

Course Code: BCEL – 501

Course Name: Construction Planning & Management

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To make student conversant with the concepts and importance of the subject of construction planning & management.
- 2) To provide a broad knowledge on how to make bar chart, work break structure of a project, schedules.
- 3) To provide a broad knowledge on how to analyze a problem using various techniques of project management like CPM, PERT & optimization of time & cost of a project.
- 4) To provide knowledge on how to prepare a tender document, contract & arbitration for a project.
- 5) To provide an insight into various types of machinery used in construction works & various concepts of man & material management.

**Syllabus:**

**Unit I:** Introduction, Significance of Construction Management, Roles of a project manager, Stakeholders in construction project, An overview of planning process, work break down structure, planning, sequencing, scheduling, preparing bar charts, milestone charts, limitations, Introduction to network techniques.

**Unit II: Network Techniques in Project Management:** Basics of developing a network, activities, events, numbering, rules for developing networks, network analysis using CPM, determination of schedules, critical paths, floats, probability concepts in networking, optimistic time, pessimistic time, mean, standard deviation, variance, slack, determination of critical path using PERT technique, Resources Smoothing & Leveling.

**Unit III: Time & Cost Optimization using Network Techniques:** Time computations using CPM & PERT, Probability of achieving completion time, Project cost, Direct & Indirect cost, Cost vs. Time curves, Total project cost & optimum duration, Contracting the network for cost optimization, Time cost optimization.

**Unit IV: Contracts:** Different types of contracts, Notice inviting tenders, Contract document, Rate list, Security deposit and Earnest money, Conditions of contract, Arbitration, Breach of contract.

**Unit V: Resource Management:** Factors affecting selection of construction equipments, Various types of equipments used in construction works like earth work, dredging, conveyance, hoisting, compacting & grouting, Equipment management, Manpower Management: Labour laws (Compensation Act etc.) & Human relations, Welfare facilities, Safety Management.

**Course Outcomes:**

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

- 1) Understand the responsibilities & roles of a project manager.
- 2) Prepare schedule of activities including bar charts.
- 3) Analyze various problems of time & cost optimization using network techniques like CPM & PERT.

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- 4) Develop a management system, incorporating constraints of time and cost, social, legal and ethical aspect of various phases of project life cycle.
- 5) Prepare tender & contract document for a construction project.
- 6) Plan and manage effectively for man, material & equipment of a project along with suitable safety measures.

**Books Recommended:**

- 1) B. C. Punmia & K. K. Khandelwal, Project Planning & Control with PERT & CPM, Laxmi Publishers
- 2) Gahlot & Dhir, Construction Management, New Age International Publishers.
- 3) K. K. Chitkara, Construction Project Management, Mc Graw Hill International Publishers.
- 4) L.S. Srinath, PERT & CPM - Principles & Applications, East West Press.
- 5) Sengupta & Guha, Construction Management & Planning, Mc Graw Hill Publishers.
- 6) U.K. Shrivastava, Construction Planning & Management
- 7) Neeraj Kumar Jha, Construction Project Management, Pearson Publishers.

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Course Code: BCEL – 502

Course Name: Traffic Engineering

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To introduce the concepts of traffic engineering.
- 2) To provide a broad knowledge on traffic characteristics & various studies conducted in traffic engineering.
- 3) To analyze various requirements of traffic operation & control system & effectively design traffic signal.
- 4) To effectively design street light system.
- 5) To provide knowledge on concepts of accident studies & mass transportation system.

**Syllabus:**

**Unit –I Traffic Characteristics:**

(i) Road user's characteristics – general human characteristics, physical, mental and emotional factors, factors affecting reaction time, PIEV theory. (ii) Vehicular characteristics: Characteristics affecting road design – width, height, length and other dimensions. Weight, power, speed and braking capacity of a vehicle.

**Unit –II Traffic Studies:**

(i) Spot Speed Studies and Volume Studies. (ii) Speed and Delay Studies-purpose, causes of delay, methods of conducting speed and delay studies (iii)Origin and Destination Studies (O&D): Various methods, collection and interpretation of data, planning and sampling (iv) Traffic capacity Studies: Volume, density, basic practical and possible capacities, level of service (v) Parking Studies: Methods of parking studies cordon counts, space inventories, parking practices.

**Unit – III Traffic Operations and Control:**

(i) Traffic regulations and various means of control. (ii) One-Way streets-advantages and limitations. (iii) Traffic signals-isolated signals coordinated signals, simultaneous, alternate, flexible and progressive signal systems. Types of traffic signals, fixed time signals, traffic actuated signals, speed control signals, pedestrian signals, flashing signals, clearance interval and problems on single isolated traffic signal. Signs, markings and islands channelization of intersections Traffic rotary. Grade separated intersections and fly over and clover leaf function.

**Unit-IV Street Lighting:**

(i) Methods of light distribution (ii) Design of street lighting system (iii) Definitions-Luminaire, foot candle, Lumen, utilization and maintenance factors. (iv) Different types of light sources used for street lighting (v) Fundamental factors of night vision.

**Unit-V Accident Studies & Mass Transportation:**

(i) Accident Studies: Causes of accidents, accident studies and records, condition and collision diagram, preventive measures (ii) Expressways and freeways, problems on mass transportation and remedial measures, brief study of mass transportation available in the country.

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### Course Outcomes:

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

- 1) Estimate basic characteristics of traffic stream.
- 2) Conduct traffic studies and estimate traffic data.
- 3) Analyze various requirements of effective traffic operation & control system.
- 4) Design traffic signal system.
- 5) Understand the concepts of street lighting system & design an efficient street lighting system.
- 6) Conduct accident studies & plan for preventive measures.
- 7) Get an insight into various existing forms of mass transportation in India.

### Reference Books:

- i) Traffic Engineering and transport Planning by L.R. Kadiyali, Khanna Publishers Delhi
- ii) Traffic Engineering by Matson, W.S. Smith & F.W. Hurd
- iii) G.J. Pingnataro, Principles of Traffic Engineering
- iv) D.R. Drew, Traffic Flow Theory
- v) W.R. Mcshane and R.P. Roess "Traffic Engg"
- vi) Wohl & Martin Traffic System Analysis for Engineering & Planners
- vii) Highway Engg. by Justo & Khanna

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Course Code: BCEL – 503

Course Name: Water Resources Engineering - I

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To develop an understanding of various components of hydrological cycle, their behaviors & factors affecting it & solve problems on measurement on rainfall, infiltration, evaporation.
- 2) To understand concepts of Hydrometry & ground water hydrology.
- 3) To discuss the importance of estimation of runoff, analysis of rainfall data and various hydrographs and analyze various problems off runoff using various hydrograph theories.
- 4) To develop an understanding of various methods of flood estimation in general & flood frequency in detail.
- 5) To develop the concept of flood routing through reservoir & channel and its application in flood forecasting & flood control.

**Syllabus:**

**Unit -I Hydrology:**

Hydrological cycle, Precipitation and its measurement, Recording and non recording rain gauges, Estimating missing rainfall data, Rain gauge net works, Mean depth of precipitation over a drainage area, Mass rainfall curves, Intensity – duration curves, Depth – Area Duration curve, Infiltration and infiltration indices, Evaporation, evaporimeters, evapotranspiration & estimation.

**Unit - II**

**Hydrometry and Ground Water:**

Methods of Stream gauging, Direct and Indirect methods, Area – velocity method, Dilution technique methods, Ultrasonic method, Stage – Discharge Relationship (Rating curves).

Forms of subsurface water, Aquifer properties, Geological formations as aquifers, Hydraulics of wells, Steady flow into a well, Well loss, Introductions to ground water recharge methods and Rain water harvesting.

**Unit-III**

**Hydrographs:**

Runoff, Flow duration curve, Flow mass curve, Estimation of runoff, Rainfall – Runoff relationship, Hydrograph and its analysis, Unit hydrograph and its derivation for isolated and complex storms, S-curve hydrograph, Instantaneous unit hydrograph, Synthetic unit hydrograph.

**Unit-IV**

**Floods:** Floods and its estimation by different methods, Design flood by Unit hydrograph and Design Storm, Flood frequency studies: Gumbel's Method, Log Pearson Types – III Distribution, Lognormal distribution, Limitations of Frequency studies.

**Unit-V**

**Floods Routing:** Hydrologic Routing: Reservoir Routing – Modified Pul's method, Goodrich method. Channel Routing - Muskingum method

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**Hydraulic Routing:** Numerical methods. Introduction to Time series models, Flood control measures.

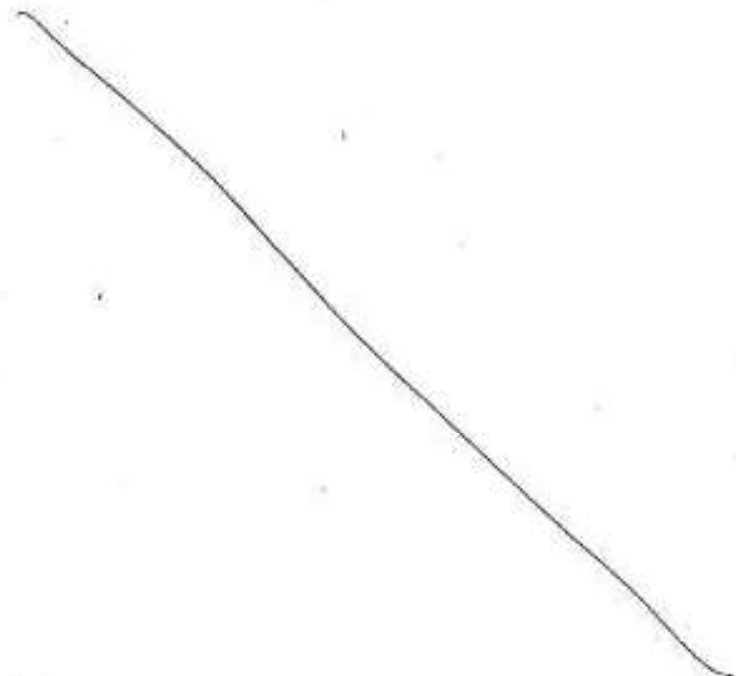
**Course Outcomes:**

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

- 1) Understand the fundamental concepts of hydrological cycle, various hydrological parameters, measurement of rainfall & analysis of rainfall data.
- 2) Understand various methods of stream flow measurement & gauging.
- 3) Understand various concepts of ground water hydrology.
- 4) Understand the basic concepts of runoff, various hydrograph theories, & estimate runoff using various hydrograph theories.
- 5) Develop an understanding of flood estimation & estimate flood discharge using various methods.
- 6) Apply various flood routing techniques in river protection works & implement various types of flood control measures.

**Reference Books:**

- i) Engineering Hydrology - J. NEMEC - Prentice Hall.
- ii) Hydrology for Engineers Linsley, Kohler, Paulus - Tata Mc Graw Hill.
- iii) Engineering Hydrology by K. Subramanya - Tata Mc Graw Hills Publ. Co.
- iv) Hydrology & Flood Control by Santosh Kumar - Khanna Publishers.
- v) Engineering Hydrology by H.M. Raghunath.



