

**R15**
**B.Tech IV-I Semester (C.E)**

S. No.	Course Code	Subject	L	T	P	C
1.	15A01701	Finite Element Methods	3	1	-	3
2.	15A01702	Transportation Engineering - II	3	1	-	3
3.	15A01703	Environmental Engineering	3	1	-	3
4.	15A01704	Water Resources Engineering – II	3	1	-	3
5.	15A01705 15A01706 15A01707	<b>CBCC-II</b> 1. Design and Drawing of Irrigation Structures 2. Ground Improvement Techniques 3. Air Pollution and Quality Control	3	1	-	3
6.	15A01708 15A01709 15A01710	<b>CBCC-III</b> 1. Bridge Engineering 2. Earth Quake Resistant Design of Structures 3. Rehabilitation and Retrofitting of Structures	3	1	-	3
7.	15A01711	CAD Laboratory	-	-	4	2
8.	15A01712	Environmental Engineering Laboratory	-	-	4	2
<b>Total:</b>			<b>18</b>	<b>6</b>	<b>8</b>	<b>22</b>

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**15A01701 FINITE ELEMENT METHODS**

**Course Objective:** To familiarize the student with the latest developments in analysis for Civil Engineering problems using Finite Element Methods.

**UNIT –I**

**INTRODUCTION:** Concepts of FEM – Steps involved – Merits & Demerits – Energy Principles – Discretization – Rayleigh –Ritz method of functional approximation.

**PRINCIPLES OF ELASTICITY:** Equilibrium equations – strain displacement relationships in matrix form – Constitutive relationships for plane stress, plane strain and Axi-symmetric bodies of revolution with axi-symmetric loading.

**UNIT –II**

**ONE DIMENSIONAL & TWO DIMENSIONAL ELEMENTS:** Stiffness matrix for bar element – shape functions for one dimensional elements – one dimensional problems .Two Dimensional Elements - Different types of elements for plane stress and plane strain analysis – Displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – Geometric invariance – Natural coordinate system – area and volume coordinates

**UNIT –III**

**GENERATION OF ELEMENT :** Generation of element stiffness and nodal load matrices for 3-node triangular element and four noded rectangular elements.

**UNIT –IV****ISOPARAMETRIC FORMULATION:**

Concepts of, isoparametric elements for 2D analysis –formulation of CST element, 4 – Noded and 8-noded iso-parametric quadrilateral elements –Lagrangian and Serendipity elements.

**AXI-SYMMETRIC ANALYSIS:** Basic principles-Formulation of 4-noded iso-parametric axi-symmetric element

**UNIT-V**

**SOLUTION TECHNIQUES:** Numerical Integration, Static condensation, assembly of elements and solution techniques for static loads.

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**R15****TEXT BOOKS:**

1. Finite Element Analysis for Engineering and Technology, Tirupathi R Chandraputla, Universities Press Pvt Ltd, Hyderabad. 2003.
2. Finite Element analysis – Theory & Programming by C.S.Krishna Murthy- Tata Mc.Graw Hill Publishers
3. Finite Element Methods by R.Dhanaraj& K.Prabhakar Nair, Oxford Publishers.

**REFERENCES:**

1. Finite Element Methods in Civil Engineering by M.Rama Narasimha Reddy, Dr.K.Sreenivasu Reddy, D.Srinivasulu Reddy, Sci-Tech Publications Pvt.Ltd.
2. Finite Element Analysis And Procedures In Engineering by H.V.Lakshminarayana, 3<sup>rd</sup> Edition, Universities Press, Hyderabad.
3. A First Course in the Finite Element Methods by Daryl Logan, Cengage Publishers.
4. Finite Element Analysis in Engineering Design by S.Rajasekharan, S.Chand Publications, New Delhi.
5. Finite Element Analysis By S.S. Bhavakatti-New Age International Publishers

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. *Demonstrate the differential equilibrium equations and their relationship*
2. *Apply numerical methods to FEM*
3. *Demonstrate the displacement models and load vectors*
4. *Compute the stiffness matrix for isoperimetric elements*
5. *Analyze plane stress and plane strain problems*

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<b>15A01702</b>	<b>TRANSPORTATION ENGINEERING – II</b>			

**Course Objective:**

*This subject deals with different components of Transportation Engineering like Railway, Airport Engineering, Ports & harbours. Sound knowledge can be acquired on components of airports, railways, docks and harbours after completion of course*

**Unit – I:**
**Railway Engineering:**

Introduction – Permanent Way Components – Cross Section Of Permanent Way – Functions And Requirements Of Rails, Sleepers And Ballast – Types Of Gauges – Creep Of Rails – Theories Related To Creep – Coning Of Wheels – Adzing Of Sleepers – Rail Fastenings.

