properties effecting groundwater, groundwater basin, ground water in hydrologic cycle, vertical distribution of ground water, Hydrologic balance equation, types of aquifers, unconfined, confined and leaky aquifers. Darcy's law and limitations, compressibility of aquifer, aquifer parameters, specific yield, safe yield, general equation of ground water flow, steady unidirectional flow. Steady radial flow to a well in unconfined and confined aquifers. Steady flow with uniform recharge.

UNIT-II:

Unsteady radial flow to a well: Non equilibrium equation for pumping tests. Theis method of solution, Cooper Jacob method, Chow's methods of solution. Law of times, well flow near a quifer boundaries, Image well theory, multiple well systems, well losses, pumping and recuperation tests.

UNIT-III:

Geophysical Exploration:

Surface investigations: Surface investigations of ground water – electrical resistivity method, seismic refraction method, gravity and magnetic methods, geologic methods, dowsing, remote sensing.

Subsurface Investigations: Test drilling, resistivity logging, temperature logging, caliper logging, Interpretation of logs and selecting the groundwater potential zones.

Unit- IV:

Artificial Recharge of groundwater: Methods of recharge, water spreading, sewage discharge, recharge through pits and shafts, recharge through well, induced recharge.

Seawater intrusion in coastal aquifers, occurrence, Ghyben–Herzberg relation, shape of fresh – salt water interface, Length of the intruded sea water wedge. Prevention and control of sea water intrusion.

Unit-V:

Modeling Techniques: Introduction, ground water models, sand models, viscous fluid models, membrane models, thermal models, electric - analog models.Numerical modeling, finite difference method.

Qualityofgroundwater: GroundwaterContamination,sourcesofgroundwater contamination, groundwater quality criteria, advection process, diffusionand dispersion process, pollutant transport equation and modeling of pollutant transport.

Text Books:

1. D.K. Todd, "*Ground Water Hydrology*", John Wiley & Sons, Inc., USA,2015
2. H.M.Raghunath,"*GroundWater*",WileyEasternLimited,NewDelhi, 2007.

Suggested Reading:

1. Bouwer,"*GroundWaterHydrology*",Mc.GrawHill,Newyork,2013
2. A. K. Rastogi, "*Numerical Groundwater Hydrology*", PenramInternational Publishing, Mumbai,2007.
3. J.Bear,"*HydraulicsofGroundWater*",Mc-GrawHill,Newyork,2013.

18CE E17

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING
(Core Elective 4)

Instruction	3LHoursperweek
DurationofSemesterEndExamination	3Hours
SemesterEndExamination	70Marks
CIE	30Marks
Credits	3

Course Objectives: The main objectives of this course are:

1. Provide a strong foundation of fundamental concepts in Artificial Intelligence.
2. Learn various types of neural networks and study the applications of neural networks
3. Learn the concepts of Fuzzy systems and applications in civil engineering
4. Study the applications of support vector machines in civil engineering
5. Study the different types of regression analysis techniques and applications in civil engineering

Course Outcomes: On Successful completion of this course, student will be able to

1. recall fundamental knowledge on artificial intelligence.
2. understand neural networks and their types and apply neural networks in the domain of civil engineering.
3. understand and apply fuzzy controllers to solve real-world civil engineering problems.
4. explain basic concepts of support vector machines and choose appropriate techniques relevant to civil engineering.
5. develop a regression models for civil engineering problems.

UNIT I:

Introduction: introduction, brief history, intelligent systems: ELIZA, categorization of intelligent systems, components of AI program. Foundations of AI, sub areas of AI, applications, current trends in AI.

UNIT II:

Artificial Neural Networks: introduction, artificial neural networks: neuron model, activation functions, neural network architecture. Single layer feed forward networks, multi-layer feed forward networks, radial basis function networks, design issues of artificial neural networks, recurrent networks.

Applications: construction technology evaluation, predicting carbonation depth in concrete structures, optimal calibration of water distribution systems, traffic control system for isolated intersections, classification of pavement surface distress, back calculation of flexible pavement moduli from falling weight deflectometer data, back calculation of pavement profiles from the Spectral analysis of surface waves test

UNIT III:

Fuzzy sets and fuzzy logic: introduction, fuzzy sets, fuzzy set operations, types of membership functions, multi valued logic, fuzzy logic, linguistic variables and hedges, fuzzy propositions, inference rules, fuzzy systems.

Applications: pipe networks, real time reservoir operation, evaluation of existing reinforced concrete bridges, optimization of steel structures, diagnosing cracks in RC structures, construction scheduling, wastewater treatment systems, pavement cracking detection, road accident analysis

UNIT IV:

Machine learning: introduction, machine learning systems, supervise and unsupervised learning, inductive and deductive learning, clustering, support vector machines

Applications: slope stability analysis, settlement of shallow foundations on cohesionlesssoils, evaporate losses in reservoirs, undrained shear strength of clay, prediction of compressive strength of self-compacting concrete, traffic signal coordination.

UNIT V:

Regression Analysis: Relationship between attributes using Covariance and Correlation, Relationship between multiple variables: Regression (Linear, Multivariate) in prediction. Residual Analysis, Hypothesis testing of Regression Model, R-square and goodness of fit, Multiple Linear Regression, Non-Linear Regression, logistic regression.

Applications: determination of uniaxial compressive strength and modulus of elasticity, prediction of fracture parameters of concrete, choose alternative route by optimization in transportation, capacity of signalized and unsignalized intersections, choose different mode by cost optimization.

Text Books:

1. PijushSamui, DwarkadasPralhaddas Kothari, Artificial intelligence in Civil Engineering: AI in Civil Engineering, 2012.
2. Ian Flood, Nabil Kartam, Artificial Neural Networks for Civil Engineers: advanced features and applications, 1998.

Suggested Reading:

1. S.M Yadav, Application of soft computing techniques in civil engineering, 2018.
2. SarojKaushik, "*Artificial Intelligence*", Cengage Learning India, 2012.
3. Nelson M. Mattos, "*An Approach to Knowledge Base Management*", Springer Berlin Heidelberg, 1991.

Online Resources:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

18CE C22

ENVIRONMENTAL ENGINEERING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: The objectives of the course are to

1. Perform the experiments using different equipments
2. Determine water quality using standard test procedures
3. Understand the water & waste water sampling, their quality standards
4. Estimate air quality and classify the level of pollution
5. Estimate bacteriological quality of water.

Course outcomes: After the completion of the course student should be able to

1. Demonstrate skills to use equipments in conducting the test procedures.
2. Evaluate water quality and summarize the suitability in accordance with IS: 10500- 2012, Drinking Water specifications.
3. Evaluate characteristics of wastewater and summarize the suitability for disposal/reuse as per standards.
4. Measure air quality and classify the level of pollution based on standards set by Pollution Control Board.
5. Evaluate and analyse bacteriological quality of water**.**

Practical Work: List of Experiments

1**.** Determination of pH, turbidity
2. Determination of Electrical Conductivity
3. Determination of Total Solids (Organic and inorganic, volatile and fixed)
4. Determination of Alkalinity
5. Determination of Hardness (Total, Calcium and Magnesium Hardness)
6. Determination of Chlorides and sulphates
7. Determination of optimum coagulant Dosage
8. Determination of COD
9. Determination of DO and BOD
10. Determination of Breakpoint chlorination
11. Determination of MPN
12. Measurement of air quality

Suggested Reading:

1. Government of India & Government of The Netherlands –Hydrology Project Technical Assistance, “Standardanalytical procedures for water analysis”, May 1999

2. D. R. Khanna and R. Bhutiani, “Laboratory Manual of Water and Wastewater Analysis”, Daya Publishing House, 2008

18CE C23

ENGINEERING GEOLOGY LAB

Instruction	3P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	35 Marks
CIE	15Marks
Credits	1

Course Objectives: The students will:

1. Familiarize with the procedures for the identification of minerals rocks and
2. Describe different structural models.
3. Measure the attitude of beds and draw the sections for geological maps.
4. Operate electrical resistivity meter.
5. Describe the various types of maps.

Course Outcomes: Upon the Completion of this course students will be able to

1. identify the minerals, rocks and various
2. identify structural features like folds, faults and unconformities.
3. measure the electrical resistivity of rocks, soil etc.
4. interpret the topographic maps.
5. identify the geological and geotechnical features of given places.

LIST OF EXPERIMENTS:

1. Identification and description of physical properties of minerals.
2. Identification and description of Geotechnical characteristics of Rocks.
   IS 1123-1975
3. Study of structural models, folds, faults and unconformities.
4. Measurement of strike and dip of joints in granites using clinometers compass.
5. Measurement of electrical resistivity of rocks, soils and water.
6. Study of geological and Geotechnical map of Telangana, Andhra Pradesh and India.
7. Study of Topographic Maps of Srisailam and NagarunaSagar dams.
8. Study of maps and sections pertaining to the study of folds, faults and unconformities.

Suggested Reading:

1. IS 113-1975, "*Methodof Identification of natural Building stones*", Bureau of Indian Standards.
2. Parbinsingh, "*Engineering and general Geology*", S.K.Kataria& sons, New Delhi 2010.
3. F. G. Bell, "*Fundamentals of Engineering Geology*", Aditya Books Pvt. Ltd., New Delhi 2007
4. "*Seismo Tectonic Map of India*", Geological Survey of India 2005.
5. Kuzin M., Egorov N., "*Field Manual of Minerals*", Central Books
Ltd., 1997.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Model Curriculum (with effect from 2021-2022)

B.E (CIVIL ENGINEERING)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1	18CE C24	Construction Engineering and Management	3	-	-	3	30	70	3
2	18CE C25	Hydrology and Water Resources Engineering	3	-	-	3	30	70	3
3	18CE C26	Estimation, Specifications and Costing	3	-	-	3	30	70	3
4		Core Elective 5	3	-	-	3	30	70	3
5		Open Elective 2	3	-	-	3	30	70	3
	PRACTICALS								
6	18CE C27	Concrete Technology Lab	-	-	3	3	25	50	1.5
7	18CE C28	Computer Applications Lab	-	-	3	3	25	50	1.5
8	18CE C29	Project Part 1	-	-	4				2
		Total	**15**	**-**	**10**		**200**	**450**	**20**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Core Elective 5:

1. 18CE E18 - Design of Steel Structures-II
2. 18CE E19 - Airport Engineering
3. 18CE E20 - River Engineering
4. 18CE E21 - Water and Air Quality Modeling
5. 18CE E22 -Applications of Data Analytics in Civil Engineering

Open Elective 2:

1. 18ME O07 – Intellectual Property Rights
2. 18EG O02 – Gender Sensitization

3. 18CS O01 – Basics of Artificial Intelligence
4. 18EE O04 – Energy Conservation

18CE C24

CONSTRUCTION ENGINEERING AND MANAGEMENT

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the students

1. Understand different types of construction, execution methods and basics of construction project management.
2. Develop knowledge in respect of project planning and application of different techniques for project planning and control.
3. Analyse the projects in respect of time and cost to result in resource optimization.
4. Understand the various construction safety measures and quality management systems applicable for construction projects.
5. Distinguish various construction equipment used and understand essential contracting systems adopted in construction industry.