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Course Code: BCEL – 504

Course Name: Fluid Mechanics - II

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To develop and understanding of fluid flow patterns and learn to use boundary layer theory and drag.
- 2) To apply theories of laminar & turbulent flow to solve typical pipe flow problems in the field.
- 3) To apply boundary layer theory to estimate drag & lift for various shapes of the objects.
- 4) To classify the types of flows in open channel and also to design open channel sections in a most economical fashion with minimum wetted perimeter and learn about critical flows.
- 5) To study about non uniform flows in open channel and longitudinal slopes in open channel and also to learn about the characteristics of hydraulic jump.
- 6) To understand design philosophy of various types of pumps & turbines.

**Syllabus:**

**Unit-I**

**Turbulent Flow:** Laminar and turbulent boundary layers and laminar sub layer, hydro dynamically rough boundaries, velocity distribution in turbulent flow, Resistance of smooth and artificially roughened pipes, Commercial pipes, aging of pipes.

**Pipe Flow Problems:** Losses due to sudden expansion and contraction, losses in pipe fittings and valves, Concepts of equivalent length, Hydraulic and energy gradient lines, Siphon, Pipes in series, in parallel, Branching of pipes.(Hardy Cross method)

**Pipe Network:** Water hammer (only quick closure case) transmission of power.

**Unit-II Forces on immersed bodies:**

Introduction, Force Exerted by a flowing fluid on a stationary body, Expression for Drag & Lift, Drag on a sphere, Terminal velocity of a Body, Drag on a cylinder. Introduction to Development of Lift on a Circular Cylinder and an Airfoil

**Unit -III**

**Uniform Flow in open Channels:**

Channel geometry and elements of channel section, Velocity distribution, Energy in open channel flow, Specific energy, Types of flow, Critical flow and its computations, Uniform flow and its computations, Chezy's and Manning's formulae, Determination of normal depth and velocity, Normal and critical slopes, Economical sections.

**Unit-IV**

**Gradually varied flow** – Basic assumptions and dynamic equations of gradually varied flow, characteristics analysis and computations of flow profiles, rapidly varied flow-hydraulic jump in rectangular channels and its basic characteristics, Surges in open channels.

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## Unit-V

### Introduction to Fluid Machinery: Turbines & Pumps

**A) Turbines:** Classifications, definitions, Similarity laws, Specific speed and unit quantities, Pelton turbine – their construction and settings, Speed regulation, Dimensions of various elements. Action of jet, Torque, Power and efficiency for ideal case, Characteristics curves. Reaction turbines construction & setting, Draft tube theory, Runaway speed, Simple theory of design and characteristic curves, Cavitation.

**(B) Pumps:** Principle of working & criteria for selection of different types of pump, viz. Centrifugal, Reciprocating.

### Course Outcomes:

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

- 1) Apply the theories of laminar & turbulent flow to solve various pipe flow problems.
- 2) Apply the theory of boundary layer to estimate lift & drag on various shapes of the objects.
- 3) Design the most efficient open channel section for carrying maximum discharge.
- 4) Understand the significance of critical flow & uniform flow & apply these concepts in gradually varied flow problems.
- 5) Understand the working principles of pump & turbine & subsequently apply them.

### Reference Books:

- i) Fluid Mechanics – Modi & Seth – Standard Book house, Delhi.
- ii) Open Channel Flow by Rangaraju – Tata Mc Graw – Hill Publishing Comp. Ltd., New Delhi.
- iii) Fluid Mechanics – A.K. Jain – Khanna Publishers, Delhi.
- iv) Fluid Mechanics, Hydraulics & Hydraulic Mechanics – K.R. Arora – Standard Publishers Distributors 1705-B, Nai Sarak, Delhi-6.
- v) Hydraulics of open channels By Bakhmetiff B.A. (McGraw Hill, New York).
- vi) Open Channel Hydraulics by Chow V.T. (McGraw Hill, New York).
- vii) Hydraulic M/c in Engineering Hydraulics By Rouse.
- viii) Open Chanel Flow by K. Subhramanya – Tata M.C. Gram Hill, New Delhi.

### List of Practical's:

1. Study the performances characteristics of Pelton Wheel
2. Study the performances characteristics of Francis Turbine.
3. Study the performances characteristics of Kaplan Turbine.
4. Calibration of multistory (Two) Pump & Study of characteristics of variable speed pump.
5. To study the performance & details of operation of Hyd. Ram.
6. Study of the characteristics of the Reciprocating pump at variable speed.

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Course Code: BCEL – 505

Course Name: Structural Design & Drawing – I (R.C.C.)

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To understand the behavior of reinforced concrete components & systems subjected to gravity loads.
- 2) To study the stress strain behavior of steel and concrete.
- 3) To understand the concept of working stress & limit state method.
- 4) To provide knowledge on limit state design of beams, design for flexure, shear, torsion, bond & anchorage as per relevant IS codes.
- 5) To provide knowledge on design of slabs, columns, footings & staircases as per relevant IS codes.

**Syllabus:**

**Unit-I Basic Principles of Structural Design:**

Mechanism of load transfer, Introduction to working stress limit state and ultimate load methods of design. Introduction of IS Codes 456, 13920.

**Design of Beams:** Analysis and design of singly reinforced rectangular beams, Lintel, Cantilever, Simply supported and continuous beams.

**Unit-II Design of Beams:**

Doubly reinforced and Flanged Beam. Design for Shear and design for bond.

**Unit-III Design of Slabs:**

Slabs spanning in one direction, (Cantilever, Simply supported and Continuous slabs); Slabs spanning in two directions, Circular slabs.

**Unit-IV Columns & Footing:**

Short and long columns. Columns subjected to axial loads and bending moments (section with no tension). Isolated and combined footings, Strap footing. Raft foundation.

**Unit-V Staircases:**

Staircases with waist slab having equal and unequal flights with different support conditions, Tread-riser staircase.

**Course Outcomes:**

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

- 1) Recognize the design philosophy of R.C.C. structures & apply the concepts of working stress method & limit state method.
- 2) Design different elements of R.C.C. structural elements like beams, slabs, columns, footings & staircases using relevant IS Codes.
- 3) Use the techniques, skills & modern engineering tools necessary for design & detailing.

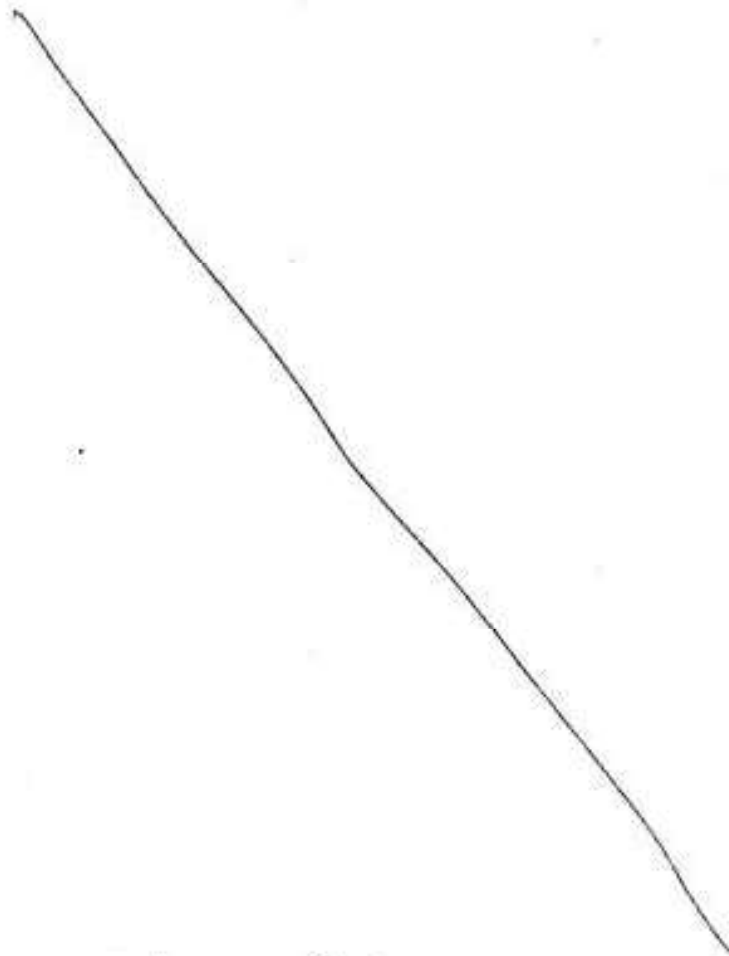
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4) Analyze and interpret the results using analytical tools & further plan, design & detail different components of civil engineering structures.

5) Design a structure/component, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction & its sustainability as per the codal provisions.

**Reference Books:**

- i) Limit State Design by P.C. Varghese; Prentice Hall of India, New Delhi.
- ii) Design of Reinforced Concrete by Pillai & Menon; Tata McGraw Hill, New Delhi.
- iii) Reinforced Cement Concrete by Gupta & Mallick, Oxford and IBH.
- iv) Reinforced Cement Concrete by P. Dayaratnam, Oxford and IBH.
- v) Reinforced Concrete Design by S.N. Sinha, Tata McGraw Hill
- vi) Plain and Reinforced Concrete by O.P. Jain and Jai Krishna, Nem Chand Pub.
- vii) Limit State Design by A.K. Jain, Nem Chand Pub.
- ix) Reinforced Cement Concrete by Winter & Nelson



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Course Code: BCEL – 506

Course Name: Theory of Structures - I

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To develop an understanding of the behavior of structure under serviceability load.
- 2) To understand the mechanics of the material behavior of different type of structures.
- 3) To understand the concepts of analysis of indeterminate structures by various classical methods.
- 4) To make student aware of different methods of structural analysis.

**Syllabus:**

**Unit-I**

**Deflection of beams**

Double Integration method. Area Moment Method and Slope-Deflection Method. Beam of variable cross section,  $M/EI$  diagram, Conjugate Beam Method.

**Unit-II**

**Virtual work and Energy Principles**

Principles of Virtual work applied to deformable bodies. Maxwell's Reciprocal theorems, Energy theorems, Application to pin jointed frames only.

**Unit – III Indeterminate Structures-I**

Static and Kinematics indeterminacy, Analysis of Fixed and continuous beams by Theorem of three moments, Effect of sinking and rotation of supports.

**Unit-IV Indeterminate Structures-II**

Analysis of beams and analysis of frames (with and without sway) by slope Deflection method.

**Unit-V Moment Distribution Method**

Moment distribution method for analysis of beams and analysis of frames (without sway) Three hinged arches of different shapes, Eddy's Theorem. Two Hinged and Fixed Arches. Analysis of frame using STAAD Pro Software.

**Course Outcomes:**

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

- 1) Apply fundamental concepts of mathematics, statics, mechanics of deformable bodies, and principle of dynamics to the solution of fundamental civil engineering structural analysis problems.
- 2) Understand the significance of the basic mechanical properties of structural materials.
- 3) Understand the deformations of structures under loading and be able to apply various methods to determine the deformations.
- 4) Solve statically indeterminate structures using classical methods.
- 5) Develop the ability to analyze cable and arch structures.