**Unit – II:**
**Geometric Design Of Railway Track:**

Gradients – Grade Compensation – Cant And Negative Super Elevation – Cant Deficiency – Degree Of Curves – Safe Speed On Railway Track – Points And Crossings – Layout And Functioning Of Left Hand Turn Out And Right Hand Turn Outs – Station Yards – Signaling And Interlocking.

**Unit –III:**
**Airport Engineering:**

Airport Site Selection – Factors Affecting Site Selection And Surveys- Runway Orientation – Wind Rose Diagram – Basic Runway Length – Correction For Runway Length – Terminal Area – Layout And Functions – Concepts Of Terminal Building – Simple Building , Linear Concept, Pier Concept And Satellite Concept – Typical Layouts

**Unit – IV:**
**Geometric Design Of Runways And Taxiways:**

Aircraft Characteristics – Influence Of Characteristics On Airport Planning And Design – Geometric Design Elements Of Runway – Standards And Specifications As Per - Functions Of Taxiways – Taxiway Geometric Design – Geometric Elements And Standard Specifications – Runway And Taxiway Lighting.

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**R15****Unit – V:****Ports and Harbours:**

Requirements Of Ports And Harbours – Types Of Ports – Classification Of Harbours – Docks And Types Of Docks – Dry Docks, Wharves And Jetties – Breakwaters: Layouts Of Different Types Of Harbours And Docks – Dredging Operations – Navigation Aids.

**Text Books:**

1. A Text Book of Railway Engineering-S.C.Saxena and S.Arora, Dhanpatrai and Sons, New Delhi.
2. Transportation Engineering:Railways,Airports,Docks and Harbours, Bridges and Tunnels, by C.Venkataramaiah, Universities Press, Hyderabad (2016)
3. Airport Planning and Design- S.K. Khanna and M.G Arora, Nemchand Bros.

**References:**

1. Highway, Railway, Airport and Harbour Engineering – K.P. Subramanian, Scitech publishers.
2. Harbour, Dock and Tunnel Engineering – R. Srinivasan, Charotar Publishing House Pvt. Limited, 2009
3. A Text book of Transportation Engineering – S.P.Chandola – S.Chand & Co. Ltd. – (2001).
4. Dock and Harbour Engineering – Hasmukh P Oza, Gutam H Oza, Chartor Publishers pvt ltd.

**Course Outcomes:**

*On completion of this course, the student will be able to*

*Understand the components of Permanent way and their functions*

- a) *Able to understand the geometric design elements of Railway Track and their design methods*
- b) *Understand the aircraft characteristics and their influence on various design elements*
- c) *Acquire the knowledge of types of Docks, Ports and Harbours*

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**15A01703 ENVIRONMENTAL ENGINEERING**

**Course Objective:** This subject provides the knowledge of water sources, water treatment, design of distribution system, waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

#### UNIT – I

**INTRODUCTION:** Importance and Necessity of Protected Water Supply systems, Objectives of Protected water supply system, Flow chart of public water supply system, Role of Environmental Engineer.

**WATER DEMAND AND QUANTITY STUDIES :** Estimation of water demand for a town or city, Types of water demands, Per capita Demand, Factors affecting the Per Capita Demand, Variations in the Demand, Design Period, Factors affecting the Design period, Population Studies, Population Forecasting Studies.

**QUALITY AND ANALYSIS OF WATER:** Characteristics of water – Physical, Chemical and Biological. Analysis of Water – Physical, Chemical and Biological. Impurities in water, Water borne diseases. Drinking water quality standards.

#### UNIT - II

**WATER TREATMENT:** Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants – feeding arrangements. Filtration and Chlorination: 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- Miscellaneous treatment methods

**WATER DISTRIBUTION :** Distribution systems – Requirements, Layout of Water distribution systems - Design procedures- Hardy Cross and equivalent pipe methods service reservoirs – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house, waste detection and prevention.