Course Outcomes: After completion of the course, students will be able to

1. choose a suitable type of construction method and project delivery system for successful project completion.
2. plan the construction project and apply a suitable technique for the project under consideration.
3. optimize project time and cost with the exercise of proper monitoring and control in construction projects
4. recall construction safety and quality management systems to be implemented in construction projects.
5. select proper equipment for the execution of various operations in construction and recall various issues of contracting.

UNIT-I: Introduction to Construction and Construction Management: Construction and unique features of construction, construction projects-types and features, phases of a construction project, agencies involved and their methods of execution- Project Delivery Methods: BOT, SBOO, BOOT; Public Private Partnership (PPP); Significance of construction management, Construction Team. Organisation – principles and types.

UNIT-II:Construction project planning: Stages of project planning: pre-tender planning,pre-construction planning, detailed construction planning, Types of Project plans- Time plan, man power plan, material plan, construction equipment plan; Work break-down structure- Methodologies of WBS; estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi critical paths, calendaring networks. PERT-Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

UNIT-III:Project Monitoring & Control: Introduction - Supervision, record keeping, periodic progress reports. Updating of plans: purpose, frequency and methods of updating- using bar charts, PERT/CPM, and Precedence network. Schedule/time progress control; Cost control- Classification of costs, time-cost trade-off in construction projects; Implement

UNIT-IV:Construction Safety and Quality Management Safety: Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health; Quality control: construction quality, Quality control and Quality Assurance in construction projects, ISO Standards-Benefits of ISO 9000, Principles of quality management systems, ISO 9000 -2000 family of Standards.

UNIT-V:Construction Equipment and Contracts: Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials.

Contracts**:** Introduction, types of construction contracts and their advantages and disadvantages, conditions of contracts, Tender: Tender form, Tender Documents, Tender Notice, Work Order. Delays, penalties and liquid4.ated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Text Books:

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.

Reference Books:

1. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
2. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
3. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015.
4. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016..

18CE C25

HYDROLOGY AND WATER RESOURCES ENGINEERING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the students to understand
1. Surface & sub-surface hydrology, rainfall and measurement of rainfall.
2. Runoff, runoff estimation and surface reservoir planning.
3. Groundwater and its occurrence, theory of subsurface flow, flow to wells and yield, and irrigation practices.
4. Canal system, design theories, and canal outlets.
5. Design of Gravity dams, earth dams and seepage analysis, spillways and energy dissipators.

Course Outcomes: On completion of the course, students will be able to
1. analyse the components of hydrologic cycle and determine rain gauge network.
2. interpret various methods to estimate runoff and understand reservoir planning.
3. identify aquifer types , understand the process of sustainable groundwater management and evaluate the performance of irrigation system.
4. understand canal systems and design canals using regime concept.
5. analyse the stability of dams and understand spillways.

UNIT- I:
Introduction: Hydrologic cycle, water-budget equation, world water balance, hydrology applications in engineering, surface water resources of India.
Precipitation: Forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, depth-duration-frequency relationship, Probable Maximum Precipitation (PMP).Infiltration, infiltration capacity, infiltration indices, evaporation, and evapotranspiration.

UNIT- II:
Runoff: Runoff, factors affecting runoff, flow-duration curve, flow-mass curve, hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph.
Reservoirs: Types, selection of suitable site, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation and life of reservoir.

UNIT- III:
Ground water: Types of aquifers, Aquifer parameters, steady radial flow into a confined and unconfined aquifer, Darcy's law, yield of an open well, well hydraulics, Safe yield, Water harvesting structures and augmentation of ground water, Sustainable Ground Water management.
Irrigation: Duty, delta and base period of crops, crop water requirements, methods of applying water to the fields, micro irrigation, irrigation efficiencies, soil-water relationship, depth of irrigation, frequency of irrigation, wilting point, water logging, consumptive use.

UNIT- IV:
Distribution systems : Canal systems, alignment of canals, balancing depth, canal losses, estimation of design discharge. Design of canals- rigid boundary channels, alluvial channels, Kennedy's and Lacey's theory of regime channels. Lining of canals, types of lining.
Types of Canal outlets, Introduction to diversion head works and its components, canal regulation works.

UNIT- V:

Gravity dams: Types of dams, Forces on gravity dams, causes of failure, stress analysis, elementary and practical profile, and economical height of dam.

Earth dams: Classification, design considerations, control of seepage, slope protection.

Spillways: Types, components of spillways.

Text Books:

1. P. N. Modi, "Irrigation Water Resources & Water Power Engineering", Standard Publishers, 2014.

2. S. K. Garg, "Irrigation Engineering and Hydraulic Structures: Water Resources Engineering - Vol.II", Khanna Publishers, Delhi, 2017.

Suggested Reading:

1. Ch. S. N. Murthy, "Water Resources Engineering: Principles and Practice", New Age International Publishers, Delhi, 2002.

2. G. L. Asawa, "Irrigation and water Resources engineering", New Age International Publishers, Delhi, 2005.

3. VenTe Chow, "Handbook of Applied Hydrology", McGraw-Hill Book Company, New York, 1964.

18CE C26

ESTIMATION, SPECIFICATIONS AND COSTING

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To enable the students understand

1. The working of detailed estimates for different structures.
2. The working of steel quantities of R.C.C Framed works and preparation of BBS.
3. The rate Analysis for different items of works.
4. About TSDSS and Departmental procedures.
5. About Specifications and standard procedure for construction works.

Course outcomes: At the end of the course, the students will be able to

1. prepare approximate estimates, detailed estimates for simple and complex buildings.
2. understand the RCC drawings and estimate the steel qualities to prepare BBS of various items of the buildings – beams, columns, slabs, footings and other civil engineering structures.
3. apply engineering knowledge to estimate quantities of roads, culverts, canals and septic tanks.
4. understand the work force required for the quantities estimated, as per TSSDSR and apply rate analysis to compute unit cost for different items of works of buildings, concrete and bituminous road works.
5. understand general and detailed specifications of works and record details of measurements in the M-Book and work force details in muster roll.

UNIT – I:

Introduction to Estimation, objectives of estimation, factors influencing estimation, types of estimates, detailed estimates for Flat roof buildings - load bearing and RCC framed using long wall and short wall method, centre line method.

UNIT – II:

Estimation of steel quantities and preparation of bar bending schedule (BBS) for RCC framed works - slabs (one way and two way), beams and columns, footings, stair case and retaining walls.

UNIT – III:

Detailed estimate of WBM roads, CC roads and Bituminous roads (including earth work), single cell rectangular box culvert, Septic tank and earth work of irrigation canals.

UNIT – IV:

Preparation of analysis of rates and theoretical requirements of materials as per Telangana State Standard Data and Schedule of Rates (TSSDSR) for major items of works of a building, all items of Bituminous and concrete road works.

UNIT – V:

General and detailed specifications of various items of buildings and road works, M-Book and Muster Roll.

Text Books:

1. B. N. Dutta, "*Estimating and Costing in Civil Engineering – Theory and Practice*", UBS, publishers' distributors (p) ltd.-New Delhi 2012.
2. M.Chakraborti, "*Estimating, Costing, Specifications and Valuation in Civil Engineering"*, Chakraborti 2006.

Suggested Reading:

1. Jagjit Singh, "*Estimating and Costing in Civil Engineering*", Galgotia Publications, New Delhi, 1996.
2. B. S. Patil," *Civil Engineering Contracts and Estimation*", Orient Black swan Private Ltd; Fourth edition 2015.
3. Telangana State Standard Schedule of Rates (TSSDSR).

18CE E18

DESIGN OF STEEL STRUCTURES - II

(Core Elective 5)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Codes required: IS 800 – 2007, steel tables, Bridge rules, Bridge Code (RDSO), IS: 875 Part-2 & Part-3

Course Objectives: To enable the students

1. Gain exposure to a few basic types of steel structures (Plate Girders,Gantry girders, Trussed girders etc.) and their components, used in Highway bridges, Industrial workshops and Railway bridges .
2. Attain fundamental knowledge of design of plate girder, gantry girder,steel railway bridges (plate girder & truss girder type), rocker &rollerbearings and is able to interpret the specifications of relevant codes.
3. Acquire adequate conceptual knowledge and skills to extend the sameto investigate into critical issues , compare various options &choosebest solution for the problems in the areas of highway , industrial andrailway steel structures
4. Consider economy in the design of these structures without sufferingthe safety, in a given situation.
5. Understand the intricacies of detailing aspects of these structures and their connections

Course Outcomes: At the end of the course, the students will be able to

1. understand the phenomenon of shear buckling in beams with larger depths, design and detail welded plate girder for various structural actions.
2. estimate the loads on gantry girders, design and detail gantry girder including connections.
3. identify suitable bridge type, design roller & rocker bearings for railway bridges.
4. develop the layout of the bridge, design and detail deck type riveted plate girder bridge including wind effects.
5. choose the appropriate truss configuration, develop layout of the bridge, and design & detail truss girder bridges.

UNIT- I:

Design of Plate girders: Design of welded plate girder for static loads–Economical Depth, Design of Cross Section, Flange curtailment, intermediate and bearing stiffeners, connections- as per IS 800-2007.

UNIT- II:

Design of Gantry girders: Basic principles, Loads, Codal provisions, Detailed Design- Cross section and connections, Drawing- general layout and cross section;

UNIT- III:

Introduction to Railway Bridges and Design of bearings: Bridges: Deck and through type bridges – Economical span – Indian standard railway broad gauge train loadings – permissible stresses.