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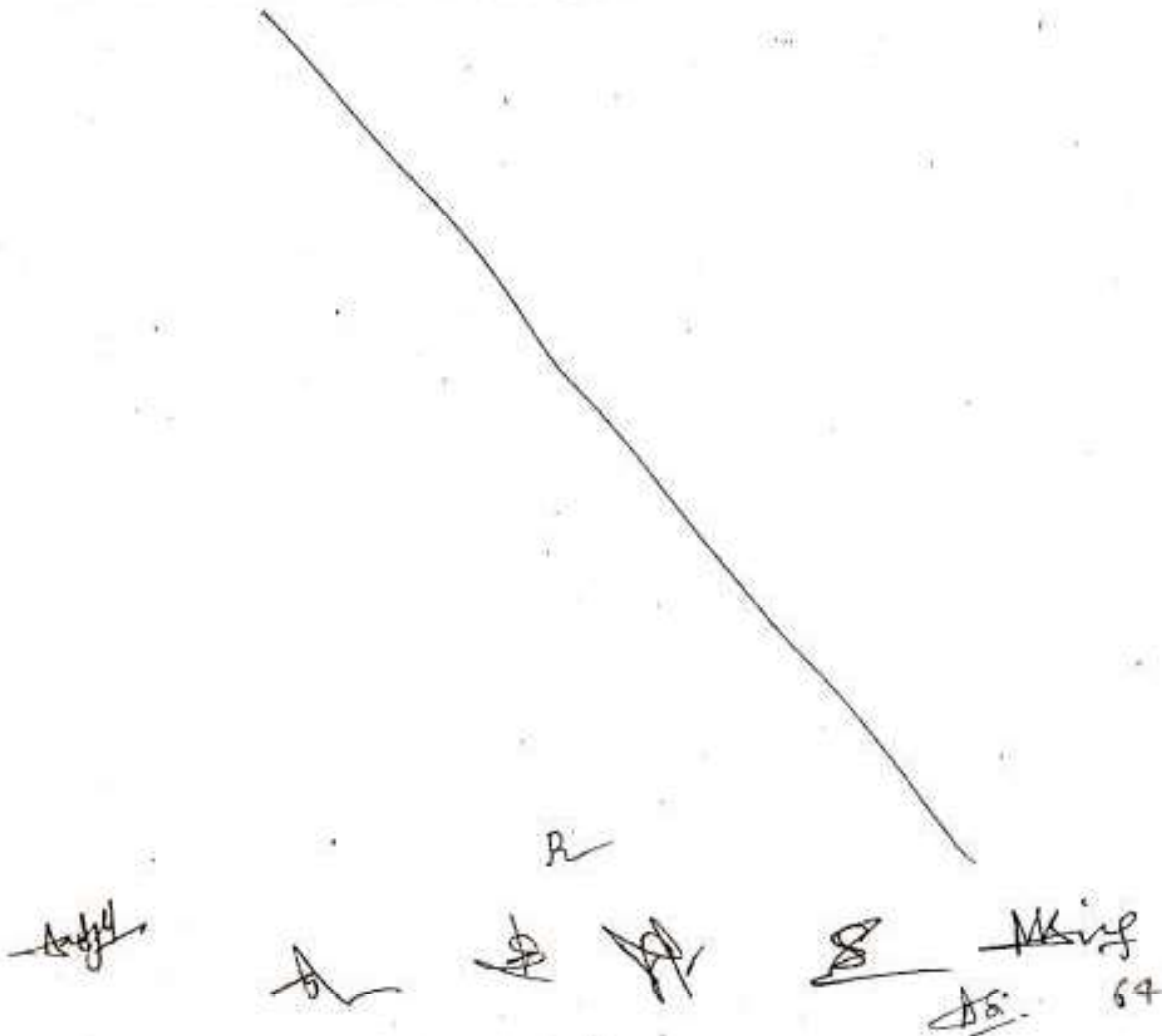
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### Reference Books:

- i) Ghali A & Neville M, Structural Analysis – A Unified classical and matrix Approach Chapman and Hall, New York.
- ii) Wang C.K. Intermediate structural analysis, McGraw Hill, New York.
- iii) Kinney Streling J. Indeterminate structural Analysis, Addison Wesley.
- iv) Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Company, New Delhi.
- v) Norfis C.H., Wilbur J.B. and Utkys. Elementary Structural Analysis, McGraw Hill International, Tokyo.

### List of Experiments:

- (i) Verification of Maxwell's theorem of reciprocal deflections with the help of a truss.
- (ii) Verification of Maxwell's theorem of reciprocal deflections for a beam.
- (iii) To determine experimentally the horizontal displacement of the roller end of a two hinged arch.
- (iv) To determine the horizontal thrust in a three hinged arch for a given system of loads experimentally and verify the same with calculated values.
- (v) Verification of frame using STAAD Pro Software.



Course Code: BCEP – 507

Course Name: Civil Lab

L	T	P	Credit
0	0	2	1

**Course Objectives:**

- 1) To make student conversant with the concepts of mix design of concrete.
- 2) To make student conversant with various tests performed on road materials.
- 3) To make student conversant with various tests performed on soil.

**Syllabus: List of Practical's:**

1. Mix design of concrete.
2. Job mix formula of bituminous aggregate mix by Marshall stability method.
3. Determination of bearing capacity of soil by Triaxial method.
4. Determination of bearing capacity of soil by plate load test.
5. Determination of bearing capacity of soil by SPT.
6. NDT using various methods for estimation of strength of old structure.

**Course Outcomes:**

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

- 1) Analyze & Design mix of concrete
- 2) Carry out Marshall Stability test on bitumen & determine its value.
- 3) Determine the bearing capacity of soil by various tests.
- 4) Student will be able to access residual strength of old existing building.



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Course Code: BCEL - 602

Course Name: Solid Wastes, Air & Noise Pollution

L	T	P	Credit
3	1	0	4

### Course Objectives:

- 1) To provide broad knowledge on various aspects of planning & implementation of a solid wastes management system in a city/ town.
- 2) To provide a broad knowledge on various sources & effects of air pollution, air pollutants, existing air quality standards in India, various techniques to reduce the air pollutants in atmosphere.
- 3) To provide a basic knowledge on sources, effects of noise pollution & also how to reduce the pollution.
- 4) To provide an insight into various existing laws on air, noise & solid wastes in India.
- 5) To provide a basic knowledge on environment impact assessment.

### Syllabus:

**Unit I: Solid Wastes:** Introduction, Classification, Municipal Solid Waste: Generation, Characterization (Physical, Chemical & Biological), Nuisance associate with solid wastes, Functional elements of solid waste management system, 3R policy, Waste reduction at source, On site storage - collection of waste at source, containers, bins, Material & resource recovery / recycling.

**Unit II:** Collection systems, Transportation of solid wastes, Routing & scheduling, Transfer stations, Transformations, Processing & Treatment options including Composting, Vermicomposting, Incineration, Refuse Derived Fuels, Pyrolysis, Biological digestion & Sanitary landfill, Existing solid waste management laws in India.

**Unit III: Air Pollution:** Sources and classification of air pollutants; Standards and guidelines for Air Quality Parameter, Existing air pollution laws in India, Effects of air pollutants on man, material, vegetation, art treasures. Air pollution disasters, Economic effects, Global effects, Introduction to Indoor air pollution.

**Unit IV:** Meteorology & Air Pollution, Factors influencing air pollution, wind roses, atmospheric stability, plume behavior, estimation of plume rise, Control of air pollution: types of equipments, settling chambers, cyclones, separators, filters, ESP, scrubbers/ wet collectors, towers, Gaseous pollution control equipments.

**Unit V: Noise Pollution:** Sources, Effects, Scales of noise, Noise standards, Noise rating systems, Sound level meter, Control & prevention of noise pollution, Existing noise pollution laws in India, Introduction to environmental impact assessment: Necessity, Process of impact assessment, case study.

### Course Outcomes:

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

- 1) Understand the basic concepts of solid waste management system.
- 2) Analyze the requirements of treatment & disposal of solid waste in a sustainable manner.

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- 3) Understand the basic concepts of air pollution, its effects & pollutant dispersion theory.
- 4) Analyze various techniques required to control the air pollution.
- 5) Acquire knowledge about noise pollution, its effects & its control.
- 6) Acquire knowledge about various existing environmental legislations in India.
- 7) Understand the basics of environmental impact assessment.

**Books Recommended:**

- 1) Rowe, Peavy & Tchobanoglous, Environmental Engineering, Tata McGraw Hill Publications.
- 2) M. N. Rao & H. V. N Rao, Air pollution & Control, Tata McGraw Hill Publications.
- 3) Iqbal H. Khan and Naved Ahsan, Text Book of Solid Wastes Management, CBS Publishers.
- 4) S.K. Garg, Sewage Disposal & Air Pollution Engineering, Khanna Publishers.

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Course Code: BCEL – 603

Course Title: Environmental Impact Assessment & Ethics

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To develop an understanding about the requirements of environment impact assessment in modern day.
- 2) To provide a broad knowledge on the process of environmental impact assessment.
- 3) To provide a broad knowledge on various methods used in impact assessment.
- 4) To provide a practical knowledge on how to carry out environmental impact assessment process through various case studies.
- 5) To provide an insight into various existing environmental laws in India

**Detailed Syllabus:**

**Unit I:** Environment and its components, Concept of Ecological imbalances, Carrying capacity and Sustainable development, EIA: Definitions, Necessity of EIA, Historical Evolution of EIA: Global, Indian EIA rules 1994 & 2006, Environmental clearance process in India, Step by step detailed procedure for carrying out EIA: Screening, Scoping, Baseline Studies, Impact Assessment, Public Consultation, Documentation, Mitigation, EMP, EIS, Life Cycle Assessment, Risk Assessment.

**Unit II: Environmental Impact Assessment Methodologies:** Characteristics of EIA Methods, Ad-hoc method, Checklist, Matrices, Networks, Overlays, Environmental Quality Index, Predictive Models, Comparative study of EIA Methodologies.

**Unit III: Prediction and assessment of impact on water & air environment:** Basic information of air & water quality, Data requirements for impact assessment, Existing standards for air & water quality (surface & subsurface), Identification of impacts, Prediction & assessment of impacts, Mitigation measures. Case Studies - Environmental Impacts of Road, Rail, Dam and thermal power projects.

**Unit IV: Prediction and assessment of impact on cultural & socio-economic environment:** Basic information on cultural resources like archaeological, historical structures, Cultural system, Basic information of socio-economic environment, Description of existing socio-economic environment, Identification of impacts, Prediction & assessment of impacts, Mitigation measures, R & R study.

**Unit V: Environmental Legislations:** List of prevalent environmental acts in India, Brief about provisions in Water Act 1974, Air Act 1981, EPA 1986, Objective of Ethics, Importance of Ethics, Environmental ethics in India, Environmental Audit: Introduction, Necessity, Types, and Process of audit.

**Course Outcomes:**

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

- 1) Understand the importance & concepts of carrying out EIA.
- 2) Acquire knowledge of current EIA process in India.

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- 3) Acquire knowledge of various methods & data requirements for conducting EIA.
- 4) Analyze Impact's associated with various components of environment.
- 5) Plan for mitigation of the impacts & monitor the mitigation measures.
- 6) Acquire knowledge about Environmental Legislation, Ethics & Environmental Audit.

**Books Recommended:**

- 1) Y. Anjaneyulu & Valli Manickam, Environmental Impact Assessment Methodologies, B S Publishers
- 2) O. V. Nandimath, Handbook of Environmental Decision Making in India: An EIA Model, Oxford University Press.
- 3) R. L. Canter, Environmental Impact Assessment, Mc Graw Hill International Publishers International Edition.
- 4) R. R. Barthwal, Environmental Impact Assessment, New Age International Publishers.