#### UNIT – III

**INTRODUCTION TO SANITATION :** systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage

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systems- Estimation of sewage flow and storm water drainage – fluctuations – types of sewers – Hydraulics of sewers and storm drains– design of sewers – materials for sewers- appurtenances in sewerage – cleaning and ventilation of sewers .

**WASTE WATER COLLECTION AND CHARACTERISTICS :** Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow – characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. – C.O.D. equations.

**UNIT IV**

**WASTE WATER TREATMENT:** Layout and general out line of various units in a waste water treatment plant – primary treatment: design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – biological treatment – trickling filters – standard and high rate – Construction and design of Oxidation ponds.

**SLUDGE TREATMENT:** Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks and Imhoff Tanks, working principles and design – soak pits.

**UNIT – V**

**SOLID WASTE MANAGEMENT:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

**AIR POLLUTION:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

**NOISE POLLUTION:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

**TEXT BOOKS:**

1. Water Supply And Sanitary Engineering By G.S. Birdi, Dhanpat Rai & Sons Publishers.
2. Water Supply Engineering, Vol. 1, Waste Water Engineering, Vol. II, B.C.Punmia, Ashok Jain & Arun Jain, Laxmi Publications Pvt.Ltd, New Delhi
3. Environmental Engineering By Peavy, TMH Publishers.

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**R15****REFERENCES :**

1. Environmental Science and Engineering by J.G.Henry and G.W.Heinke – Person Education..
2. Waste Water Treatment- Concepts And Design Approach By G.L. Karia And R.A. Christian, Prentice Hall Of India
3. Elements Of Environmental Engineering By K.N. Duggal, S. Chand Publishers.

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. *Identify the source of water and water demand*
2. *Apply the water treatment concept and methods*
3. *Apply water distribution processes and operation and maintenance of water supply*
4. *Prepare basic process designs of water and wastewater treatment plants collect, reduce, analyze, and evaluate basic water quality data*
5. *Determine the sewage characteristics and design various sewage treatment plants*
6. *Carry out municipal water and wastewater treatment system design and operation*
7. *Apply environmental treatment technologies and design processes*



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**15A01704 WATER RESOURCES ENGINEERING-II**

**Course Objective:** This subject aims to impart the knowledge of various head works, canal structures and their design principles to the students. The subject also covers the river structures, their classifications, designs, etc.

**UNIT – 1**

**CANAL REGULATION WORKS:** Canal falls: Necessity and location of falls; Types of falls; classification of falls; cistern design; roughening devices; design of sarda type fall. Canal regulators: off-take alignment; head regulators and cross-regulators; design of cross-regulator and distributary head regulator.

**CROSS DRAINAGE WORKS:** Introduction; types of cross drainage works; selection of suitable type of cross drainage work; classification of aqueducts and siphon aqueducts.

**UNIT-II**

**STREAM GAUGING:** Necessity; Selection of gauging sites; methods of Discharge Measurement; Area-Velocity method; Slope-Area method; Tracer method, Electromagnetic induction method; Ultrasonic method; Measurement of depth – Sounding rod, Echo-sounder; Measurement of velocity: Floats – Surface floats, Sub-surface float or Double float, Velocity rod; Pitot tube; Current meter- rating of current meter, measurement of velocity; chemical method; Measurement of stage-Staff gauge, wire gauge, water stage recorder, bubble gauge recorder; stage-discharge curve.

**RIVER ENGINEERING:** Classification of rivers; Meandering; Causes of meandering; Basic factors controlling process of meandering; Aggrading type of river; Degrading type of River; River training: objectives, Classification of river training works; Types of River training works : Guide banks, Marginal embankments, Groynes or spur, levees, bank protection, pitched islands.

**UNIT-III**

**RESERVOIR PLANNING:** Introduction; Investigations for reservoir planning; Selection of site for a reservoir; Zones of storage in a reservoir; Storage capacity and yield; Mass inflow curve and demand curve; Calculation of reservoir capacity for a specified yield from the mass inflow curve; Determination of safe yield from a reservoir of a given capacity; Sediment flow in streams: Reservoir sedimentation; Life of reservoir; Reservoir sediment control; Flood routing; Methods of flood routing-Graphical Method (Inflow – storage discharge curves method).