Bearings: Types and general description of various bearings, detailed Design of Rocker and roller bearings for railway bridges.

UNIT- IV:

Design of Deck type riveted plate girder railway bridges: Economical depth, detailed design of Cross section, connections, intermediate and bearing stiffeners, Wind effects-Design of Cross frames- Detailing; General layout, longitudinal and cross sections

UNIT- V:

Design of Through type riveted truss girder railway bridges: Truss configurations, Detailed design of stringer beams, Cross girders and Truss girders; Wind effects- Design of top lateral and bottom Lateral bracing, Portal and sway bracings; Drawing-General layout , generation of longitudinal and cross sections.

Text Books:

1. S. K. Duggal, “Limit State Design of Steel Structures”, 3rd Edition, McGraw Hill HED, 2019.
2. B.C. Punmia and Ashok Kumar Jain, “Comprehensive Design of Steel Structures”, Laxmi Publications, 2015.

Suggested Reading:

1. A.S. Arya and J.L Ajmani “Design of Steel Structures”, Nem Chand & Bros. 2014.
2. M.R. Shiyekar, “Design of Steel Structures, (Limit State Method”, Second Edition, PHI Learning Pvt Ltd. 2013
3. Ramachandra and VirendraGehlot, “Design of Steel Structures”,Volume – 2, Scientific Publishers, 2008.

18CE E19

AIRPORT ENGINEERING
(Core Elective –5)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: to enable the student

1. know the components of airports
2. know the factors effecting different airport component
3. know the site selection for airports
4. understand the design standards applicable in airport engineering
5. get an idea about air traffic management

Course Outcomes: At the end of the course**,** students will be able to

1. understand the structure of airport system.
2. understand the components of aircraft and airport.
3. apply engineering knowledge for selection of airport sites, plan airports and facilities as per international standards and also understand the corrections to be applied for runway.
4. design airports as per ICAO standards and develop the facilities required for passengers and aircrafts.
5. create the facilities required for the airport traffic management and understand the importance of the drainage system and its design in airports.

UNIT- I:

Introduction of Air Transport System: History of air transportation, roles and responsibilities of director of Civil Aviation and National Airport Authority, International Airport Authority of India, Airports Authority of India, ICAO, growth of air transport.

UNIT- II:

Aircraft Characteristics:

General introduction, relationship between aircraft and airport, effects of aircrafts on airports, aircraft characteristics, components of an aircraft.

UNIT- III:

Airport Planning: Airport master plan- FAA and ICAO recommendations, regional planning, airport site selection, airport location, typical layout of a terminal areas and airport incorporating airport components- terminal building, apron, hangar, Runway design- runway orientation, wind rose diagrams, basic runway length, connections to runway lengths, airport classifications and airport obstructions.

UNIT- IV:

Airport Capacity: Factors influencing runway capacity, methods for practical capacity determination, gateway, capacity, taxiway capacity, airport configuration – single runway, parallel runway, intersecting and non-intersecting runway, taxiway design, factors controlling taxiway layout and geometric design standards, exit taxiways.

UNIT- V:

Air Traffic Management: Visual aids-airport marking, airport lighting, air traffic control– need of air traffic control, concepts of air traffic control network, air communication, air traffic control aids, ILS and installations, landing aids, airport drainage system– special requirements of airport drainage system, design procedures for surface and sub– surface drainage systems.

Text Books:

1. Khanna. S. K. Arora, M. G. and Jain. S. S, "*Airport Planning and Design*" Fifth edition. Nem Chand & Bros, Roorkee, India, 1999.
2. K. P. Subramanian," *A text book on Highway, Railway, Airport and Harbour Engineering*", Scitech Publications (India) Pvt. Ltd., 2015.

Suggested Reading:

1. Subash C Saxena, " *Airport Engineering Planning and design*", CBS 1st edition, 2010.
2. Norman J.Ashford, Saleh A. Mumayiz and Paul H. Wright "*Airport Engineering Planning - Design and development and Planning- 21st century airports*", Wiley India Pvt. Ltd, 2012.
3. R. Srinivasa Kumar, "*Airport, Railway, Dock and Harbors*", Universities Press, 2014

18CE E20

RIVER ENGINEERING
(Core Elective-5)

Instruction	3 Hours perweek
DurationofSemesterEndExamination	3Hours
SemesterEndExamination	70Marks
CIE	30Marks
Credits	3

Course Objectives: To enable the students to understand

1. The concepts of rivermorphology
2. The methods of stage measurement.
3. Hydraulicriver models.
4. Riverprotectionandtrainingworks
5. Designflood protection structures

Course Outcomes: At the end of the course, the students will be able to

1. define basic terms and understand the concepts of rivermorphology.
2. determine scour depth of hydraulic structure and identify methods of stage measurement.
3. understand hydraulic river models.
4. identify river training works and understand protective measures.
5. designflood protection structures.

UNIT- I:

Rivermorphology: Behaviourofriverflow,roleofsedimentsinrivers,changes in regimes. Sediment transport mechanics - bed forms, bed load transport, and transport of suspended sediment, critical shear stress, and sediment transport equations.

UNIT-II:

AggradationandDegradation: Localscouratbridgepiersandotherhydraulic structures, measurements in rivers - stage measurements, channel geometry, discharge, and sediment samplers and suspended and bed loadmeasurement.

UNIT-III:

Hydraulicmodellingofrivers: Hydraulicsimilitude,physicalrivermodels-fixed and movable bed models; sectional models, distorted models, mathematical models for aggradations, degradation and localscour.

UNIT- IV:

River Protection and Training Works: Introduction, classification of river training,typesoftrainingworks,protectionforrevetments,dikes,gabions,spurs, bank protective measures and bed controlstructures.

UNIT- V:

Design of river flood protection structures: Diversion and cofferdam, river regulations systems, dredging and disposal, river restoration.

Text Books:

1. P.Y.Julien,"*RiverMechanics*",CambridgeUniversityPress,March 2018
2. S.K.Garg,"*IrrigationEngineeringandHydraulicStructures",* Khanna Publishers, 2017

Suggested Reading:

1. R.J. Gardeand K.G. RangaRaju, "*Mechanics of sediment transportationandAlluvialstreamproblems"*,WileyEasternlimited, 1977
2. Central Board OfIrrigation And Power, "*River BehaviourManagementandTraining(Vol.I&II)",*NewDelhi,1991

3. U.S.ArmyCorpsofEngineers,"*RiverHydraulics*",UniversityPress ofthePacific,2004.

18CE E21

WATER AND AIR QUALITY MODELING
(Core Elective –5)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student
1. Understand various systems, models and their development.
2. Learn about the river water quality modelling and Benthal Oxygen Demand of sediments.
3. Get educated on the models for lakes and estuaries & transport mechanisms.
4. Learn about plume characteristics, air pollution modelling and its applications.
5. Understand plume behaviour using Gaussian plume equation for different atmospheric stability conditions.

Course Outcomes: At the end of the course the student will be able to

1. develop and validate mathematical models for stream water quality and perform cost benefit analysis.
2. assess water quality of rivers using models such as Streeter Phelps model and determine oxygenation coefficients, oxygen consumption by the sediments in rivers.
3. develop models for estuaries for their continuous quality monitoring and understand transport mechanisms.
4. apply knowledge of plume characteristics and diffusion of stack emissions in modelling.
5. derive models for air quality monitoring, Gaussian plume equation and compute stack height.

UNIT -I:
Introduction to Mathematical Models: Role of mathematical models; systems approach, systems and models, kinds of mathematical models, model development and validation effluent and stream standards; water quality model development, cost: benefit analysis using models, model requirements and limitations; Dissolved Oxygen model for streams sources and sinks of dissolved oxygen.

UNIT -II:
Surface Water Quality Modelling: Historical development of water quality models; rivers and streams water quality modelling, Streeter Phelps model, oxygen sag curve, determination of deoxygenation and re-aeration coefficient, Benthal oxygen demand.

UNIT -III:
Mass transport mechanisms: Models for Estuary and Lakes: Physical chemical and biological processes in estuaries; estuarine transport, net estuarine flow, estuary dispersion coefficient; Lakes and impoundments: Water quality response to inputs; water quality modelling process.

UNIT - IV:
Air pollution Modelling: Chemistry of air Pollutants, atmospheric reactions, sinks for air pollution, transport of air pollutants, meteorological settling for dispersal of air pollutants, vertical structure of temperature and stability, self cleaning of atmosphere, transport and diffusion of stack emissions, atmospheric characteristics significant to transport and diffusion of stack emission, stack plume characteristics.

UNIT - V:
Air quality models: Types of modelling techniques, multiple sources and area sources, fixed box models, Diffusion models, Gaussian plume derivation, modifications of Gaussian plume equation, stack height computation.

Text books:

1. Steven C. Chapra," *Surface Water Quality Modelling*", Tata McGraw Hill New York, 1997.
2. Alex De Visscher, "*Air dispersion modelling: Foundations and applications*", Wiley-Blackwell Publications, Nov 2013.
3. AbhishekTiwary, Ian Williams, "*Air Pollution: Measurement, Modelling and Mitigation*", CRC Press; 4 edition, 2018.

Suggested Readings:

1. R.W. Boubel, D.L. Fox, D.B. Turner & A.C. Stern, "*Fundamentals of Air Pollution*", Academic Press, New York, 2006.
2. P. Zannetti, "*Air pollution modelling*", WIT, Software edition 1990.

18CE E22

APPLICATION OF DATA ANALYTICS IN CIVIL ENGINEERING
(Core Elective –5)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: The main objectives of this course are:

1. To identify the sources and characteristics of civil engineering data
2. To find the hidden patterns within the data by processing the raw data
3. To use the information obtained in order to make civil engineering project decisions
4. Study the applications of data analytics in civil engineering
5. To identify various open source tools and resources related to data analytics

Course Outcomes: On successful completion of this course, student will be able to

1. define the descriptive, predictive and prescriptive models and select suitable tools or techniques for application in civil engineering problems
2. identify the discrete and continuous random variables and select appropriate mathematical models which support decision making under uncertainty
3. design data collection process required for descriptive and exploratory models for problems in civil engineering
4. relate estimators and estimates to process of estimation and thus implement the various modeling techniques to uncover the patterns in the civil engineering related data
5. formulate hypothesis and their corresponding confidence intervals for various count data based and discrete choice models along with goodness of fit measures

UNIT I:

Introduction: Fundamentals and the context of data analytics, descriptive, predictive and prescriptive models of data analytics, evolution of data analytics solutions such as SQL analytics, visual analytics, big data analytics, and cognitive analytics. Data analytics tools and techniques used in civil engineering.