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Course Code: BCEL – 604

Course Name: Geotechnical Engineering - I

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To inculcate the basic knowledge of soil such as its identification and classification, determination of various engineering properties and its suitability as a foundation/subgrade material.
- 2) To develop an understanding of the relationships between physical characteristics and mechanical properties of soils by experimentally measuring them.
- 3) To explain role of water in soil behaviour and how soil stresses, permeability and quantity of seepage including flow net are estimated.
- 4) To determine shear parameters and stress changes in soil due to foundation loads & estimate the magnitude and time-rate of settlement due to consolidation.
- 5) To apply the principles of soil mechanics in stability analysis of slopes and settlement calculations.
- 6) To compute the lateral earth pressure, select size of retaining walls and ensure safety against external forces and moments.

**Syllabus:**

**Unit-I Basic Definitions & Index Properties:**

Definition and scope of soil mechanics, Historical development. Formation of soils. Soil composition. Minerals, Influence of clay minerals on engineering behavior. Soil structure. Three phase system. Index properties and their determination. Consistency limits. Classification systems based on particle size and consistency limits.

**Unit-II Soil Water and Consolidation:**

Soil water, Permeability Determination of permeability in laboratory and in field. Seepage and seepage pressure. Flownets, uses of a flownet, Effective, neutral and total stresses.

Compressibility and consolidation, Relationship between pressure and void ratio, Theory of one-dimensional consolidation. Consolidation tests, Fitting of curves. Normally and over consolidated clays. Determination of consolidation pressure settlement analysis. Calculation of total settlement.

**Unit-III Stress Distribution in Soils and Shear Strength of Soils:**

Stress distribution beneath loaded areas by Boussinesq and water guard's analysis. Newmark's influence chart. Contact pressure distribution.

Mohr - Coulomb's theory of shear failure of soils, Mohr's stress circle, Measurement of shear strength, Shear box test, Triaxial compression test, unconfined compression test, Value shear test, Measurement of pore pressure, pore pressure parameters, critical void ratio, Liquefaction.

**Unit - IV Stability of Slopes:**

Infinite and finite slopes. Types of slope failure, Rotational slips. Stress path. Stability curves. Effect of ground water. Selection of shear strength parameters in slope stability analysis. Analytical and graphical methods of stability analysis. Stability of Earth dams.

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## Unit – V Lateral Earth Pressure:

Active, passive and at rest conditions. Rankine, Coulomb, Terzaghi and Culmann's theories. Analytical and graphical methods of determination of earth pressures on cohesionless and cohesive soils. Effect of surcharge, water table and wall friction. Arching in soils. Reinforced earth retaining walls.

### Course Outcomes:

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

- 1) Understand the significance of the properties of soils, and also the experimental methods used to measure them.
- 2) Understand both the applications and limits of engineering methods commonly used to solve soil mechanics problems in Civil Engineering.
- 3) Recognize and be able to apply fundamental soil mechanics principles underlying common civil engineering applications.
- 4) Recognize behavior of soils in slopes, behind retaining structures and phenomena affecting foundation capacity and settlement.
- 5) Determine allowable bearing pressures and load carrying capabilities of different foundation systems.

### Reference Books:

- i) Soil Mech. & Found. Engg. By Dr. K.R. Arora – Std. Publishers Delhi
- ii) Soil Mech. & Found. By Dr. B.C. Punmia – Laxmi Publications, Delhi
- iii) Modern Geotech Engg. By Dr. Aram Singh-IBT Publishers, Delhi
- iv) Geotech Engg. By C. Venkatramaiah – New Age International Publishers, Delhi
- v) Soil Mech. & Found Engg. By S.K. Garg-Khanna Publishers, Delhi
- vi) Soil Testing for Engg. By T.W. Lambe-John Wiley & Sons. Inc.

### List of Practical's:

1. Moisture Content Determination. Oven Drying Method.
2. Grain Size Analysis – Mechanical Method.
3. Grain Size Analysis – Hydrometer Method.
4. Liquid & Plastic Limit Tests.
5. In-Place Density tests – Core Cutter Method, Sand Replacement Method.
6. Specific Gravity Tests.
7. Permeability Tests, Variable Head Method.
8. Compaction Test.
9. Unconfined Compression Test.
10. Direct Shear Test.
11. Triaxial Shear Test (Demonstration)
12. Consolidation test (Demonstration)
13. Visual classification test (Demonstration)

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Course Code: BCEL – 605

Course Name: Structural Design & Drawing – II (Steel)

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To learn IS 800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections.
- 2) To understand the behavior of steel structural components subjected to gravity loads.
- 3) To study the design of bolted and welded connections.
- 4) To study the behaviour and design of compression and tension members using simple and built-up sections.
- 5) To understand behaviour of flexural members and the design laterally restrained & unrestrained beams.
- 6) To design plate girders & stiffeners.
- 7) To use software's like STADD – PRO for design of tension & compression members.

**Syllabus:**

**Unit-I**

Various loads, Partial Load factors, Structural properties of steel, Design of structural connections – Bolted and Welded connections, eccentric connection. Codal provision.

**Unit-II**

Design of Tension members. Codal provision. Lug angles & Tension splices.

**Unit-III**

Design of Compression member, Design of columns-simple and compound, Lacings & Battens. Design of footings for steel structures, Slab base, gusseted base. Codal provision.

**Unit-IV**

Design of built up beams, web buckling and crippling, curtailment of flanges. Design of Laterally supported and unsupported beams, web buckling and crippling. Codal provision.

**Unit-V**

Design of plate girder. Curtailment of flanges, Design of stiffeners (bearing, Vertical and horizontal), Codal provision.

**Course Outcomes:**

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

- 1) Follow and apply relevant and upcoming BIS standards and design philosophies prevalent in the world.
- 2) Understand the structural behavior of different steel structural elements and their analysis.
- 3) Design welded connections for both axial and eccentric forces.

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- 4) Analyze the behaviour of bolted connections and design them.
- 5) Analyze and design different elements of steel structural elements under gravity loads and submit the designs in complete and concise manner.
- 6) Analyze and interpret the results using analytical tools and further plan design & detail different civil engineering structures.
- 7) Design a structure/component to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability as per the codal provisions

**Reference Books:**

- i) Design of steel structures by Arya & Azmani Nemchand & Bros, Roorkee
- ii) Design of steel structures by P. Dayaratnam
- iii) Design of steel structures by Ramchandra.

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Course Code: BCEL - 606

Course Name: Theory of Structures - II

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Course Code: BCEL - 606

Course Name: Theory of Structures - II

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To understand the analytical procedure related to the analysis of building frame by some classical methods viz. Kani's methods and approximate methods of analysis.
- 2) To study the multi storey frames subjected to gravity loads and lateral loads
- 3) To understand matrix method and its application for computer based analysis of structure.
- 4) To understand the influence line concepts for indeterminate structures
- 5) To develop the skill to deal with the problems of moving loads in the structures & their analysis techniques.
- 6) To understand the concepts of plastic analysis of structures.

**Syllabus:**

**Unit-I**

Moment distribution method in analysis of frames with sway, Analysis of box frames, analysis of beams and frames by Kani's methods.

**Unit-II**

Analysis of tall frames, Calculation of various loads including wind and earthquake loads, Introduction to Codal provisions for lateral loads. Approximate analysis of multistorey frames for vertical and lateral loads.

**Unit-III**

Matrix method of structural analysis: Force method and displacement method.

**Unit-IV**

Rolling Loads and Influence Lines

Maximum SF and BM curves for various types of Rolling loads, EUDL, Influence Lines for Determinate Structural Beams, Trusses, Three Hinged Arches.

**Unit-V**

Plastic analysis of beams and frames

**Course Outcomes:**

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

- 1) Understand the structural actions viz. rotations and displacements, especially in building frames subjected to vertical and lateral loadings.
- 2) Analyze building framing system and its components under the action of gravity and lateral loads and thereby developing database for the design of the structure.

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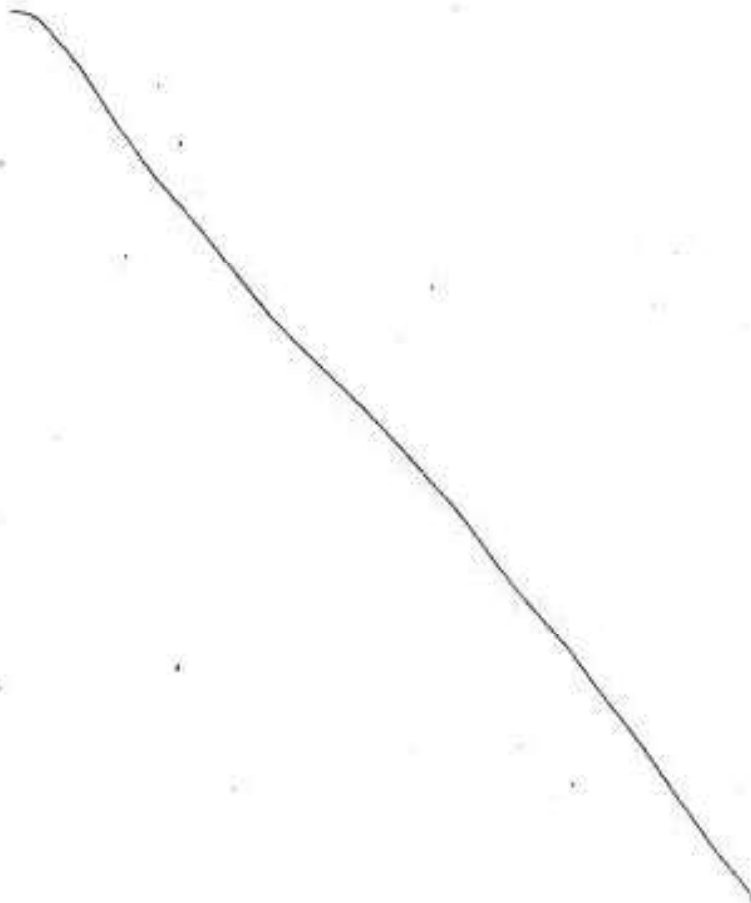
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- 3) Identify, formulate and solve engineering problems and to effectively use and apply the computer friendly structural analysis techniques viz. stiffness and flexibility methods to the field problems.
- 4) Deal with the problems of moving loads in the structures and their analysis techniques such as influence line diagram.
- 5) Understand the concepts of plastic analysis of structures.

**Reference Books:**

- i) Wang C.K. Intermediate structural analysis, McGraw Hill, New York.
- ii) Kinney Sterling J. Indeterminate structural Analysis, Addison Wesley.
- iii) Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Company, New Delhi.
- iv) Norris C.H., Wilbur J.B. and Utkys Elementary Structural Analysis, McGraw Hill International, Tokyo.
- v) Weaver W & Gere J.M. Matrix Methods of Framed Structures, CBS Publishers & Distributors, Delhi.



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Course Code: BCEP - 607  
Course Name: Minor Project - I

L	T	P	Credit
0	0	2	1

**Course Objectives:**

- 1) To develop an appreciation of civil engineering problems & have a feel of real life situations in planning & execution of projects.
- 2) To impart training of handling various types of civil engineering problems by use of conventional methods as well as software's.
- 3) To utilize the expertise in engineering to solve industry's technological problems.
- 4) To become innovative and professional in technology development, and system implementation.
- 5) To be able to function in their profession with social awareness and responsibility.
- 6) To be able to interact with their peers in industry and society as engineering professionals and leaders & inculcate a habit of working in a group.
- 7) Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Syllabus:**

Each candidate shall work on an approved project of a public building or any other civil engineering work and shall submit design and a set of drawings.

OR

Shall submit a detailed report of report of experimental work/software package on any specific problem of importance.