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**DAMS :GENERAL:** Introduction; Classification according to use; classification according to material- Gravity dams, Arch dams, Buttress dams, Steel dams, Timber dams, Earth dams and rock fill dams-advantages and disadvantages; Physical factors governing selection of type of dam ; selection of site for a dam.

**UNIT-IV**

**GRAVITY DAMS:** Introduction; Forces acting on a gravity dam; Combination of loading for design; Modes of failure: stability requirements; principal and shear stresses; Stability analysis; Elementary profile of a gravity dam; Practical profile of a gravity dam; Limiting height of a gravity dam- High and low gravity dams; Design of gravity dams—single step method; Galleries; Stability analysis of non—overflow section of Gravity dam.

**EARTH DAMS:** Introduction; Types of earth dams; Causes of failure of earth dams; Criteria for safe design of earth dams; Section of an earth dam; Design to suit available materials; Seepage control measures; Slope protection. Seepage through earth dam – graphical method

**UNIT-V**

**SPILLWAYS:** Introduction; Types of spillways; Profile of ogee spillway; Energy dissipation below spillways for relative positions of jump height curve and tail water curve; Stilling basins; Indian standards on criteria for design of hydraulic jump type stilling basins with horizontal aprons; Spillway crest gates-Types and description only.

**WATER POWER ENGINEERING:** Development of hydro power in India; Classification of hydel plants: runoff river plants, storage plants and pumped storage plants; low, medium and high head schemes ; Investigation and planning; components of hydel schemes – fore bay, intake structure, surge tanks, penstocks ,power house, turbines-selection of suitable type of turbine, Scroll casing ,draft tube and tail race; assessment of available power; definition of gross head,operating head ,effective head; Flow duration curve; Power duration curve; Load duration curve; Load curve ; primary power and secondary power; installed capacity, dependable capacity; firm power, secondary power; power factor ;load factor, capacity factor ,utilization factor and Diversity factor.

**TEXT BOOKS:**

1. Irrigation and Water Power Engineering by Dr. B.C.Punmia & Dr. Pande B.B. Lal; Laxmi Publications pvt. Ltd., New Delhi.
2. Irrigation Engineering and Hydraulic Structure by S. K. Garg; Khanna Publishers, Delhi.

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**R15****REFERENCES:**

1. Irrigation And Water Resources Engineering By G.L. Asawa, New Age International Publishers
2. Irrigation, Waterpower And Water Resources Engineering By K R Arora; Standard Publication, New Delhi.
3. Water Resources Engineering By Satyanarayana Murthy. Challa, New Age International Publishers

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. *Design various canal systems*
2. *Design head and cross regulator structures*
3. *Identify various types of reservoir and their design aspects*
4. *By the Establishes the understanding of cross drainage works and its design*  
*Design different types of dams*

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**15A01705 DESIGN AND DRAWING OF IRRIGATION STRUCTURES  
(CBCC-II)****Course Objectives:**

1. To provide the knowledge of design of reservoir, operation and sedimentation
2. To provide knowledge on various hydraulic structures such as energy dissipaters, head and cross regulators, canal falls and structures involved in cross drainage works

**Design and drawing of the following irrigation structures.**

1. Sloping glacis weir
2. Surplus weir.
3. Tank sluice with tower head
4. Type III Syphon aqueduct.
5. Canal regulator.

**Final Examination pattern:** Any two questions of the above Five designs may be asked out of which the candidate has to answer one question. The duration of examination will be three hours.

**TEXT BOOKS:**

1. Design Of Minor Irrigation And Canal Structures By C.Satyanarayana Murthy, New Age Publications.
2. Irrigation Engineering And Hydraulic Structures By S.K.Garg, Standard Book House.

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. design various irrigation structures like head and cross regulator structures
2. identify various types of reservoirs and their design aspects

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**15A01706 GROUND IMPROVEMENT TECHNIQUES  
(CBCC - II)**

**Course Objective:-** The knowledge on the problems posed by the problematic soils and the remedies to build the various structures in problematic soils will be imparted to the students.

**UNIT – I**

**DEWATERING:** Methods Of De-Watering- Sumps And Interceptor Ditches- Single, Multi Stage Well Points - Vacuum Well Points- Horizontal Wells-Foundation Drains- Blanket Drains- Criteria For Selection Of Fill Material Around Drains –Electro-Osmosis.