UNIT II:

Random variables: Sample, population, sample space, frequentist and Bayesian notations of probability, discrete and continuous random variables and their distributions.

Statistical Modelling: Overview, application, desirable features, issues and pitfalls of statistical models, framework for developing models, basic steps in model building and decision making under uncertainty.

UNIT III:

Experimental and observational study design: sample selection, recruitment, and data collection method selection. Descriptive and exploratory data analysis, including: measures of central tendency, histograms, density distributions, and box plots. Examples of descriptive and exploratory analysis for civil engineering related problems.

UNIT IV:

Estimation, estimators and estimates; criteria for assessing estimators, asymptotic properties. Estimation techniques: method of moments, ordinary least squares (OLS) regression, log likelihood estimation. OLS – assumptions of linear regression, linear relationship, and estimation of coefficients. Log likelihood estimation - definition of likelihood and log likelihood, parameter estimation using maximum likelihood estimation technique, desirable properties of maximum likelihood estimators.

UNIT V:

Statistical inference of models including tests, confidence intervals and hypothesis testing. Statistical models of independent data including simple and multiple linear regression.Count data and discrete choice models: Binary, multinomial logit models, and count data models with applications in travel choice and transport safety. Process of model selection, goodness of fit and sensitivity analysis.

Text Books:

1. MashrurChowdary, Amy Apon and KakanDey, Data Analytics for Intelligent Transportation Systems, 2012
2. SubhashishSamaddar and SatishNargundkar,Data Analytics: Effective methods for Presenting Results, CRC press, 2012.

Suggested Reading:

1. S.M Yadav, Application of soft computing techniques in civil engineering, 2018.
2. V.K.Jain, Data Science and Analytics, Khanna Publishing, 2018.
3. http://nptel.ac.in/courses/106106126/

18CE C27

CONCRETE TECHNOLOGY LAB

Instruction		3P Hours per week
Duration of Semester End Examination		3 Hours
Semester End Examination		50 Marks
CIE		25 Marks
Credits	1.5	

Course Objectives:

1. Conduct tests on cement
2. Conduct tests on Fine Aggregate and Coarse Aggregate
3. Conduct tests on concrete in fresh and hardened states.

Course outcomes: At the end of the course, the student will be able to

1. determine the properties of given cement sample and assess its suitability for use in construction.
2. determine the properties of fine and coarse aggregate samples to assess their suitability for use in construction works.
3. measure the workability of concrete and recommend its suitability for structural works.
4. design a suitable concrete mix proportion as per the code provisions for the specified grade.
5. conduct destructive and non-destructive tests to evaluate the quality and strength of concrete.

List of Experiments:

1. Determination of the specific gravity of the given cement sample
2. Determination of the standard consistency of the given cement sample
3. Determination of the initial setting time of the given cement sample
4. Determination of the bulking of Fine Aggregate
5. Determination of the bulk density, void ratio, porosity and specific gravity of given Fine and coarse Aggregate
6. Determination of the fineness modulus of Fine Aggregate & Coarse Aggregate
7. Determination of the slump & compaction factor of concrete mix
8. Determination of the compressive strength of concrete cubes and split tensile strength of concrete cylinders
9. Mix design as per IS:10262-2019
10. Demo on Non-destructive testing of concrete specimen

Referencebooks:

1. M.S. Shetty, “Concrete Technology- Theory & Practice”, S. Chand & Company Publishers.
2. IS 10262:2019,”Indian Standard Concrete Mix Proportioning – Guidelines”.

18CE C28

COMPUTER APPLICATIONS LAB

Instruction	3 Periods per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Enable the students

1. Explore a few software packages used in various areas of Civil Engineering (Structural Analysis & Design, Soil Mechanics, Water Supply & Sanitary Engineering, and Surveying) and the applications of different software packages.
2. Attain the fundamental knowledge of navigation of software packages.
3. Acquire adequate conceptual knowledge and skills to use software packages in the field in order to provide solutions to civil engineering problems.
4. Provide accelerated/time bound solutions with help of software packages without effecting the accuracy of computations.
5. Understand the rectification of errors while using software packages.

Course Outcomes: At the end of the course the students will be able to

1. develop a model of framed structure and analyze using STAAD-Pro.
2. design the components of a framed structure including isolated footings using STAAD-Pro and STAAD Foundation.
3. evaluate stability of slope using Slip Circle method and design a cantilever retaining wall using GEO5.
4. analyze pipe networks using EPANET and sewer networks using SEWER Gems.
5. develop geo-referenced thematic maps and carry out overlay analysis using ArcGIS/QGIS

List of Exercises:

1. Modelling and analysis of plane frames using STAAD-Pro.
2. Modelling and analysis of space frames using STAAD-Pro.
3. Design structural components of a RC building using STAAD-Pro.
4. Design of isolated footing using STAAD Foundation.
5. Analysis of a slope for stability by Slip Circle method using GEO5 (Slope Stability module).
6. Design of cantilever retaining wall using GEO5 (Cantilever Wall module).
7. Steady state analysis of pipe networks (open/looped) using EPANET.
8. Analysis of sewer networks using SEWER Gems.
9. Digitization of topo-sheets and perform overlay analysis using ArcGIS.

Textbooks/References:-

1. STAAD.Pro V8i (SELECTseries 4) manual on staad exercises, July 2019.
2. EPANET 2 Users Manual Paperback – Import, 30 January 2013 by U S Environmental Protection Agency (Creator)
3. Instructional Guide for The ArcGIS Book 1st Edition, Kindle Edition by Kathryn Keranen (Author), Lyn Malone (Author), Esri Press; 1 edition (June 21, 2016)
4. Design of Sewer Network Using SewerGEMS Software Paperback – September 17, 2018 by HinalSopariya (Author)
5. https://www.finesoftware.eu/engineering-manuals/ for GEO5 execises.

18CE C29

PROJECT: PART-1

Instruction	Hours per week
Continuous Internal Evaluation	50 Marks
Credits	2

The objective of Project Part -1 is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic
2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/Modeling/Simulation/Experiment/ Design/Feasibility
4. Preparing a Written Report on the Study conducted for Presentation to the Department
5. Final Seminar, as oral Presentation before a departmental Committee.

Course Outcomes:

At the end of the course, the students will be able to

1. identify the domain of one's interest through critical review of literature.
2. define a problem in the domain of interest and understand its scope and also develop the skill of coordinating with the team in the form of discussions during the progress of finding the solution.
3. examine various approaches and build a preliminary approach to the problem on chosen topic.
4. defend their approach by healthy interactions with the participants and modify, if necessary and cultivate the culture of ethical practices.
5. develop the technical skill in preparing a well structured report and present.

Guidelines for the award of Marks:

Maximum Marks: 50

Evaluation by	Maximum Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Departmental Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Model Curriculum (with effect from 2021-2022)

B.E (CIVIL ENGINEERING)

SEMESTER – VIII

S. No.	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
	THEORY								
1		Core Elective 6	3	-	-	3	30	70	3
2		Open Elective 3	3	-	-	3	30	70	3
	PRACTICALS								
3	18CE C30	Technical Seminar (On the latest trends and other than project)	-	-	2	-	50	-	1
4	18CE C31	Project Part 2	-	-	20				10
		Total	**06**	**-**	**22**		**110**	**140**	**17**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

Core Elective 6:

1. 18CE E23 - Earthquake Resistant Design of Structures
2. 18CE E24 - Ground Improvement Techniques
3. 18CE E25 - Design of Hydraulic Structures/Irrigation Engineering
4. 18CE E26 - Rural Water Supply and Onsite Sanitation Systems
5. 18CE E27Applications of Block Chain Technology in Civil Engineering

Open Elective 3:

1. 18ME O06 – Nano Materials and Technology
2. 18IT O03 – Principles of Internet of Things
3. 18EE O05 – Waste Management
4. 18EC O08 – Neutral Networks and Fuzzy Logic

18CE E23

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
(Core Elective-6)

Instruction	3L Hours per week		
Duration of Semester End Examination	3 Hours	Semester End Examination	70 Marks
CIE	30 Marks	Credits	3

Course objectives: To enable the student

1. Understand the causes of earthquakes , their Magnitude & effects and various types of earthquake waves
2. Understand the concepts of damped and un damped vibrations and the response of single , two and multi-degree systems to thesevibrations , and concepts of Response spectrum
3. Review various case studies of past earthquakes, and performance of buildings during those earthquakes, understand the concepts of Seismic Design Philosophy and Earthquake Resistant Design of Masonry, RC and Steel structures. Evaluate the seismic loads on the structures using IS 1893 Part I codal provisions.
4. Gain knowledge of Seismic Performance of Engineered and NonEngineered Urban and Rural buildings
5. Understand the basic concepts of Seismic resistant construction, Base isolation techniques and other energy dissipation devices and Concepts of Seismic retrofitting

Course Outcomes: At the end of the course, the student will be able to

1. relate the fundamentals of engineering seismology, understand the characteristics and effects of strong motion earthquakes.
2. understand the concepts of damped and un-damped vibrations in single and multi-degrees of freedom systems.
3. estimate the seismic loads on structures and analyse using seismic coefficient and response spectrum methods.
4. examine the causes of damages of urban and rural buildings and interpret the design provisions from IS-1893 part - I (2016) and IS - 13920(2016).
5. know the use of various earthquake resistant devices, apply suitable construction techniques for retrofitting.

UNIT – I:

Engineering Seismology& Elements : Causes of Earthquakes–Geological faults,Tectonic Plate theory – Elastic Rebound theory –Focus - Epicentre – Hypocenter,Seismic waves –Primary and Secondary waves, Seismogram - Magnitude, Intensity and Energy release during earthquakes – Magnitude & Intensity Scales, Characteristics of strong earthquake ground motions – Effect of soil properties – Liquefaction of soils.

UNIT – II:

Theory of Vibrations: Introduction to Vibrating Systems – mass, stiffness and damping parameters – Concept of inertia, elastic restoring force and damping –types of damping, difference between static forces and dynamic excitation.