**Course Outcomes:**

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

- 1) Identify, formulate various engineering problems and to use techniques, skills & modern engineering tools necessary for engineering practice.
- 2) Design, work on a set of drawings and conduct experimental studies on various engineering problems.
- 3) Learn different software's and apply them in solving various civil engineering problems.
- 4) Understand the ethical and professional responsibility and to know how to write professional and concise technical reports.
- 5) Interact with other streams of engineering in multidisciplinary system to manage various issues.
- 6) Develop the habit of working in group.
- 7) Develop innovative skills.



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ANNEXURE - XI

Course Code: 11040#6 MSF

Course Name: Water Resources Engineering

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To understand the water requirements of various types of crops.
- 2) To understand the different types of irrigation systems.
- 3) To plan the reservoir systems as per the requirements.
- 4) To understand the concepts of Khosla's and Bligh's theory & its applications.
- 5) To understand the concepts of Lacey's and Kennedy theory for design of canal systems.
- 6) To develop an understanding of various components of hydrological cycle, their behaviors & factors affecting it & solve problems on measurement on rainfall, infiltration, evaporation.
- 7) To understand concepts of Hydrometry & ground water hydrology.
- 8) To discuss the importance of estimation of runoff, analysis of rainfall data and various hydrographs and analyze various problems of runoff using various hydrograph theories.
- 9) To develop an understanding of various methods of flood estimation in general & flood frequency.

**Syllabus:**

**Unit-I Irrigation Water Requirement and Soil Water Crop Relationship:**

Irrigation, Definition, Necessity, Advantages and disadvantages, Type and methods, Irrigation development.

Soil: Types and their occurrence, Suitability for irrigation purposes, Wilting, Coefficient and field capacity, Optimum water supply, Consumptive use and its determination. Irrigation methods - surface and subsurface, Sprinkler and drip irrigation.

Duty of water, factors affecting duty and methods to improve duty, Suitability of water for irrigation, Crops and crop seasons, Principal crops and their water requirement, Crop ratio and crop rotation, Intensity of irrigation, Water logging-causes, effects & its prevention.

**Unit - II Reservoir Planning and Canal Irrigation**

Types of reservoir, Reservoir planning, Estimation of storage capacity by mass curve analyses, Economical height of dam, Reservoir sedimentation, Canal systems, Planning and layout of canal systems, Regime concept and tractive force method of channel design, Channel losses, Design of unlined and lined canals, Kennedy's and Lacey's silt theories, Typical canal section, Water-logging: Causes and effects, Remedial measures, Salinity, Land reclamation and Drainage.

**Unit - III Diversion works and Canal Regulation Structures**

Elements of diversion works, Type of weirs and barrages, Weir design for surface and sub-surface flow, Bligh's, Lane's and Khosla's theories, Silt excluders and Silt ejectors. Canal regulation structure like Head & Cross regulations, falls, Escapes, Outlets, Their Need, Functions sketches.

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**Unit - IV**

**Hydrology:** Definition, Hydrological Cycle, Precipitation, Evaporation, Infiltration, Runoff, Estimation of Runoff, Empirical Formulae, Rainfall-Runoff relationships, Hydrometry, Methods of Stream Gauging, Rating Curves, Ground Water: Elements of Ground water Hydrology, Well Hydraulics, Equations of Ground Water flow, Solutions and applications.

**Unit - V**

**Hydrographs & Hyetographs, Hydrographs analysis, Unit Hydrographs, Methods of constructing, Unit Hydrographs, S-curve Hydrograph, Synthetic unit Hydrograph, Flood and its estimation by different methods.**

**Course Outcomes:**

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

- CO 1: Analyse various requirements for an efficient irrigation project.
- CO 2: Design different components of irrigation system using different theories.
- CO 3: Plan an efficient, economical & safe irrigation system.
- CO 4: Explain the concept of hydrology and hydrograph
- CO 5: Apply basic principles for measurement & forecasting of rainfall & runoff.
- CO 6: Analyse runoff hydrograph by various methods.

**Text Books:**

1. Engineering Hydrology, K. Subramanya, Tata McGraw Hill Publ. Co. 4<sup>th</sup> edition, 2013
2. Hydrology & Water Resources Engineering, S. K. Garg, Khanna Publishers, 2016
3. Irrigation Engineering & Hydraulic Structures, Santosh Kumar Garg, Khanna Publishers, 2017
4. Irrigation, Water Power & Water Resources Engg., K.R. Arora, Standard Publishers Distributors, 2010

**Reference Books:**

1. Engineering Hydrology, J. NEMEC, Prentice Hall, 1972
2. Hydrology for Engineers, Linsley, Kohler, Paulus, Tata Mc GrawHill, 2014
3. Engineering Hydrology, H. M. Raghunath, New Age International Publishers, 5<sup>th</sup> edition, 2015.
4. Irrigation, Water Resources & Water Power, Dr. P.N. Modi, Standard Book House, 9<sup>th</sup> edition, 2014
5. Irrigation Engineering by Varshney & Gupta, Vol I & II, Nem chand Publishers, 2007.

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**Course Code: 110302**  
**Course Name: Building Planning & Design**

L	T	P	Credit
3	1	0	4

**Course Objectives:**

1. To make aware the student with sustainability aspects of building.
2. To impart knowledge to students about significance of building bye-laws & rules & regulation regarding building planning
3. To impart knowledge to students regarding specific consideration required to be considered under Indian condition for planning & designing of building.
4. To appraise students about the rules & consideration to get adequate ventilation, lighting & Sound insulation for improved energy efficiency of building.
5. To make students understand about various essential requirements of different type of building.
6. To make aware students about green building rating for enhanced sustainability

**Syllabus:**

**Unit I**

Natural Environment & Built environment, Ecology, Ecosphere - sustainable development, Dimensions of sustainability. Built Environment & liveability, integrated approach in design, challenges in sustainable development. Green environment, expectations from green building. IGBC, USGBC, LEED - GRIIIA, SYA, GRIIIA.

**Unit II**

Building Bye - laws, Functions of local authority, Terminology i.e. (Building line, control line, FAR, light plane etc.) Principles underlying building bye- laws, classification of building, requirements of parts of Buildings, site section of building, orientation, factors affecting orientation, orientation criteria's for Indian conditions. Provisions of NBC

**Unit III**

Principles of planning of buildings (Aspects, prospect, Furniture requirement, rooming, grouping, privacy circulation etc.), Principles of architectural composition (Unity, contrast, scale, proportion, balance, Rhythm, character, etc.), Massing, Sun and the Building, Sun path, Sun shading & devices, Design of sun shades.

**Unit IV**

Thermal insulation, Heat transfer in building, Thermal insulation materials, methods of thermal insulation ventilation: natural & artificial, necessity & functional requirement of ventilation, system of ventilation, types of mechanical ventilation, air conditioning, functional requirement of air conditioning, Essentials of air conditioning, acoustic and sound insulation, Behavior of sound acoustical defects. Sabine formula, acoustical design of various spaces, sound insulation methods & materials, illumination (natural & artificial).

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## Unit V

Design and planning consideration for various types of building i.e. Residential Building, Education buildings, Hospitals & Dispensaries, Hotels, Commercial building, recreational buildings, government offices & other, standards specified by Bye-laws, various aspects of sustainability & energy efficiency applied to various types of Building, green building concept applied to various types of building.

### Course Outcomes:

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

- CO 1: Explain basics of building planning & design.
- CO 2: Describe sustainability principle, by laws & characteristics of thermal and sound insulation.
- CO 3: Apply sustainability concepts & principles in planning & design of buildings.
- CO 4: Evaluate environmental, sustainable & safety aspects of a building.
- CO 5: Plan different types of buildings as per by laws & codal provisions.

### Text Books:

1. Building Drawing (Built Environment), Sah, Kale and Pathi, Tata McGraw hill, 4<sup>th</sup> edition, reprint 2007
2. Building Planning, Designing and Scheduling, Gurucharan Singh, Standard Publisher, distribution, 2009
3. Building Design and Drawing, Mallik and Meo, Computech Publication Ltd New Asian; 5<sup>th</sup> edition 2009

### Reference Books:

1. Building Design and drawing, Y S Sane, Standard Publisher, 2006
2. National Building Codes (Latest Edition), 2016 by Bureau of Indian Standards (Third Revision)
3. Building Construction, B.C. Punmia, Laxmi Publication, 11<sup>th</sup> edition, 2016

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Course Code: 110303

Course Name: Building Materials & Construction

L	T	P	Credit
3	0	2	4

**Course Objectives:**

1. To study the properties of concrete ingredients i.e. cement, Sand and coarse aggregate by conducting different tests.
2. To select of different types of admixtures to improve the properties of concrete for different field applications.
3. To conduct the field and laboratory tests on concrete in fresh and hardened state.
4. To provide knowledge about various types of bricks, stones, woods & timber, ferrous & non ferrous construction material & their applications.
5. To provide knowledge on design of foundation, including selection of appropriate foundation.
6. To understand laying & construction of brick & stone masonry and various methods of damp proofing etc.
7. To provide knowledge about stairs, floors & roofs in various types of buildings

**Syllabus:**

**Unit-I**

Types of Foundation & its design: masonry construction, masonry classification, stone v/s brick masonry, joints in stone masonry, brick masonry (bonds in brick masonry, characteristics of bonds, type of bonds), typical structures in brickwork, Damp prevention (causes, effects, control & prevention techniques, material used for damp proofing), **Anti termite treatment, water proofing treatment, Arches & lintels, stair & stair case, (types & design of stair case), Types of floor & flooring, Roof & roof covering.**

**Unit- II**

Ingredients of Concrete: Portland cement Chemical composition of cement, Hydration of cement, setting of cement, tests on physical properties of cement. Types of Portland cement - Ordinary Portland cement - Rapid Hardening Portland cement - low heat Portland cement- Sulphate Resisting cement - Portland Blast furnace cement- Super Sulphated cement- Portland Pozzolana cement and Pozzolanas: Fly ash; use of pozzolanas, white cement, Expansive cements - High alumina cement.

Aggregates: General classification of aggregates, natural and artificial aggregates, particle shape and texture, bond of aggregate, strength of aggregate, Mechanical properties of aggregate, specific gravity, Bulk density, porosity and absorption of aggregate, moisture content of aggregate, Bulking of sand deleterious substances in aggregates, organic impurities. Soundness of aggregates, Alkali-aggregate reaction, Alkali carbonate reaction, sieve analysis - Grading curves, Fineness modulus, Grading requirements, Grading of fine and coarse aggregates and Gap graded aggregates. Thermal properties of aggregates.

Admixtures: Introduction, functions of admixtures, classification of admixtures, Accelerators, Retarders, Water Reducing Agents, Super plasticizers.

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### Unit-III

**Fresh and Hardened Concrete:** Fresh Concrete, Workability of concrete, factors affecting workability, measurement of workability using slump test, Compaction factor test, Flow test, Vee-Bee Test, Ball penetration test, Nasser's "K"- probe test, Segregation and Bleeding of concrete, Mixing of concrete, Vibration of concrete, Different types of mixers and vibrators. Concreting in Hot weather and Cold weather.

**Hardened Concrete:** Compressive & Flexural strength of concrete, Stress and strain characteristics of concrete, drying shrinkage of concrete, Creep of concrete, Permeability and durability of concrete, Fire resistance of concrete, Thermal properties of concrete. Micro-cracking of concrete, methods of curing, Influence of temperature on strength, Fatigue & Impact strength of concrete.