**GROUTING:** Objectives Of Grouting- Grouts And Their Properties- Grouting Methods- Ascending, Descending And Stage Grouting- Hydraulic Fracturing In Soils And Rocks- Post Grout Test.

**UNIT – II**
**DENSIFICATION METHODS IN GRANULAR SOILS:-**

In – Situ Densification Methods In Granular Soils:- Vibration At The Ground Surface, Impact At The Ground Surface, Vibration At Depth, Impact At Depth.

**DENSIFICATION METHODS IN COHESIVE SOILS:-**

In – Situ Densification Methods In Cohesive Soils:- Preloading Or Dewatering, Vertical Drains – Sand Drains, Sand Wick Geodrains – Stone And Lime Columns – Thermal Methods.

**UNIT – III**

**STABILISATION:** Methods Of Stabilization-Mechanical-Cement- Lime-Bituminous-Chemical Stabilization With Calcium Chloride,Sodium Silicate And Gypsum

**UNIT – IV**

**REINFORCED EARTH:** Principles – Components Of Reinforced Earth – Factors Governing Design Of Reinforced Earth Walls – Design Principles Of Reinforced Earth Walls.

**GEOSYNTHETICS :** Geotextiles- Types, Functions And Applications – Geogrids And Geomembranes – Functions And Applications.

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**R15****UNIT - V**

**EXPANSIVE SOILS:** Problems Of Expansive Soils – Tests For Identification – Methods Of Determination Of Swell Pressure. Improvement Of Expansive Soils – Foundation Techniques In Expansive Soils – Under Reamed Piles.

**TEXT BOOKS:**

1. Engineering Principles of Ground Modification, Hausmann M.R. (1990), McGraw-Hill International Edition.
2. Ground Improvement Techniques by Dr.P.Purushotham Raj, Laxmi Publications, New Delhi / University Science Press, New Delhi
3. Ground Improvement Techniques by Nihar Ranajan Patra. Vikas Publications, New Delhi

**REFERENCES:**

1. Ground Improvement, Blackie Academic and Professional by Moseley M.P. (1993), Boca Taton, Florida, USA.
2. Ground Control and Improvement by Xanthakos P.P, Abramson, L.W and Brucwe, D.A (1994), John Wiley and Sons, New York, USA.
3. Designing with Geosynthetics by Robert M. Koerner, Prentice Hall New Jercey, USA

**Course Outcomes:**

*On completion of this course the students will be able to*

1. *Identify the problems in Expansive soils*
2. *Implement the stabilization methods*
3. *Apply grouting and dewatering techniques*

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15A01707 AIR POLLUTION AND QUALITY CONTROL (CBCC - II)				

**Course Objectives:**

1. To make the student to understand the aspects of atmospheric pollution
2. To throw light on the issues such as atmospheric composition, monitoring, acidic deposition, urban air quality
3. To make the student to understand the use of models in air pollution studies

**UNIT – I**

**INTRODUCTION** : Air Pollution – Definitions, Scope, Significance and Episodes, Air Pollutants – Classifications – Natural and Artificial – Primary and Secondary, point and Non- Point, Line and Areal Sources of air pollution- stationary and mobile sources.

**EFFECTS OF AIR POLLUTION:** Effects of Air pollutants on man, material and vegetation: Global effects of air pollution – Green House effect, Heat Islands, Acid Rains, Ozone Holes etc.

**UNIT-II**
**THERMODYNAMIC OF AIR POLLUTION:**

Thermodynamics and Kinetics of Air-pollution – Applications in the removal of gases like Sox, Nox, CO, HC etc., air-fuel ratio. Computation and Control of products of combustion.

**PLUME BEHAVIOUR** : Meteorology and plume Dispersion; properties of atmosphere; Heat, Pressure, Wind forces, Moisture and relative Humidity, Influence of Meteorological phenomena on Air Quality-wind rose diagrams.

**UNIT-III**

**POLLUTANT DISPERSION MODELS** : Lapse Rates, Pressure Systems, Winds and moisture plume behaviour and plume Rise Models; Gaussian Model for Plume Dispersion.

**CONTROL OF PARTICULATES** : Control of particulates – Control at Sources, Process Changes, Equipment modifications, Design and operation of control, Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators.