Single Degree of Freedom (SDOF) Systems – SDOF idealization - Formulation of Equation of motion(for mass as well as base excitation) and response for free, forced (harmonic loads only), damped &undamped vibrations, Logarithmic Decrement & Influence of gravitational force on the equation of motion, Natural Time period & Natural Frequency.

Multi Degree of Freedom (MDOF) Systems - Equation of Motion–Mass, stiffness and damping matrices, Modal Analysis -Natural frequencies - generation of modal frequencies and mode shapes, Concept of Response Spectrum – Response Spectrum Curve as per IS: 1893 Part I (2016).

UNIT – III:

Evaluation of Seismic Loads on Structures: Concepts of over strength, Ductility and Redundancy –Determination of earthquake forces on structures – Seismic Co-efficient and Response Spectrum Methods.

UNIT – IV:

Seismic Performance of Buildings: Case Studies of damages to urban and rural buildings during some past earthquakes – Damage Patterns in structural and non –structural elements – Soft storey effect, Design Provisions as per IS – 1893(2016), Ductile detailing as per IS – 13920(2016).

UNIT – V:

Earthquake Resistant Devices &Construction Techniques: Vibration Control Devices - Base isolators, Energy dissipating devices – Dampers, Lateral Displacement Control - Bracing Systems, Shear Walls.

Seismic Retrofitting: Repair, rehabilitation and retrofitting, retrofitting strategies – Importance of Re-analysis, Retrofitting Techniques for RCC, Masonry and rural buildings, IS – 13935(2009) codal provisions for Retrofitting.

Text Books:

1. PankajAgarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd, 2011.
2. S.K Duggal, "Earthquake Resistant Design of Structures", Oxford Higher Education, Second Edition, 2013.

Suggested Readings:

1. A.K. Chopra, "Dynamics of Structures", Pearson Education, Fifth Edition,2017.
2. Jai Krishna, A.R Chandrasekaran, Brijesh Chandra, "Elements of Earthquake Engineering", South Asian Publishers Pvt. Ltd, Second Edition,2014.
3. Steven L Kramer, "Geo-Technical Earthquake Engineering", Pearson Education Ltd, 2013.

18CE E24

GROUND IMPROVEMENT TECHNIQUES
(Core Elective-6)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To make the students able to
1. Understand the importance of ground improvement and learn about various types of ground improvement techniques suitable for given soil conditions.
2. Understand the concepts behind a range of ground improvement and soil remediation techniques by using chemical stabilization and grouting methods.
3. Understand the different concepts of vibration techniques for cohesionless soils stabilization.
4. Select suitable stabilization method for cohesive soils.
5. Understand the Types, functions and applications of Geo-textiles, geo-grid, tests on geo-textiles and Reinforced earth.

Course Outcomes: At the end of the course, the student will be able to
1. review the importance of ground improvement techniques and types, for different soils.
2. apply suitable chemical stabilization and grouting techniques to address the field problems.
3. modify the cohesionless soil properties to required degree by using suitable vibration techniques.
4. identify suitable ground improvement techniques for cohesive soils in a specific project.
5. explain different advanced stabilizing techniques for slopes.

UNIT- I:
Introduction: Need for ground improvement, applications, and factors affecting – different mechanical, chemical, static and dynamic techniques – mechanical stabilization – blending of aggregate – Rothfutch Testing. Concept of Soil confinement, Gabion Walls, Crib Walls and Sand Bags.

UNIT – II:
Chemical stabilization: Lime, Cement, Bitumen, Emulsions, Chemicals, factors influencing–Design approach, construction procedure, laboratory testing, additives. Suspension and solution grouts, Principles, method, equipment, applications, compaction grouting, jet grouting, field compaction control.

UNIT – III:
Stabilization of Cohesion less soils: In Situ densification, Vibro techniques– Mechanisms. Factors affecting, suitability number, compacting piles.Vibro replacement process, Vibro flotation process, Terra Probe Method, Dynamic Compaction.

UNIT- IV:
Stabilization of Cohesive soils: Expansive Soils- parameters of expansive soils and their classification- moisture changes in expansive soils- CNS technique. In Situ densification, Pre-loading–Dewatering– sand drains. Sand wicks, geo-drains, rope-drains, band-drains, stone columns, and lime piles, thermal and vacuum methods.

UNIT – V:
Ground treatment for Slopes: Different types of in-situ soil stabilization like soil nailing, anchoring, pre-stressed anchoring - design methods and construction techniques.
Geo-textiles: Woven and non-woven fabrics. Types, functions and applications– Geo-textiles, geo-grids, tests on geo-textiles, Reinforced earth – Principles and factors governing design.

Text Books:

1. P. Purushothama Raj, “Ground Improvement Techniques”, Laxmi publications 2016.
2. K.R Arora, “Soil Mechanics and Foundation Engineering”, 5th Edition, Standard Publishers, 2005.

Suggested Reading:

1. NiharRanjanPatra, “Ground Improvement Techniques”, Vikas publishing house Pvt. Ltd, 2012.
2. R. Hausmann., “Engineering Principles of Ground Modification”, McGraw Hill Publishing Co.,2013.
3. H. Fang,” Foundation Engineering Hand Book”, 2nd Edition, CBS Publication, New Delhi, 2004.
4. G. V. Rao and G. V. S. S. Raju, “Engineering with Geosynthetics”, McGraw Hill Education, 1998 5. IRC-SP 58 (2001): “Guidelines for use of fly ash in road embankments”.

18CE E25

DESIGN OF HYDRAULIC STRUCTURES
(Core Elective-6)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: The student should be able to understand
1. Principles and design of surplus weir.
2. Functioning of sluice, design of various components.
3. Types of canal falls, basic principles of glacis type canal drop and its design.
4. Basic principles of design of cross regulator and its design.
5. Design of spillways.

Course Outcomes: On completion of the course, students will be able to
1. analyse and design surplus weir.
2. analyse and design direct sluice.
3. identify types of falls and design glacis type canal drop.
4. understand and design cross regulator.
5. identify types of spillways and design energy dissipators.

UNIT - I:
Surplus weir: Types of weirs, components of diversion head works, crest level of weir, afflux, design of surplus weir, design for surface flow and sub - surface flow, length, level and thickness of downstream apron, upstream and downstream cut-offs, protection works.

UNIT- II:
Direct Sluice: Hydraulic particulars of main canal and distributary, general arrangements of various components- Design of vent way, Sluice barrel, Head walls, Wing Walls and return walls.

UNIT- III:
Canal Falls: Definition, types of falls.
Glacis type Canal Drop: Design of Components, General arrangements, fluming ratio, fixing the crest level, length of weir, U/S and D/S glacis, Transitions - Protection works -Curtain wall, Energy dissipation arrangements .

UNIT- IV:
Cross Regulator: General design principles - General arrangements of various components - design of vent way by drowning ratio - arrangements of energy dissipation - U/S & D/S protection works.

UNIT- V:
Spillways: Spillways, Ogee spillway and design of its components. Design of Energy Dissipation structures, Bucket type and cistern type.

Text Books:
1.B.C. Punmia, "Irrigation & Water Power Engineering", Lakshmi Publications, Delhi, 2016.
2. Ch. S. N. Murthy, "Water Resources Engineering: Principles and Practice", New Age International Publishers, Delhi, 2002.

Suggested Reading:
1. R S Varshney, S C Gupta, R L Gupta, "Theory & Design of Irrigation Structures Vol. 1", Nem Chand & Brothers, 1992.
2. S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi, 2017.
3.Sharma, S. K. Irrigation Engineering and Hydraulic Structures. S. Chand Publishing, 2017.

18CE E26

RURAL WATER SUPPLY AND ONSITE SANITATION SYSTEM
(Core Elective-6)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To enable the student
1. Identify the problems pertaining to rural water supply and sanitation.
2. Be conversant about water treatment and sanitation system for rural community.
3. Understand wastewater treatment collection and treatment units in rural areas.
4. Get educated on Industrial hygiene, sanitation and occupational hazards.
5. Design low cost waste management systems for rural areas, plan and design an effluent disposal mechanism.

Course Outcomes: At the end of the course, the student will be able to
1. solve the issues related to rural water supply and sanitation.
2. relate the needs for water treatment and develop different stages of water treatment and sanitation system for rural community.
3. plan wastewater collection system in rural areas and identify compact wastewater treatment units.
4. develop occupation related onsite sanitation and hygiene system and identify occupational hazards.
5. design an effluent disposal mechanism; develop solid waste management system in rural areas.

UNIT- I:
Rural Water Supply: Issues of rural water supply, various techniques for rural water supply- merits, National rural drinking water program, rural water quality monitoring and surveillance, operation and maintenance of rural water supplies, relationships between diseases and water quality, hygiene and sanitation.

UNIT- II:
Water Treatment: Need for water treatment, point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, solar disinfection systems, removal of arsenic, fluoride and iron; hygiene and sanitation, epidemiological aspects of water quality methods for low cost water treatment - specific contaminant removal systems.

UNIT- III:
Rural Sanitation: Introduction to rural sanitation, community and sanitary latrines, planning of wastewater collection system in rural areas, treatment and disposal of wastewater, compact and simple wastewater treatment units and systems in rural areas.

UNIT- IV:
Onsite sanitation system: Nexus between water quality and sanitation, importance of hydrogeology on selection of onsite sanitation systems, Industrial hygiene and sanitation, occupational hazards in schools, public buildings and hospitals; Industrial plant sanitation.

UNIT- V:
Septic tanks: Design of septic tanks, single pit and double pit toilets, small bore systems, bio digesters, reed beds, constructed wetlands, sludge/seepage management systems, stabilization ponds; Solid Waste Management: Biogas plants, rural health, other specific issues and problems encountered in rural sanitation.