### Unit IV

Bricks (classification, characteristics, manufacturing, testing, and types), Stones (classification, Quarrying, seasoning characteristics, testing, selection & uses, preservation), Wood & Timber (Classification, Structure & characteristics, seasoning and its methods, defects & diseases, preservation & various treatment testing), wood products and their applications.

### Unit V

Mortar (Classification, characteristics, functions of ingredients). Types of mortar and their uses grout, guniting, ferrous material (Pig iron, CI, Mild steel, wrought iron, stainless steel, compositions & proposition). Reinforced steel bars (classification, types, designation), Aluminium (its alloys & uses). Copper (its alloys & uses), Ceramics (classification, properties, commercial forms), Paint varnishes & enamels (types, composition, method of application, defects)

### Course Outcomes:

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

- CO 1: Explain the basic elements of buildings, engg. materials & construction.
- CO 2: Evaluate the properties of various materials like cement, aggregate, concrete, admixture, brick, stone etc.
- CO 3: Distinguish the suitability of building materials in the construction of elements of buildings.
- CO 4: Evaluate various types of concrete in building construction accordingly.
- CO 5: Apply various techniques for finishing & protection works of various elements of building.

### Text Books:

1. Concrete Technology, M. L. Gambhir, Tata McGraw Hill education Pvt. Ltd., 5<sup>th</sup> edition 2013
2. Concrete Technology, M.S. Shetty, S. Chand Publications, 2006
3. Building Materials, M. L. Gambhir, Tata McGraw Hill education Pvt. Ltd., 2017
4. Building Construction, B.C. Punmia, A.K. Jain, Laxmi Publishers New Delhi, 2016

### Reference Books:

1. Properties of Concrete, Neville, ELBS, Pearson Education, 5<sup>th</sup> edition 2012
2. Building Material, S.K. Duggal, New Age Publishers, 4<sup>th</sup> revised edition 2012

### List of Experiments:

1. Determination of properties of cement, sand & aggregate.
2. Determination of workability of concrete by slump test.
3. Determination of workability of concrete by compacting factor apparatus.
4. Determination of workability by Vee Bee consistometer.

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5. Water absorption & efflorescence of brick.
6. Field testing on bricks.
7. Crushing strength of bricks.

Upon completion of practical course, the students will be able to:

- CO 1: Determine the properties of cement, sand & aggregate as per IS code.
- CO 2: Determine the workability of concrete for suitability of concrete mix in different construction works.
- CO 3: Evaluate compressive strength of various concrete mixes.
- CO 4: Determine physical properties of brick by experiment and practice accordingly.
- CO 5: Examine the properties of the cement mortar for various elements of the buildings

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Course Code: 110304  
Course Name: Surveying

L	T	P	Credit
3	0	2	4

**Course Objectives:**

- 1) To understand the working of theodolite.
- 2) To understand the determination of heights & distances by tacheometry.
- 3) To understand various types of curves used in practice.
- 4) To provide knowledge on setting out civil engineering works & detailed field surveying.
- 5) To understand the concepts of photographic surveying & GIS.

**Syllabus:**

**Unit I**

Traversing by theodolite, Fieldwork checks, traverse computations, latitude and departures, computations of co-ordinates, plotting & adjustment of traverse. Omitted measurements. Trigonometrical levelling, precise levelling.

**Unit II: Tacheometry**

Tacheometric systems and principles, stadia system, uses of anallactic lens, tangential system, substance system, instrument constant, field work reduction, direct reading tacheometers, use of tacheometry, accuracy.

**Unit III: Curves:**

Classification and use, elements of circular curves, setting out curves by offsets and by theodolites, obstacles and special problems, compound curves, reverse curves, transition curves, cubic spiral and lemniscate, vertical curves, computation and setting out.

**Unit IV: Control Surveys**

Providing frame work of control points, triangulation principle, forms of framework, reconnaissance survey, selection and making of stations, Control line, baseline measurement & corrections, flexible apparatus and corrections, computation of sides, precise traversing.

**Unit V: Photographic Surveying & GIS:**

Principles of photographic surveying – aerial photography, tilt and height distortions, uses, Basics of GIS & GPS.

**Course Outcomes:**

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

- CO 1: Explain the techniques used for linear & angular measurements in surveying.
- CO 2: Analyse different geodetic methods of survey such as triangulation, trigonometric levelling, tachometry, photographic survey & GIS.
- CO 3: Apply methods in control surveys.
- CO 4: Apply tachometry in traverse computations.
- CO 5: Apply various methods for setting curves, area & volume computations.

**Text Books:**

1. Surveying Vol. I, II, III, B.C. Punmia, Laxmi Publications New Delhi, 2016
2. Fundamentals of surveying, S.K. Roy, Prentice Hall of India New Delhi, 2<sup>nd</sup> edition 1999

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### Reference Books:

1. Surveying theory & Practice, R.I. Devise, Mc Graw Hill, New York, 4<sup>th</sup> revised edition 2001
2. Plane & Geodetic surveying Vol. I & II, David Clark & J Clendinning, Constable & C. London, 2017
3. Surveying Vol. I & II, K.R. Arora, Standard book House, New Delhi, 13<sup>th</sup> edition 2016

### List of Experiments:

1. Measurement of horizontal and vertical angle by Vernier Theodolite.
2. Theodolite traversing.
3. Determination of R.L. of a point whose base is accessible by Trigonometrical levelling.
4. Determination of R.L. of a point whose base is inaccessible by Trigonometrical levelling.
5. Determination of tachometric constants in field.
6. Determination of height & distance by using Tangential tachometry.
7. Determination of height & distance by Stadia method of tachometry.
8. Measurement of base line by using Substance Bar.
9. Setting out of a simple circular curve by using Rankine's method.
10. Setting out of a simple circular curve by using Offset from the chord produced or deflection distance.
11. Determination of horizontal & vertical position of a point by Total Station.
12. Traversing by Total Station.

Upon completion of practical course, the students will be able to:

- CO 1: Follow the guidelines for field surveying.
- CO 2: Follow the working principles of survey instruments for measurements.
- CO 3: Measure horizontal & vertical angle by theodolite for traversing and levelling.
- CO 4: Determine tachometric constants for linear measurements by tacheometry.
- CO 5: Create a simple circular curve by using Rankine's method for alignment.

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Course Code: 110305  
Course Name: Strength of Materials

L	T	P	Credit
3	0	2	4

**Course Objectives:**

- 1) To understand the concepts of simple and compound stresses and strains.
- 2) To understand the behaviour of elastic materials in bending, shear and torsion.
- 3) To understand the stability behaviour of long columns under axial load.
- 4) To understand the power transmission by shaft.
- 5) To understand stresses & strain developed in storage vessels
- 6) To calculate stresses / strain in statically indeterminate structures.

**Syllabus:**

**Unit-I**

**Stress and Strains:** Concept of Elastic body, stress and strain. Hooke's law various types of stress and strains. Elastic constants and their relation Stresses in compound bars, composite and tapering bars, temperature stresses.

Two-dimensional stress system. Normal and tangential stresses, Principal Planes, Principal Stresses and strains. **Mohr's circle of stresses.** Strain energy and theories of failure.

**Unit - II**

**Theory of simple bending:** Concept of pure bending and bending stress, equation of bending, Neutral axis, Section-Modulus, Bending stress distribution across a section, Shear Stresses in Beams, beams of uniform strength, shear centre.

**Unit-III**

**Torsion of Shafts:** Concept of pure torsion, Torsion equation, Determination of shear stress and angle of twist of shafts of circular section, Hollow circular shafts. Combined bending and torsion. Open and closed springs, leaf spring and spiral spring.

**Pressure Vessels:** Thin cylinders and spheres. Stress due to internal pressure. Change in diameter and volumes.

**Unit-IV**

**Columns and Struts:** **Euler's buckling load for uniform section,** various end conditions. Slenderness Ratio. Merchant Ranking formulae, Eccentric loading on columns.

**Unit-V**

Deflection of statically determinate structure by Geometrical methods & Introduction of method of virtual work.

**Course Outcomes:**

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

**CO 1:** Explain the concepts of stress, strains, bending, deflection, buckling & torsion.

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**CO 2:** Explain various theories for determining stress, buckling of columns & deflections of structures.

**CO 3:** Apply various theories for determining stress, buckling of columns & deflections of structures.

**CO 4:** Evaluate the stresses in bending, shear and torsion.

**CO 5:** Analyse various sections for stresses, strain, bending, torsion, buckling & deflections.

**Text Books:**

1. Strength of Materials, Sadhu Singh, Khanna Publishing, 1<sup>st</sup> edition 2016
2. Strength of Materials, S. Ramamrutham, R. Narayanan, Dhanpat Rai Publishing Company, 18<sup>th</sup> edition 2014
3. Strength of Materials, R. K. Bansal, Laxmi Publication; 6<sup>th</sup> edition 2018

**Reference Books:**

1. Strength of Materials, Timoshenko, Publisher CBS, 3<sup>rd</sup> edition 2004
2. Strength of Materials, Higdon Style, Publisher Wiley, 3<sup>rd</sup> edition 1978
3. Strength of Materials Vol. I & II, B. C. Punmia, Laxmi Publication, 10<sup>th</sup> edition 2018
4. Mechanics of Materials, R.C. Hibbler, Pearson Publication, 2016
5. Mechanics of Materials, J. M. Gere & B.J. Goodno, Cengage Publisher, 8<sup>th</sup> edition 2014

**List of Experiments:**

1. Impact Test
2. Brinell Hardness Test
3. Behaviour of columns with Different End Conditions
4. Tensile test
5. Compression test
6. Flexure test
7. Shear test

Upon completion of practical course, the students will be able to:

**CO 1:** Evaluate properties of material by impact test.

**CO 2:** Evaluate properties of material by hardness test.

**CO 3:** Evaluate properties of material by tensile test.

**CO 4:** Determine compressive & flexural strength of materials.

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Course Code: 110306  
Course Name: Software Lab

L	T	P	Credit
0	0	2	1

**Course Objectives:**

- 1) To draw plan, elevation & section of various components of a building.
- 2) To prepare sketches of various components of building like doors, windows etc.
- 3) To expose students to use software's like AutoCAD in civil engineering drawing.

**Syllabus:**

**List of Experiments:**

1. One drawing sheet containing Foundations and Footing using AutoCAD
2. One drawing sheet containing Doors, Windows, Ventilators using AutoCAD
3. One drawing sheet containing Lintels, Trusses and Arches etc. using AutoCAD
4. One drawing sheet containing detailed planning of one/two room residential building (Common to all students)
5. Drawing sheets one each of residential building using AutoCAD
6. One Drawing sheet of Institutional / Commercial building / Hospital etc. using AutoCAD
7. Sketches of various building components i.e. masonry, brick / stone, floors, roof & roof covering

**Course Outcomes:**

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

- CO 1: Attempt to draw different components of a building.
- CO 2: Produce plan, elevation & section of various components of a residential and institutional building.
- CO 3: Use AutoCAD software in civil engineering drawing.
- CO 4: Prepare drawing sheets of various types of buildings like residential, institutional, commercial etc

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Course Code: 110308

Course Name: Summer Internship Project - I

L	T	P	Credit
0	0	4	2

**Course Objectives:**

- 1) To encourage students to read, study & understand different topics of civil engineering.
- 2) To make student acquire good oral & written communication skills.
- 3) To promote the habit of lifelong learning

**Syllabus:**

Each candidate shall have to undergo 15 days in-house summer internship at the institute after the completion of their 2<sup>nd</sup> Semester exams (in summer vacations). Candidate can choose from various modules which are offered by the institute and after successful completion of internship they have to submit detailed report.