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**R15****UNIT – IV**

**CONTROL OF GASEOUS POLLUTANTS :** General Methods of Control of Nox and Sox emissions – In-plant Control Measures, process changes, dry and wet methods of removal and recycling.

**UNIT – V**

**AIR QUALITY MANAGEMENT:** Air Quality Management – Monitoring of SPM, SO<sub>x</sub>; NO<sub>x</sub> and CO Emission Standards– Air sampling – Sampling Techniques – High volume air sampler – Stack sampling - Analysis of Air pollutants – Air quality standards – Air pollution control act.

**TEXT BOOKS:**

1. Air Pollution By M.N.Rao And H.V.N.Rao – Tata Mc.Graw Hill Company.
2. Air Quality By Thod Godish, Levis Publishers, Special India Edition, New Delhi
3. Environmental Pollution Control Engineering, 2nd Edition By Rao C.S. (2006), New Age International, Newdelhi

**REFERENCE:**

1. An introduction to Air pollution by R.K. Trivedy and P.K. Goel, B.S. Publications.
2. Air Pollution and Control by K.V.S.G.Murali Krishna, Kousal & Co. Publications, New Delhi.
3. Air Pollution Control Engineering, 2nd Edition by Noel De Nevers (2000), McGraw Hill International Edition.

**Course Outcomes :**

*Students will be able to*

1. *Describe the main chemical components and reactions in the atmosphere and examine the factors responsible for perturbing these*
2. *Implement the methods for monitoring and modeling spatial and temporal patterns of pollution*
3. *Assess the environmental impacts of atmospheric pollution.*



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**15A01708 BRIDGE ENGINEERING  
(CBCC - III)**

**Course Objective:** This course deals with different types of Bridges like deck slab bridge, T – Beam Bridge and gives a good knowledge on different components of bridges.

**UNIT - I****INTRODUCTION:**

Importance Of Site Investigation In Bridge Design. Highway Bridge Loading Standards. Impact Factor. Railway Bridge Loading Standards (B.G. ML Bridge) Various Loads In Bridges.

**BOX CULVERT :** General Aspects. Design Loads, Design Of Box Culvert Subjected To RC Class AA Tracked Vehicle Only.

**BRIDGE BEARINGS :**

General Features – Types Of Bearings – Design Principles Of Steel Rocker & Roller Bearings – Design Of A Steel Rocker Bearing – Design Of Elastometric Pad Bearing.

**UNIT - II****DECK SLAB BRIDGE :**

Introduction – Effective Width Method Of Analysis Design Of Deck Slab Bridge (Simply Supported) Subjected To Class AA Tracked Vehicle Only.

**UNIT - III****BEAM & SLAB BRIDGE (T-BEAM BRIDGE)**

General Features – Design Of Interior Panel Of Slab – Pigeauds Method – Design Of A T-Beam Bridge Subjected To Class AA Tracked Vehicle Only.

**UNIT – IV****PLATE GIRDER BRIDGE :**

Introduction – Elements Of A Plate Girder And Their Design. Design Of A Deck Type Welded Plate Girder – Bridge Of Single Line B.G.

**COMPOSITE BRIDGES :**

Introduction – Advantages – Design Of Composite Bridges Consisting Of RCC Slabs Over Steel Girders Including Shear Connectors

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**R15****UNIT V****PIERS & ABUTMENTS:**

General Features – Bed Block – Materials Piers & Abutments Types Of Piers – Forces Acting On Piers – Stability Analysis Of Piers – General Features Of Abutments – Forces Acting On Abutments – Stability Analysis Of Abutments – Types Of Wing Walls – Approaches – Types Of Bridge Foundations (Excluding Design).

**TEXT BOOKS :**

1. Bridge Engineering By Ponnu Swamy, TATA Mcgraw Hill Company, New Delhi.
2. Design Of Bridges By N.Krishnam Raju, Oxford & IBH, Publishing Company Pvt.Ltd., Delhi.
3. Relevant – IRC & Railway Bridge Codes.

**REFERENCE :-**

1. Design Of Steel Structures, By B.C. Punmia, Ashok Kumar Jain And Arun Kumar Jain, Laxmi Publications, New Delhi.
2. Essentials Of Bridge Engineering By D.J.Victor, Oxford IBH Publishers Ltd
3. Design Of R.C.C. Structures B.C. Punmia, Ashok Kumar Jain And Arun Kumar Jain, Laxmi Publications, New Delhi.
4. Design Of Bridges Structure By T.R.Jagadish & M.A.Jayaram Prentice Hall Of India Pvt., Delhi.