Text Books:
1. V. M. Eulersand E. W. Steel, "*Municipal and Rural Sanitation*", 6th Ed., McGraw Hill Book Company, 1965
2. F. B. Wright, "*Rural Water Supply and Sanitation*", 3rd Revised edition, McGraw-Hill Inc.,US, 1977
3. P. Juti, S. K.Tapio, and H. Vuorinen, "*Environmental History of Water: Global Views on Community Water Supply and Sanitati*on", IWA Publishing (Intl Water Assoc), 2007

Suggested Reading:

1. Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New Delhi.
2. A handbook on "*Technological Options for On-site sanitation in rural areas",* Ministry of Drinking water & Sanitation, Govt. of India, June 2016
3. A Guide to the Development of on-site sanitation, WHO, 1992

18CEE27

APPLICATIONS OF BLOCKCHAIN TECHNOLOGY IN CIVIL ENGINEERING
(Core Elective-6)

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives:

1. To get the terminologies and overview of Blockchain technology
2. To study the concepts and foundation of Blockchain technology
3. To understand the applications of Blockchain technology in civil engineering
4. To design use cases and architecture Blockchain technology
5. To study benefits, limitations and identify application area of Blockchain technology

Course outcomes: at the end of course, students would be able to:

1. Gain a clear understanding of the concepts that underlie Blockchain and Blockchain and types of Blockchain.
2. Understand key mechanisms like decentralization, transparency and trust, immutability.
3. Understand the importance of Blockchain in construction industry apply the concepts of smart contracts using Blockchain technology.
4. Understand and apply the project management systems using Blockchain technology.
5. Apply the concepts of building information modelling using Blockchain technology.

UNIT 1:Introduction to Blockchain: Introduction to centralized, decentralized and distributed system, History of Blockchain, Various technical definitions of Blockchain. **Generic elements of a blochchain:** Block, Transaction, Peer to peer network, Node, Smart contract, Why it's called blckchain. **Types of Blockchain:** Public Blockchains, Private Blockchains, Semi-private Blockchains, Sidechains, Permissioned ledger, Distributed ledger, shared ledger, Fully private and proprietary Blockchains, Tokenized Blockchains, Token less Blockchains, CAP theorem and Blockchain.

UNIT II: Concepts of Blockchain Technology: Cryptography, Hashing, Nonce, Distributed database, Consensus, Smart Contract, Component of block, and Structure of Blockchain. Applications of Blockchain technology, Tiers of Blockchain technology: Blockchain 0, Blockchain 1, Blockchain 2, Blockchain 3, generation of Blockchain X.

UNIT III:Applications of Blockchain technology in Civil Engineering: Importance of Blockchain in construction industry. Blockchain in operation, public and Private Blockchain types, Smart contracts on the Blockchain to enhance efficiency, Ideal solution for the construction industry.

UNIT IV:Payment and Project Management: Blockchain enabled project collaboration, Transparency in construction industry, Procurement and Supply Chain Management, Sustainable procurement in the construction industry enabled by Blockchain, Fostering enhanced and trust in the supply chain

UNIT V:Building Information Modelling (BIM) – BIM and Blockchain. Project delivery 'designed' to 'as built'.Smart Asset Management through BIM.Challenges and Implementation – Stages of Blockchain implementation in the industry.

Crypto currency: Bitcoin, Bitcoin definition, keys and addresses, public keys in Bitcoin, private keys in Bitcoin, Bitcoin currency units.

Textbooks:

1. Imran Bashir, "Mastering Blockchain", Packt Publishing Limited, 2nd edition 2018.
2. Narayan Prusty, "Building Blockchain Projects", Packt Publishing, 1st edition 2017.

References:

1. Blockchain For dummies, IBM Limited Edition, John Wiley & Sons, Inc.
2. Lemes, Samir, and LamijaLemes. Blockchain in Distributed CAD Environments". In International Conference "*New Technologies Development and Applications*", pp. 25-32. Springer, Cham, 2019.
3. Blockchain Technology in the Construction Industry-Digital Transformation for High Productivity, 2018.

18CE C30

TECHNICAL SEMINAR

Instruction	2 Hours per week
Continuous Internal Evaluation	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

Course Outcomes:

At the end of the course, the students will be able to

1. Identify their domain interest through critical review of literature.
2. Develop the technical skill in preparing a well structured report on the chosen topic of Civil Engineering by following ethical practices.
3. Develop the skill of presenting a structured seminar using Power Point presentation tools.
4. Improve communication skills.
5. Defend one's presentation by healthy interactions with the participants.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks, students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Maximum Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

18CE C31

PROJECT: PART-2

Instruction	10 Hours per week
Continuous Internal Evaluation	100 Marks
Semester End Examination	100 Marks
Credits	10

Course Outcomes:

At the end of the course, the students will be able to

1. Examine the chosen problem with a deeper insight and identify a path to problem solving while developing the skill of coordinating with the team.
2. Develop and demonstrate problem solving skills through detailed Analysis/ Modeling / Simulation/ Experimental works.
3. Evaluate the results based on deeper studies and draw conclusions along with scope for further studies to facilitate continuous learning.
4. Develop the art of technical report writing by following ethical practices.
5. Defend the work through a well structured presentation.

The object of 'Project: Part-2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/ Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned.
2. Review and finalization of the Approach to the Problem relating to the assigned topic.
3. Preparing an Action Plan for conducting the investigation, including team work.
4. Detailed Analysis/Modeling/Simulation/Design/Problem Solving/ Experiment as needed.
5. Final development of product/process, testing, results, conclusions and future directions.
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible.
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in Continuous Internal Evaluation: (Max. Marks: 100)

Evaluation by	Maximum Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical/ Programming/ Experimental Skills

Guidelines for awarding marks in Semester End Examination: (Maximum Marks: 100)

Evaluation by	**Maximum Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project Innovations Applications Live Research Projects Scope for future study Application to society
	20	Viva-Voce

OPEN ELECTIVES

and

MANDATORY COURSE

16CE O01

HISTORY OF ARCHITECTURE AND ARCHITECTURAL PRACTICES

(Open Elective-I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives: To enable the student

1. Get an insight into the architecture of prehistoric and early civilization periods
2. Understand the basic principles of architecture of classical and early medieval periods
3. Grasp the fundamentals of modern architecture
4. Learn the Principles of planning and design for lighting ventilation and acoustics in buildings
5. Comprehend the principles of interior architecture and space programming

Course Outcomes: At the end of the course the student will be able to

1. Identify interpret and emulate if necessary, the architecture of pre historic and early civilization periods
2. Identify, interpret and emulate if necessary, the architecture of classical & early medieval periods.
3. Interpret practices the principles of modern architecture.
4. apply the principles of planning and design for lighting, ventilation and acoustics in buildings
5. apply the principles of interior design and space programming.

UNIT- I:

Architecture of Ancient Constructions: An insight into architecture of pre-historic and early civilizations - Primitive people, shelters, settlements, burial systems, megaliths and memorials - examples - Nile Valley civilizations, factors that influenced architecture - Typology of shelters and buildings, Construction method and Materials - Indus valley civilizations, Contribution of Archaeologists, Socio Cultural, Religious and Political systems, Settlement patterns, Civic Utility system - Aryan (Vedic) civilization, typical Vedic village, shelter types by shape and material used, Torana and sacred railings - Euphrates and Tigris valley civilization, Planning of palaces, Staircases of Persepolis, Physical planning of Babylonia - Chinese civilizations, Architectural character, building typologies, Layout and planning principles adopted

UNIT – II:

Architecture of Classical and Early Medieval Periods (700BCE - 1000CE)

Classical Architecture: Greek and Roman Architecture - Principles of design, importance of form, material and proportions, discussion on a few building types, early Christian and Muslim architectures: Evolution of church and Mosque forms, Buddhist Architecture in India: Building elements and associated forms during Hinayana and Mahayana phases - types of structures and elements developed examples of Stupas, Viharas, Chaityas, Stambhas, Toranas, sacred railing etc in India.

Indo Aryan Architecture: Development of fortification, walled towns, Role of Shilpashastras and ArthaShastras in settlement planning - study of worshipping places - Indo Aryan temple architecture (Nagara style) - Design of buttressed structures and rock - cut structures.

Dravidians Architecture: Study of worshipping places in Dravidian style (Chola, Chalukya, Pallava, Satavahana, Hoysala, Vijayanagara etc.,) - Design of gopuram and shikharam - Hindu, Buddhist and Jain carve and rock-cut temple architecture

UNIT- III:

Modern Architecture:

The Idea of modern architecture in the 19th century: Rationalism, the engineering tradition and Reinforced concrete - Responses to Mechanization, The DeutscherWerkbund and Futurism, the architectural system of Frank lloyd wright, cubism and New conceptions of space - Le Corbusier's quest for ideal form - German Expressionism and the Bauhaus - Architectural revolution in Russia - Skyscraper and Subrub, America between the wars - Totalitarian critiques of the modern movement - The continuity of older traditions - Transformation after 1940s - Form and meaning in the late works of Corbusier - Modern architecture and developing countries since 1960 - Modernity, Tradition and Authenticity.

UNIT – IV:

Lighting, Ventilation & Acoustics:

Significance of building orientation - Daylight: Transmission of Light, Day light illuminance, Glare, Recommended illuminances, planning for daylight, daylight utilization factor, Design for Daylight using BIS method - Lux meter measurements.

Electric Lighting: Lamps, Luminaries, Core lighting, valance lighting, cornice Lighting, track lighting, flood light, dawn light, spot light, Spill, point, line and area source, Design of Electric lighting using point method, Lumen Methods, IFCS glare index System, Use of brightness meter.

Ventilation: The Wind, Effects of topography on wind patterns, Air currents around and through buildings, air changes and quality of air, use of fans, thermal induced air currents, pressure losses, Buoyancy driven effects - Use of courtyard

Architectural Acoustics: Sound waves, Measurements versus perception, NC curves, effect of material property, NRC, STC, and IIC, Reverberation time, Sound in enclosed space, Concepts and design of basic room acoustics, design of an auditorium, Conference hall, recording studio and class rooms, Environmental noise & its control.

UNIT – V:

Interior Architecture and Space programming:

Definition of interior design, History of folk arts and crafts, vernacular design in India, process and vocabulary of design in terms of principles and elements, Introduction to the design of interior spaces, various methods of treating the interior elements using different materials and methods - Functional, aesthetic and psychological effects - Interior lighting, different types of lighting fixtures, accessories and objects used for enhancing interiors : Paintings, rocks, water, flowers, fountains, pavings, aircrafts etc., Interior land scaping

Space Programming: Relationship between furniture and spaces, Human movements and furniture design, Human comfort, changing trends and Life style, Materials and methods of construction, Furniture for specific type of interiors such as offices, commercial complexes, residences, offices and design projects, interiors for specific purpose such as children's furniture, display systems etc.,

Text Books:

1. T. Copple stone and Lloyd, "*World Architecture: An illustrated History*", London Verona Printed 1979.
2. P. Brown,"*Indian Architecture: Buddhist and Hindu period*" Mumbai D. B. Taraporevala Sons & Co., 2010.
3. D. K. Bubbar*," The* spirit of Indian Architecture", NewDelhi, Rupa& Co., 2005.
4. William J Curtis, "Modern *Architecture since 1900*", Phaidan Publisher, London &Newyork 1996.
5. P. D. Crouch," *History of Architecture: Stonehenge to skyscrapers – London*", McGraw hill, 1985.
6. F. D. K. Ching ," *Interior Design Illustrated Newyork*", VNR Publications, 1987.