**Course Outcomes:**

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

- CO 1: Observe various activities in field.
- CO 2: Examine the utility of general and specific equipments for construction.
- CO 3: Differentiate the construction projects individually and in team.
- CO 4: Develop the writing and communication skills for various engineering problems.
- CO 5: Adapt lifelong learning for benefit of society.

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Course Code: 110402

Course Name: Geotechnical Engineering

L	T	P	Credit
2	1	2	4

**Course Objectives:**

- 1) To inculcate the basic knowledge of soil such as its identification and classification, determination of various engineering properties and its suitability as a foundation/ subgrade material.
- 2) To develop an understanding of the relationships between physical characteristics and mechanical properties of soils by experimentally measuring them.
- 3) To explain role of water in soil behaviour and how soil stresses, permeability and quantity of seepage including flow net are estimated.
- 4) To determine shear parameters and stress changes in soil due to foundation loads & estimate the magnitude and time-rate of settlement due to consolidation.
- 5) To apply the principles of soil mechanics in stability analysis of slopes and settlement calculations.
- 6) To explain various types of foundations.

**Syllabus:**

**Unit-I Basic Definitions & Index Properties:**

Introduction-Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Basic Definitions and their relationships - Soil as three-phase system, Index properties and their determination. Consistency limits. Classification systems based on particle size and consistency limits. Clay mineralogy & their Influence on engineering behavior, Expansive soils, their Characteristics & Challenges.

**Unit-II Permeability, Seepage and Consolidation:**

Darcy's law & its validity, Determination of coefficient of permeability: Laboratory methods: constant-head & falling-head method. Effective and total stresses, Effect of water table & capillary action. Seepage pressure, Quick sand condition. Compressibility and consolidation, Relationship between pressure and void ratio, Theory of one-dimensional consolidation. Consolidation tests, Fitting of curves. Normally and over consolidated clays. Determination of consolidation pressure settlement analysis. Calculation of total settlement.

**Unit-III Stress Distribution in Soils and Shear Strength of Soils:**

Stress distribution beneath loaded areas by Boussinesq and Westergaard's analysis. Newmark's influence chart. Contact pressure distribution.

Mohr - Coulomb's theory of shear failure of soils, Mohr's stress circle, Measurement of shear strength, Shear box test, Triaxial compression test, unconfined compression test, Value shear test, Measurement of pore pressure, pore pressure parameters, critical void ratio, Liquefaction.

**Unit - IV Stability of Slopes & Earth Pressure:**

Infinite and finite slopes. Types of slope failure, Stress path. Stability curves. Effect of ground water, Analytical and graphical methods of stability analysis.

Earth Pressure at active, passive and at rest conditions, Rankine, Coulomb, Terzaghi and Culmann's

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theories. Analytical and graphical methods of determination of earth pressures on cohesionless and cohesive soils. Effect of surcharge, water table etc

#### Unit - V Soil Foundations

**Shallow Foundation** - Types of foundations. Bearing capacity of foundation on cohesionless and cohesive soils. General & local shear failures. Factors affecting bearing capacity. Theories of bearing capacity - Terzaghi, Vesic, Skempton, Meyerhof and I.S. code on bearing capacity.

**Deep Foundation** - Pile foundation, Types of piles, estimation of individual and group capacity of piles in cohesionless and cohesive soils. Static and dynamic formulae. Settlement of pile group, Negative skin friction. Under Ream Piles, Plate load test

#### Course Outcomes:

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

- CO 1: Evaluate different properties of soil, types of foundations and its classification.
- CO 2: Examine the flow and shear parameters & their effects on various types of soil.
- CO 3: Determine the stress distribution & shear strength parameters of soil by various methods.
- CO 4: Analyse the stability of slopes, earth pressures & retaining walls using analytical methods.
- CO 5: Evaluate suitable foundation system for various site conditions.

#### Text Books:

1. Soil Mech. & Found. Engg., Dr. K. R. Arora, Std. Publishers Delhi, 7<sup>th</sup> edition 2014
2. Soil Mech. & Foundation, Dr. B. C. Punmia, Laxmi Publications, Delhi, 16<sup>th</sup> edition 2017
3. Soil Mech. & Found Engg., S. K. Garg, Khanna Publishers, Delhi, 1st edition, 2003
4. Basic & Applied Soil Mechanics, Gopal Ranjan & ASR Rao, New Age International Publisher, 2016

#### Reference Books:

1. Modern Geotech Engg., Dr. Aram Singh, IBT Publishers, Delhi, 8<sup>th</sup> edition, 2016
2. Geotech Engg., C. Venkatramiah, New Age International Publishers, Delhi, 16<sup>th</sup> edition, 2018
3. Soil Testing for Engg., T.W. Lambe, John Wiley & Sons. Inc., 1969

#### List of Experiments:

1. Moisture Content Determination. Oven Drying Method.
2. Grain Size Analysis - Mechanical Method.
3. Grain Size Analysis - Hydrometer Method.
4. Liquid & Plastic Limit Tests.
5. In-Place Density tests - Core Cutter Method, Sand Replacement Method.
6. Specific Gravity Tests.
7. Permeability Tests, Variable Head Method.
8. Compaction Test.
9. Unconfined Compression Test.
10. Direct Shear Test.
11. Triaxial Shear Test (Demonstration)

Upon completion of practical course, the students will be able to:

- CO 1: Check physical properties of soil.
- CO 2: Check strength properties of soil.
- CO 3: Differentiate the flow properties and stresses of soil.
- CO 4: Check shear strength of soil.

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Course Code: 110403  
Course Name: Fluid Mechanics - I

L	T	P	Credit
2	1	2	4

**Course Objectives:**

- 1) To understand fluid properties and concept of fluid continuum.
- 2) To understand the concepts of kinematics & dynamics of fluid flow.
- 3) To apply fluid flow principles to various fluid flow problems.
- 4) To understand the mechanism of fluid measurement.
- 5) To understand the method of simulation & dimensional analysis.
- 6) To understand the concepts of laminar flow.

**Syllabus:**

**Unit I**

Review of Fluid Properties: Engineering units of measurement, density, specific weight, specific volume, specific gravity, surface tension, capillary, viscosity, bulk modulus of elasticity, pressure and vapour pressure.

Fluid Statics: Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, manometers, Forces on plane and curved surfaces (Problems – gravity dams and Tainter gates), buoyant force, Stability of floating and submerged bodies, Relative equilibrium.

**Unit II**

Kinematics of Flow: Types of flow-ideal & real, steady and unsteady, uniform & non-uniform, one, two and three dimensional flow, path lines, streamlines, streamlines and stream tubes, continuity equation for one and three dimensional flow, rotational & irrotational flow, circulation, stagnation point, separation of flow, sources & sinks, velocity potential, stream function, flownets - their utility & method of drawing flownets.

**Unit III**

Dynamics of Flow: Euler's equation of motion along a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow, momentum equation, forces of fixed and moving vanes, velocity triangles.

Fluid Measurements: Velocity measurement, flow measurement (Orifices, nozzles, mouth pieces, orifice meter, Nozzle meter, venturimeter, weirs and notches).

**Unit IV**

Dimensional Analysis and Hydraulic Similitude: Dimensional analysis, dimensional homogeneity, use of Buckingham-pi theorem, calculation of dimensionless numbers, similarity laws, specific model investigations (submerged bodies, partially submerged bodies, weirs, spillways, etc.)

**Unit V**

Laminar Flow: Introduction to laminar, transition & turbulent flow, Reynolds experiment & Reynolds number, relation between shear & pressure gradient, laminar flow through circular pipes, laminar flow between parallel plates, laminar flow through porous media, stokes law, Bach wash processing, Instability of laminar flow to turbulent flow.

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### Course Outcomes:

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

- CO 1: Define various fluid properties & states of fluid.
- CO 2: Apply principles of fluid flow & dimensional analysis.
- CO 3: Solve fluid flow problems.
- CO 4: Analyze characteristics of fluid at rest, fluid at motion & dimensionless numbers.
- CO 5: Discriminate different types of fluid flow, measurement techniques & principles.
- CO 6: Apply the concepts of laminar flow in solving various fluid flow problems.

### Text Books:

1. Fluid Mechanics, Modi & Seth, Standard Book House, Delhi, 21<sup>st</sup> edition, 2018.
2. Fluid mechanics, Girde & Mirazgaonkar, SCI Tech Publishers, 2019
3. Fluid Mechanics, R.K. Bansal, Laxmi Publishers, 2015

### Reference Books:

1. Fluid Mechanics, A.K. Jain, Khanna Publishers, Delhi, 2014
2. Fluid Mechanics, Streeter, McGraw Hill Publishers, 9<sup>th</sup> edition, 2017

### List of Experiments:

1. Determination of viscosity of fluid by redwood viscometer
2. Determination of metacentric height of floating body
3. Calibration of Venturimeter
4. Determination of  $C_c$ ,  $C_d$ ,  $C_v$  of Circular Orifice
5. Calibration of Mouthpiece
6. Calibration of Orifice Meter
7. Reynolds experiment for demonstration of stream lined & turbulent flow
8. Determination of Friction Factor for a pipe
9. Verification of Stoke's law.

Upon completion of practical course, the students will be able to:

- CO 1: Differentiate between different flow measurements devices.
- CO 2: Notice flow through pipes & fall velocity of particle.
- CO 3: Correct the instrumental errors.
- CO 4: Apply Stoke's law to calculate terminal velocity.

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**Course Code: 110404**  
**Course Name: Structural Analysis**

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To develop an understanding of the behavior of structure under serviceability load.
- 2) To understand the mechanics of the material behavior of different type of structures.
- 3) To understand the concepts of analysis of indeterminate structures by various classical methods.
- 4) To make student aware of different methods of structural analysis.

**Syllabus:**

**Unit-I**

Deflection of beams: Double Integration method, Area Moment Method and Slope - Deflection Method, Beam of variable cross section,  $M/EI$  diagram, Conjugate Beam Method.

**Unit-II**

Virtual work and Energy Principles: Principles of Virtual work applied to deformable bodies, Maxwell's Reciprocal theorems, Energy theorems, Application to pin jointed frames only.

**Unit - III**

Indeterminate Structures - I: Static and Kinematics indeterminacy, Analysis of Fixed and continuous beams by Theorem of three moments, Effect of sinking and rotation of supports.

**Unit-IV**

Indeterminate Structures - II: Analysis of beams and analysis of frames (with and without sway) by slope Deflection method.

**Unit-V**

Moment Distribution Method: Moment distribution method for analysis of beams and analysis of frames (without sway) Three hinged arches of different shapes, Eddy's Theorem, Two Hinged and Fixed Arches

**Course Outcomes:**

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

- CO 1: Classify different type of structures based on support conditions.
- CO 2: Explain various methods & principles for analysis of structures.
- CO 3: Apply various methods & principles for structural analysis.
- CO 4: Analyse various structures using various methods, principles & theorems.
- CO 5: Evaluate different methods of structural analysis.