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. *Design the basic components of bridge structures like bridge deck slabs, longitudinal girders, transverse girders, piers and well foundations.*
2. *Understand the IRC classes of loading and railway bridge rules for detailed calculation of loadings and design of various components.*
3. *Know the methods of design of structural components of different types of Bridges*

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**15A01709 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES  
(CBCC - III)**
**Course Objectives:**

1. To introduce the basics of Earthquake Engineering
2. To introduce the engineering seismology, building geometrics & characteristics, structural irregularities,
3. To introduce tips on Earthquake Engineering - do's and don'ts
4. To introduce cyclic loading behaviour of RC, steel and pre-stressed concrete elements
5. To discuss code provisions and their application on different types of structures

**UNIT – I**

**Introduction to Structural Dynamics** : – Theory of vibrations – Lumped mass and continuous mass systems – Single Degree of Freedom (SDOF) Systems – Formulation of equations of motion – Undamped and damped free vibration – Damping – Response to harmonic excitation – Concept of response spectrum.

**UNIT – II**

**Multi-Degree of Freedom (MDOF) Systems** : - Formulation of equations of motion – Free vibration – Determination of natural frequencies of vibration and mode shapes – Orthogonal properties of normal modes – Mode superposition method of obtaining response.

**UNIT – III**

**Earthquake Analysis** : - Introduction – Rigid base excitation – Formulation of equations of motion for SDOF and MDOF Systems – Earthquake response analysis of single and multi-storied buildings – Use of response spectra-Review of the latest Indian seismic code IS:1893 – 2002 (Part-I) provisions for buildings – Earthquake design philosophy – Assumptions – Design by seismic coefficient and response spectrum methods – Displacements and drift requirements – Provisions for torsion.

**UNIT – IV**

**Earthquake Engineering** : - Engineering Seismology – Earthquake phenomenon – Causes and effects of earthquakes – Faults – Structure of earth – Plate Tectonics – Elastic Rebound Theory – Earthquake Terminology – Source, Focus, Epicenter etc – Earthquake size – Magnitude and intensity of earthquakes – Classification of earthquakes – Seismic waves – Seismic zones – Seismic Zoning Map of India –

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**R15**

Seismograms and Accelerograms-Review of the latest Indian Seismic codes IS:4326 and IS:13920 provisions for ductile detailing of R.C buildings – Beam, column and joints

**UNIT – V**

**Aseismic Planning** : - Plan Configurations – Torsion Irregularities – Re-entrant corners – Non-parallel systems – Diaphragm Discontinuity – Vertical Discontinuities in load path – Irregularity in strength and stiffness – Mass Irregularities – Vertical Geometric Irregularity – Proximity of Adjacent Buildings.

**Shear walls** : - Types – Design of Shear walls as per IS:13920 – Detailing of reinforcements.

**TEXT BOOKS:**

1. Dynamics of Structures – Clough & Penzien, McGraw Hill – International Edition.
2. Earthquake Resistant Design of Structures by S.K.Duggal, Oxford University press, New Delhi
3. Dynamics of Structures by A.K.Chopra – Pearson Education, Indian Branch, Delhi.

**REFERENCES:**

1. Structural Dynamics by Mario Paaz , Academic Publishers.
2. Earthquake Resistant Design of Structures – Pankaj Agarwal & Manish Shrikhande – Prentice Hall of India, New Delhi
3. Earthquake Hazardous Mitigation by R.Ayothiraman and Hemanth Hazarika, I.K.International Publishing House Pvt.Ltd., New Delhi.