Suggested Reading:

1. U. Singh, "*A History of Ancient and Early Medieval India*: *Stone Age to the 12th Century – Delhi*", Pearson India, 2009.
2. R. Ingersoll and S. Kostof,"*World Architecture: A cross Cultural History*", Oxford University Press 2013.

3. V S Pramar," *A Social history of Indian Architecture*", New Delhi: OUP 2005.
4. Julius Panero and Martin Zelnik," *Human Dimension and Interior Space - A source book of Design reference standards*", Newyork, Whitney Library of Design, 1979.

18CE O02

DISASTER MITIGATION AND MANAGEMENT (M)

(Open Elective-II)

Instruction	3 L Hours per Week Duration of Semester End
Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: This course aims to,

1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities.
2. Impart knowledge in students about the nature, causes, consequences and mitigation measures of the various Hydro-meteorological disasters.
3. Introduce the concepts of causes, consequences and mitigation measures of the various Geographical disasters.
4. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters.
5. Equip the students with the knowledge of the impacts of disaster, chronological phases in a disaster management cycle and to create awareness about the disaster management framework and legislations in the context of Central and State Level Authorities.

Course Outcomes: Upon completion of this course, the student will be able to,

1. Identify and understand the fundamental terminologies in disaster management.
2. Distinguish between the Hydro-meteorological disasters and apply the concepts of structural and non- structural mitigation measures.
3. Categorize different Geographical Disasters and apply the knowledge in utilizing the early warning systems.
4. Analyze various mechanisms and consequences of human induced disasters.
5. Develop an awareness of disaster management phases and formulating effective disaster management plans, ability to understand various participatory roles of stakeholders- Central and State Government bodies at different levels.

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and manmade; Introduction to Disaster management cycle; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters:

Hydro meteorological disasters:

Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Applications. Case studies related to various hydro-meteorological disasters.

UNIT- III:

Geographical based disasters: Causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various geographical based disasters.

UNIT- IV:

Human Induced Disasters: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas leakage; Management of chemical terrorism disasters and biological disasters; Case studies related to power break downs, fire accidents, traffic accidents, oil spills and stampedes, building failure disasters.

UNIT- V:

Concept of Disaster Impacts and Management:

Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects, gender, age, special needs; hazard locations; global and national disaster trends; climate change and urban disasters.

Disaster management cycle and its phases, risk analysis, vulnerability and capacity assessment; Post-disaster environmental response water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. PradeepSahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh, "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, Government of India, "National Disaster Management Plan, Part I and II",
2. K. K. Ghosh, "Disaster Management", APH Publishing Corporation, 2006.
3. http://www.indiaenvironmentportal.org.in/files/file\disaster_management_india1.pdf
4. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)
5. Hazards, Disasters and your community: A booklet for students and the community, Ministry of Home Affairs.
6. Disaster Medical Systems Guidelines, Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, Geneva: IASC.
8. http://ndma.gov.in/ (Home page of National Disaster Management Authority)

18CE M01

ENVIRONMENTAL SCIENCE

(Mandatory Course)

Instruction	2 L
Hours per week Duration of SEE	2 Hours
SEE	50Marks
CIE	0 Marks
Credits	0

Course Objectives: To enable the student

1.Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources

2. Become aware about the importance of eco system and interlinking of food chain.

3. Identify the importance of biodiversity in maintaining ecological balance.

4. Learn about various attributes of pollution management and waste management practices.

5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes: At the end of the course, student is able to

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and affects of over utilisation.

2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.

3. Contribute for the conservation of bio-diversity.

4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.

5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

UNIT- I:

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II:

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III:

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV:

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V:

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, “Introduction to Environmental Science”, B S Publications, 2004.
2. Suresh K. Dhameja, “Environmental Studies”, S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao,” Environmental Pollution Control Engineering”, Wiley, 1991.
2. S. S. Dara, “A Text Book of Environmental Chemistry &Pollution Control”, S. Chand Limited, 2006

R20 Curriculum

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

SCHEME OF INSTRUCTION AND EXAMINATION

Proposed Curriculum Components and Structure

(REGULATION -20)

1. Humanities & Social Sciences Courses including Management Courses (HSC)											
BE (CSE), BE(IT), BE(AI/DS), BE(CSE-AI/ML), BE(CSE-IoTCS,BC)						BE(CE),BE(ECE), BE(EEE), BE(Mech), B.Tech(Chem), B.Tech(Bio-Tech)					
Sno	Course Title	Hours / Week			C	Sno	Course Title	Hours / Week			C
		L	T	P				L	T	P	
1	English	2	0	2	3	1	English	2	0	2	3
2	Employability Skills	0	0	2	1	2	Employability Skills	0	0	2	1
3	Engg. Economics &Accountancy	3	0	0	3	3	Engg. Economics& Accountancy	3	0	0	3
4	Community Engagement	0	0	3	1.5	4	Community Engagement	0	0	3	1.5
5	Universal Human Values	3	0	0	3	5	Universal Human Values	3	0	0	3
	Total HSC credits	5	0	10	**11.5**		**Total HSC credits**	5	0	10	**11.5**
2. Basic Science Course (BSC)						**2. Basic Science Course (BSC)**					
1	Physics	3	0	4	5	1	Physics	3	0	4	5
2	Chemistry	3	0	4	5	2	Chemistry	3	0	4	5
3	Mathematics- I	2	1	2	4	3	Mathematics- I	3	1	0	4
4	Mathematics - II	2	1	2	4	4	Mathematics - II	3	1	0	4
5	Mathematics – III	2	1	2	4	5	Mathematics – III	3	1	0	4
	Total BSC credits	**12**	**3**	**14**	**22**		**Total BSC credits**	15	**3**	**8**	**22**
	3. Engineering Science Courses (ESC)						**3. . Engineering Science Courses (ESC)**				
1	Workshop/Manufacturing Practice	0	0	5	2.5	1	Workshop/Manufacturing Practice	0	0	5	2.5
2	CAD & Drafting	0	1	3	2.5	2	CAD & Drafting	0	1	3	2.5
3	Engineering Mechanics-I	3		0	3	3	Engineering Mechanics-I	3	0	0	3
4	Programming for Problem Solving	3	0	4	5	4	Programming for Problem Solving	3	0	4	5
5	Basic ElectricalEngineering	3	0	2	4	5	Basic Electrical Engineering	3	0	2	4
6	SI/BE/BDS/ Engg. Mechanics-II	3	0	0	3	6	BDS/BE/EM-II/SI	3	0	3	3
7	Engineering Exploration	0	0	3	1.5	7	Engineering Exploration	0	0	3	1.5
	Total ESC credits	**12**	**1**	**19**	**21.5**		**Total ESC credits**	**11**	**2**	**19**	**21.5**
4. Professional Core Courses (PCC) (to be exercised by the respective department Board of Studies) **(61 Credits)**											

5. Professional Elective Curses relevant to chosen specialization / Program (FIVE Electives are possible and each of 3 credits weightae. To be exercised by the respective department Board of Studies) **(15 Credits)**

6. Open Electives – Electives from other Technical and or emerging areas (FOUR Open Electives are possible and each of 3 credits weightage. To be exercised by the respective department Board of Studies) **(12 Credits)**

7. Internships, Project work, Seminars **(14) Credits)**

I.	MOOCs/ Industrial Training / Internship	- 2 Credits	(After II or during III Semester)
II.	Industrial Training / Rural Internship	- 2 Credits	(After IV or during V Semester)
III.	Internship	- 3 Credits	(After VI or during VII Semester)
IV.	Technical Seminar	- 1 Credits	
V.	Project (Phase-1) / Semester Internship	- 2 Credits	
VI.	Project (Phase-2) / Semester Internship	- 4 Credits	

8. Mandatory Courses: (Induction Training , Environmental Sciences, , Indian Constitution, Essence of Indian Traditional Knowledge, Gender Sensitization)

9. Attitude (Activity Points): Communication, Team works, Leadership Skills: **100** (e-portfolio)

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

SCHEME OF INSTRUCTION AND EXAMINATION
B.E (Civil Engineering)

Proposed R20 Curriculum

GROUP-2 (CE/ECE/EEE/Mech/Chem)					
SEMESTER-I					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Mathematics -1	3	1	0	4
2	Chemistry	3		4	5
3	Engineering Mechanics-I	3		-	3
4	Workshop/ Manufacturing Practice	-		5	2.5
5	Programming for Problem Solving	2	1	4	5
6	Engineering Exploration	3P/W			1.5
	Total	11	02	13	21
Clock Hours per week : 26+3					

GROUP-2 (CE/ECE/EEE/Mech/Chem)					
SEMESTER-II					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Mathematics -2	3	1	0	4
2	Physics	3	0	4	5
3	Basic Electrical Engineering	3	0	2	4
4	Engineering Mechanics-II	~~0~~ 3	~~1~~ 0	~~3~~ 0	~~2.5~~ 3
5	English	2	-	2	3
6	Comm. Engagement	30 field+2P/W			1.5
	Total	14	01	8	20.5
Clock Hours per week : 23+2					

SEMESTER-III					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Mathematics - 3	3	1	0	4
2	Surveying I	3			3
3	Solid Mechanics	3			3
4	Fluid Mechanics	3			3
5	Building Construction Practices & Concrete Technology	3			3
6	EE&A	3			3
7	Computer Aided Drafting (CAD)	~~3~~ 0	~~0~~ 1	~~0~~ 3	~~3~~ 2.5
8	Solid Mechanics Lab			3	1
9	Fluid Mechanics Lab			3	1
10	MOOCs/Training/ Internship	2-3 weeks/90 hours			2
Total		18	2	9	25.5
Clock Hours per week : 29					