**Codes/Tables:**

**IS Codes:** IS:1893, IS:4326 and IS:13920 to be permitted into the examinations Hall.

**Course Outcomes:**

*On completion of the course, the students will be able to:*

1. *apply the basics of Earthquake Engineering*
2. *demonstrate the dynamics of structural system under earthquake load*
3. *analyze the influence of the structural / geometrical design in building characteristics*
4. *demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements*
5. *apply codal provisions on different types of structures*

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**R15****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

B. Tech IV-I Sem. (C.E)	L	T	P	C
	3	1	0	3
15A01710	REHABILITATION AND RETROFITTING OF STRUCTURES (CBCC - III)			

**Course Objectives:**

*This course introduces to the student the causes of concrete structures failures and methods available to rehabilitate and for retrofitting the structures with economical applications.*

**UNIT – I**

Introduction – Deterioration of Structures – Distress in Structures – Causes and Prevention. Mechanism of Damage – Types of Damage

**UNIT – II**

Corrosion of Steel Reinforcement – Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation.

**UNIT – III**

Inspection and Testing – Symptoms and Diagnosis of Distress – Damage assessment – NDT.

**UNIT – IV**

Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

**UNIT – V**

Health Monitoring of Structures – Use of Sensors – Building Instrumentation.

**TEXT BOOKS:**

1. Concrete Technology by A.R. Santakumar, Oxford University press
2. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
3. Non-Destructive Evaluation of Concrete Structures by Bungey – Surrey University Press

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**R15****REFERENCES**

1. Diagnosis And Treatment Of Structures In Distress By R.N.Raikar, Published By R&D Centre Of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
2. Handbook On Repair And Rehabilitation Of RCC Buildings, Published By CPWD, Delhi, 2002.
3. Earthquake Resistant Design Of Structures By Pankaj Agarwal And Manish Shrikhande, Prentice-Hall Of India, 2006.

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

1. *Assess the strength and materials deficiency in concrete structures*
2. *Suggest methods and techniques used in repairing / strengthening existing concrete structures*
3. *Apply Non Destructive Testing techniques to field problems*
4. *Apply cost effective retrofitting strategies for repairs in buildings*

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**R15****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR****B. Tech IV-I Sem. (C.E)**

L	T	P	C
0	0	4	2

**15A01711 CAD LABORATORY****CAD:****SOFTWARE:**

1. STAAD PRO or Equivalent

**EXERCISIES:**

1. 2-D Frame Analysis and Design
2. Steel Tabular Truss Analysis and Design
3. 3-D Frame Analysis and Design
4. Retaining Wall Analysis and Design
5. Simple tower Analysis and Design
6. One Way Slab Analysis & Design
7. Two Way Slab Analysis & Design
8. Column Analysis & Design

**TEXT BOOK:**

1. Computer Aided Design Lab Manual by Dr.M.N.Sesha Prakash And Dr.C.S.Suresh

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**R15****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

<b>B. Tech IV-I Sem. (C.E)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>

**15A01712 ENVIRONMENTAL ENGINEERING LABORATORY****Course Objective:**

*The laboratory provides knowledge of estimating various parameters like PH, Chlorides, Sulphates, Nitrates in water. For effective water treatment, the determination of optimum dosage of coagulant and chloride demand are also included. The estimation status of Industrial effluents will also be taught in the laboratory by estimating BOD and COD of effluent.*

**LIST OF EXPERIMENTS**

1. Determination of pH and Turbidity
2. Determination of Conductivity and Total dissolved solids.
3. Determination of Alkalinity/Acidity.
4. Determination of Chlorides.
5. Determination and Estimation of total solids, organic solids and inorganic solids.
6. Determination of iron.
7. Determination of Dissolved Oxygen.
8. Determination of Nitrogen.
9. Determination of total Phosphorous.
10. Determination of B.O.D
11. Determination of C.O.D
12. Determination of Optimum coagulant dose.
13. Determination of Chlorine demand.
14. Presumptive coliform test.

**NOTE:** At least 8 of the above experiments are to be conducted.



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**R15****LIST OF EQUIPMENT**

- 1) pH meter,
- 2) Turbidity meter,
- 3) Conductivity meter,
- 4) Hot air oven,
- 5) Muffle furnace,
- 6) Dissolved Oxygen meter,
- 7) U – V visible spectrophotometer,
- 8) Reflux Apparatus,
- 9) Jar Test Apparatus,
- 10) BOD incubator.
- 11) COD Extraction apparatus

**TEXT BOOKS:**

1. Chemistry for Environmental Engineering by Sawyer and Mc. Carty
2. Standard Methods for Analysis of water and Waste Water – APHA
3. Environmental Engineering Lab Manual by Dr.G.Kotaiah and Dr.N.Kumara Swamy, Charotar Publishers, Anand.