SEMESTER-IV					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Hydraulic Engineering	3			3
2	Surveying II	3			3
3	Structural Analysis I	3			3
4	Reinforced Concrete Design - I	3	1		4
6	PE1	3			3
7	Hydraulic Engineering Lab			3	1
8	Surveying &Geomatics Lab			3	1
9	Indian Constitution (MC)	2	-	-	Non - Credit
10	Indian Traditional Knowledge (MC)	2	-	-	Non - Credit
Total		19	1	6	18
Clock Hours per week : 26					

SEMESTER- V					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Transportation Engineering	3			3
2	Geotechnical Engineering I	3			3
3	Structural Analysis II	3			3
4	Reinforced Concrete Design - II	3	1		4
5	PE - 2	3			3
6	OE - 1	3			3
7	Transportation Engineering Lab			3	1
8	Geotechnical Engineering Lab			3	1
9	Environmental Science (MC)	2	-	-	- Non-Credit
	Industrial / Rural Internship	3-4 weeks/ 175 hours			2
	Total	20	1	6	23
Clock Hours per week : 27					

SEMESTER-VI					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	Hydrology and Water Resource Engg.	3			3
2	Estimation, Specification & Costing	3			3
3	Design of Steel Structures - I	3	1		4
4	Environmental Engineering	3			3
5	Construction Engg and Management	3			3
6	PE- 3	3	-	-	3
7	Environmental Engineering Lab			3	1
8	Engineering Geology Lab			3	1
9	Employability Skills	-	-	2	1
	Total	18	1	8	22
Clock Hours per week : 27					

SEMESTER- VII					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	PE -4	3	-	-	3
2	PE - 5	3	-	-	3
3	OE - 2	3	-	-	3
4	OE - 3	3	-	-	3
5	Universal Human Values - 2	3			3
6	Concrete Technology Lab			3	1
7	Computer Applications Lab			3	1
8	Gender sensitization (MC)	2			Non Credit Course
9	Project Part 1	-	-	4	2
10	Internship	4-6 weeks / 180 hours			3
	Total	17	-	10	22
Clock Hours per week : 27					

SEMESTER-VIII					
Sl No	Name of the Course	No . of Hours			Credits
		L	T	P	
1	PE-6	3			3
2	Technical Seminar	-	-	2	1
3	Project Part 2	4-6 weeks of industry Internship (180 hours) / - 12 hours			4
	Total	3		14	8
Clock Hours per week : 17					

L : Lecture, T : Tutorial , P : Practical/Drawing/Seminar/Project

Credit Summary :

Semester	I	II	III	IV	V	VI	VII	VIII	Total credits
Credits-B	21	20.5	23.5	18	21	22	17	3	146
Internship			2		2		5	5	14
Year-wise Cumulative		41.5		85		130		160	160

Professional Electives

PE 1 (IV SEM)	PE 2 (V Sem)
1. Green Building Technologies 2. Principles of Geographical information systems 3. Solid and Hazardous Waste Management 4. Ground Water Engineering	1. Applications of Artificial Intelligence in Civil Engineering 2. Pre-Stressed Concrete 3. Hazards and Management 4. Masonry Structures
PE 3 (V Sem)	**PE 4 (VII Sem)**
1. Foundation Engineering 2. River Engineering 3. Urban Transportation Planning 4. Basics of Earthquake Engineering	1. Finite Element Methods 2. Applications of Data Analytics in Civil Engineering 3. Design of Hydraulic Structures 4. Concrete Technology & Special Concretes
PE 5 (VII Sem)	**PE 6 (VIII Sem)**
1. Railway and Airport Engineering 2. Applications of Block Chain Technology in Civil Engineering 3. Design of Steel Structures II 4. Advanced Environmental Engineering	1. Pavement management system 2. Repair and rehabilitation of Structures 3. Water shed management 4. Ground Improvement Techniques
OPEN ELECTIVES OFFERED BY CIVIL ENGINEERING Dept	
1. Infrastructure Development for Smart Cities 2. Disaster Mitigation and Management 3. Rural Water Supply and Onsite Sanitation Systems	

R20 Curriculum

ENGINEERING MECHANICS - I

Instruction:	3 L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	3

Course Outcomes: At the end of the course the student will be able to

1. calculate the components and resultant of coplanar forces system.
2. understand free body diagram and apply equilibrium equations to solve for unknown forces.
3. apply concepts of friction for solving engineering problems.
4. analyse simple trusses for forces in various members of a truss.
5. determine centroid for elementary, composite figures and bodies.

UNIT- I:

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane.Resultant of coplanar concurrent force system.Moment of a force, couple and their applications.Resultant of coplanar non-concurrent force system.

UNIT - II:

Equilibrium of Force System: Free body diagram, equations of equilibrium. Lami's theorem, equilibrium of coplanar force systems.

UNIT - III:

Friction: Theory of static friction, Laws of friction, applications to single body, connected systems, wedge friction and belt friction.

UNIT - IV:

Analysis of Simple Trusses: Introduction to trusses, analysis of simple trusses using method of joints and method of sections.

UNIT - V:

Centroid and Centre of Gravity:

Centroid of lines and areas from first principles, centroid of composite figures, theorems of Pappus, centre of gravity of bodies and composite bodies.

Text Books:

1. K. Vijaya Kumar Reddy and J. Suresh Kumar, "*Singer's Engineering Mechanics: Statics and Dynamics*", B. S. Publications (SI Units), 3rd edn. Rpt., 2019.
2. A. Nelson., "*Engineering Mechanics*", Tata McGrawHill, Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, *"Engineering Mechanics",* 4th Edition, Prentice Hall, 2006.
2. R. C. Hibbeler, *"Engineering Mechanics: Principles of Statics and Dynamics",* Pearson Press, 2006.
3. BasudebBhattacharyya, "*Engineering Mechanics*", Oxford University Press, 2nd edn., 2016.

R 20 Curriculum

ENGINEERING MECHANICS - II

Instruction:	3 L Hours per week
Duration of Semester End Examination:	3 Hours
Semester End Examination:	70 Marks
Continuous Internal Evaluation:	30 Marks
Credits:	3

Course outcomes: At the end of the course, the student will be able to

1) determine moment of inertia for plane areas and mass moment of inertia of bodies.
2) analyse the rectilinear and curvilinear translations of particles.
3) solve kinetics problems for particles and connected bodies using dynamic equilibrium equations.
4) apply work-energy principle for particles and connected bodies.
5) apply linear impulse momentum principle for the motion of bodies and understand concept of simple harmonic motion and its applications

UNIT – I

Moment of Inertia (M.I):

Area Moment of Inertia: Introduction, polar moment of inertia, radius of gyration and transfer formula. Moment of Inertia of plane areas by integration, M.I of composite areas, product of inertia, transfer formula for product of inertia.

Mass Moment of Inertia: Mass Moment of Inertia of thin plates, radius of gyration, transfer formula and mass moment of inertia of cylinder, sphere, cone and composite bodies.

UNIT – II

Kinematics: Rectilinear and curvilinear translation (uniform and variable acceleration). Rectangular, normal and tangential components of acceleration.

UNIT – III

Kinetics: General Principles of kinetics, D' Alembert's principle and its application to particle motion, angle of banking and connected bodies.

UNIT – IV

Work-Energy Method: Work done by a force and kinetic energy of a particle. Equation of work energy for translation - applied to particle motion and connected bodies.

UNIT – V

Impulse and Momentum: Introduction to linear impulse-momentum, principle of conservation of linear momentum and its applications. Elastic impact and coefficient of restitution.

Mechanical Vibrations: Introduction, amplitude, time period, frequency, simple harmonic motion, free vibrations, simple pendulum.

Text Books:

1. K. Vijaya Kumar Reddy and J. Suresh Kumar, "*Singer's Engineering Mechanics: Statics and Dynamics*", B. S. Publications (SI Units), 3rd edn. Rpt., 2019.
2. A.Nelson.,"*Engineering Mechanics*", Tata McGrawHill, Delhi, 2010.

Suggested Reading:

1. Irving H. Shames, *"Engineering Mechanics",* 4th Edition, Prentice Hall, 2006.
2. R. C. Hibbeler, *"Engineering Mechanics: Principles of Statics and Dynamics",* Pearson Press, 2006.
3. BasudebBhattacharyya, "*Engineering Mechanics*", Oxford University Press, 2nd edn.,2016.

R20

COMPUTER AIDED DRAFTING (CAD)

Instruction	1T+3P hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2.5

Course Outcomes: At the end of the course, the student will be able to

1. select and apply appropriate settings and create 2D objects using combination of commands.
2. select and apply appropriate editing tools, text and dimensions.
3. select and apply hatching and manage object properties.
4. calculate area and perimeter of boundaries and apply layers.
5. create and insert blocks and choose appropriate view ports.

UNIT-1

Introduction to Computer Aided Drafting (AutoCAD) - features and environment, basic drafting tools, initial settings, coordinates - absolute, relative cartesian and polar coordinates, use of object tools – snap and grid. Creating 2D geometry shapes by using - line, circle, arc, ellipse, polygon, polyline and spline.

Unit-2

Editing and construction techniques – creating offsets, trimming and extending of lines, filleting and chamfering of corners, creating multiple objects through mirroring and array generation. Dimensions.scale, zoom, pan commands. Create and manage – text.
Principles of Orthographic projections - conventions - projections of points and lines, inclined to both planes (without traces).

Unit-3

Managing object properties and hatching.
Projections of planes and solids: prism and cone – inclined to one plane only.

Unit-4

Calculating area, perimeter of boundaries and applying layers.
Drawing plans of buildings.

Unit-5

Create and insert blocks, view ports. Demonstration of AutoCAD 3D.
Drawing of sections and elevations of buildings.

Text Books:

1. N.D.Bhatt, 'Engineering Drawing', Charotar Publishers, 53rd edition, 2014.
2. S.P Arora and S.P Bindra, 'A text book of Building Construction', DhanpatRai& sons, 2010.
3. George Omura ,Brian C. Benton, 'Mastering AutoCAD 2019 and AutoCAD LT 2019', Wiley, 2018.

Suggested Reading:

1. K.Veenugopal, 'Engineering Drawing and Graphics + Autocad', New Age International Pvt. Ltd, 2010.
2. Balagopal A and Prabhu T. S, 'Building Drawing and Detailing', Spades publishers, Calicut, 1987.
3. BasanthAgrawal and C M Agrawal –Engineering Drawing 2e, McGraw-Hill Education, New Delhi.