**Text Books:**

1. Basic Structural Analysis, Reddy C. S., Tata McGraw Hill Publishing Company, 2017
2. Theory of Structures, S. Ramamrutham, R. Narayanan, Dhanpat Rai Publications, 9<sup>th</sup> edition, 2014
3. Theory of Structures, B.C. Punmia, Laxmi Publications, 2017

**Reference Books:**

1. Structural Analysis - A Unified classical and matrix Approach, Ghali A & Neville M, Chapman and Hall, New York, 6<sup>th</sup> edition, 2009

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2. Intermediate structural analysis, Wang C.K., McGraw Hill, New York, 1984
3. Structural Analysis, Aslam Kassimali, C. L. Publisher, 2014
4. Structural Analysis, R. C. Hibbler, Pearson Publication, 2017

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Course Code: 110407  
Course Name: Survey Practice Lab

L	T	P	Credit
0	0	4	2

Syllabus:

Field Work:

- 1 Profile leveling & cross sectioning
- 2 Prepare contour map by using Tachometric method
- 3 Locating details by Plane Table surveying
- 4 Setting out of simple circular curves
- 5 Triangulation – Adjustment of quadrilateral by least square method
- 6 Use of Total Station in surveying

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

- CO 1: Observe topographical characteristics.  
CO 2: Differentiate methods to perform ground survey.  
CO 3: Prepare longitudinal & cross section profiles  
CO 4: **Develop contour map by using tachometer & total station.**  
CO 5: Prepare the details of features using Plane table surveying.  
CO 6: Produce a simple circular curve by using Rankine's method for alignment.

Reference Books:

1. Surveying Vol. I, II, III, B.C. Punmia, Laxmi Publications New Delhi, 2015
2. Surveying Vol. I & II, K.R. Arora, Standard book House, New Delhi, 2015
3. Surveying theory & Practice, R.E. Devise, Mc Graw Hill, New York, 1997
4. Fundamentals of surveying, S.K. Roy, Prentice Hall of India New Delhi, 2<sup>nd</sup> edition, 2010

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Course Code: BCEI, -- 701

Course Name: Geotechnical Engineering - II

L	T	P	Credit
3	1	2	5

### Course Objectives:

- 1) To understand the concepts of compaction & soil stabilization.
- 2) To emphasize on the importance of soil investigations & to determine the soil parameters needed to carry out foundation design.
- 3) To learn the subsurface exploration techniques and apply them to design the foundations.
- 4) To apply the principles of soil mechanics to design of shallow and deep foundations including bearing capacity, stability analysis of slopes and settlement calculations.
- 5) To explain in what circumstances pile is needed and how do analysis the pile and pile group under various soil conditions.
- 6) To explain fundamentals of soil dynamics and its application to machine foundation analysis including codal provisions.

### Syllabus:

#### Unit-I Soil Improvement Techniques:

Compaction. Field and laboratory methods, Proctor compaction tests, Factors affecting compaction. Properties of soil affected by compaction. Various equipment for field compaction and their suitability. Field compaction control Lift thickness.

Soil stabilization: Mechanical, Lime, Cement, Bitumen, Chemical, Thermal, Electrical stabilisation and stabilization by grouting. **Geo-synthetics, types, functions, materials and uses.**

#### Unit-II Soil Exploration and Foundations of Expansive and Collapsible Soils:

Methods of soil exploration. Planning of exploration programme for buildings, highways and earth dams. Disturbed and undisturbed samples and samplers for collecting them.

Characteristics of expansive and collapsible soils, their treatment, **Construction techniques on expansive and collapsible soils, CNS layer.**

#### Unit-III Shallow Foundations:

**Type foundations shallow and deep. Bearing capacity of foundation on cohesionless and cohesive soils. General and local shear failures. Factors effecting B.C. Theories of bearing capacity Prandle, Terzaghi, Batta, Skempton, Meyerhof and Hansan. I.S. code on B.C. Determination of bearing capacity. Limits of total and differential settlements. Plate load test.**

#### Unit-IV Deep Foundation:

Pile foundation, Types of piles, estimation of individual and group capacity of piles in cohesionless and cohesive soils. Static and dynamic formulae. **Pile load test, Settlement of pile group. Negative skin friction, under-reamed piles and their design. Piles under tension, inclined and lateral load**

Caissons. Well foundation. Equilibrium of wells. Analysis for stability tilts and shifts, remedial measures.

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### Unit-V Sheet piles/Bulkheads and Machine Foundation:

Classification of sheet piles/bulkheads. Cantilever and anchored sheet pile-. Cofferdams, materials types and applications.

Modes of vibration. Mass-spring analogy. Natural frequency. Effect of Vibration on soils. Vibration isolation. Criterion for design. Design of block foundation for impact type of machines.

#### Course Outcomes:

Upon completion of theory course, the students will be able to:

- CO1: Apply various soil improvement techniques
- CO2: Illustrate the methods of soil exploration.
- CO3: Distinguish expansive, collapsible soils and treatments.
- CO4: Evaluate the bearing capacity of shallow foundations using various theories.
- CO5: Evaluate the bearing capacity of various pile foundations in individual & group.
- CO6: Analyse the elements of machine foundation & sheet piles.

Upon completion of practical course, the students will be able to:

- CO1: Determine the shear parameters by triaxial shear test.
- CO2: Perform SPT test.
- CO3: Perform plate load test.

#### Reference Books:

- i) Soil Mechanics & Foundation Engg. By Dr. K. R. Arora- Std. Publishers Delhi
- ii) Soil Mechanics & Foundation Engg. By B.C. Punmia - Laxmi Publications Delli
- iii) Modern Geotech. Engg. By Dr. Alam Singh -IBT Publishers Delhi
- iv) Geotech. Engg. By C.Venkatramaiah-New Age International Publishers, Delhi
- v) Foundation Engineering. By Galeonards Mc Graw Hill Book Co. Inc.
- vi) Found Design & Const. by MJ Towlinbou - Sor Pitman & Soms London

#### List of Practical's:

- 1. Triaxial Shear Test
- 2. Standard penetration test.
- 3. Demonstration of plate load test.
- 4. Vane shear test
- 5. Static core penetration test
- 6. Consolidation test

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Course Code: BCEL – 702

Course Name: Environmental Engineering - II

L	T	P	Credit
3	1	2	5

### Course Objectives:

- 1) To impart basic knowledge on sewerage system including estimation of sewage quantity & design of sewers.
- 2) To provide a broad knowledge on sewage composition & its characteristics.
- 3) To provide information on disposal standards of effluents & also about various methods of sewage disposal.
- 4) To provide broad knowledge on various techniques of sewage treatment including advanced processes.

### Syllabus:

#### Unit - I

Sewerage schemes & sewerage system and their importance, collection & conveyance of sewage, Estimation of and sewage storm water quantity, fluctuation in sewage flow, Flow through sewer, Design of sewer, Construction & maintenance of sewer, Testing of sewer, Sewer appurtenances, Pumps & pumping stations.

#### Unit - II

Characteristics and analysis of wastewater Physical, chemical & biological parameters Cycles of decomposition, Oxygen demand i.e. BOD & COD, TOC, TOD, ThO, relative Stability, Population equivalent, Instrumentation involved in analysis, Natural methods of waste water disposal i.e. by land treatment & by dilution, Self purification capacity of stream, Oxygen sag analysis.

#### Unit-III

Unit operations for waste water treatment, Preliminary treatment such as screens, grit chamber, floatation tank, sedimentation etc. and chemical clarification, Role of micro-organism in biological treatment, Sewage filtration – theory & design. Testing filter its design & constructions, modifications in trickling filter.

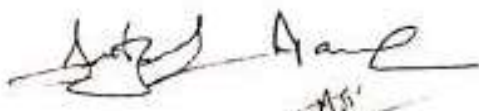
#### Unit-IV

Methods of Biological Treatment (Theory & Design) – Activated Sludge Process, Oxidation ditch, Stabilization Ponds, Aerated Lagoon, Anaerobic Lagoons, Septic Tank & Imhoff tank, Rotating Biological contactor Sources & treatment of sludge, sludge thickening and digestion, sludge drying beds, sludge disposal.

#### Unit-V

Advanced Waste Water treatment – Need of advanced treatment, Diatomaceous earth filters, Ultra filtration, Adsorption by activated carbon, Phosphorus removal, Nitrogen removal, Physico-chemical waste water treatment,

Sewage treatment plants using MBBR and SBR technology.

  
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### Course Outcomes:

Upon completion of theory course, the students will be able to:

- CO1: Design sewerage system according to the quantity of sewage generation
- CO2: Determine various sewage characteristics.
- CO3: Analyse various possible options for effective disposal of effluents.
- CO4: Explain various sewage treatment methods.
- CO5: Design sewage treatment plant.
- CO6: Analyse various options for disposal of solid waste including sludge.

Upon completion of practical course, the students will be able to:

- CO1: Determine pH, acidity & alkalinity of sewage sample & establish the relationship among them.
- CO2: Determine DO & BOD of sewage sample & establish the relationship among them.
- CO3: Determine COD of sewage sample & establish relationship with  $TiOD$ .
- CO4: Determine solids (fixed & volatile) content of sewage sample.

### Reference Books:

- i) Water Supply & Sanitary Engg. - G.S. Birdie - Dhanpat Rai Publishing Company, (P) Ltd. New Delhi
- ii) Waste Water Engg. By B.C Punmia - Laxmi Publication (P) Ltd. New Delhi
- iii) Environmental Engg. - M.L. Davis & D.A. Cornwell - Mc Graw Hill Company
- iv) Chemistry for Environmental Engg. - Sawyer & Mc Carty - Mc Graw Hill Book Company New Delhi.
- v) Water & Waste Water Technology - Mark J Hammer - Prentice - Hall of India, New Delhi
- vi) Waste Water Engineering - Metcalf & Eddy - Mc Graw Hill Book Company New Delhi

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Course Code: BCEI - 703

Course Name: Advanced Structural Design - I (R.C.C.)

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To understand the design concepts of various structures & detailing of reinforcements.
- 2) To understand the design of underground & elevated liquid retaining structures.
- 3) To understand the design of retaining walls.
- 4) To study the design of bridges according to IRC loadings.
- 5) To provide knowledge on basic concepts of prestressed concrete.

**Syllabus:**

**Unit-I**

**Design of Water Tanks:**

Design requirements, Design of Tanks resting on ground and underground tanks, Rectangular and circular tanks.

**Unit-II**

**Design of Over Head Water tanks:**

Rectangular, Circular & intze type (Membrane analysis only), Design of staging.

**Unit-III**

**Earth Retaining Structures:**

Types of retaining walls, Stability of retaining walls, Design of retaining walls (Cantilever and counter fort type)

**Unit-IV**

**Design of Bridges:**

IRC loading for highway bridges, Slab bridges and T-beams bridges for highway loading (IRC Loads)

**Unit-V**

**Prestressed Concrete:**

Prestressing concepts, materials, systems of prestressing & prestress losses. Introduction to working & limit state design method.

**Course Outcomes:**

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

CO1: Design various shapes of underground water tanks as per codal provisions.

CO2: Design various shapes of elevated water tanks as per codal provisions.

CO3: Design retaining walls as per codal provisions.

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CO4: Design bridges as per IRC loading provisions.

CO5: Apply the concepts of prestressed concrete.

**Reference Books:**

- i) Plain and Reinforced Concrete by O.P. Jain and Jai Krishna Vol. I & II
- ii) R.C.C. Structures by B.C. Punmia
- iii) Advance R.C. Design by N.K. Raju
- iv) Essentials of Bridge Engineering by D.J. Victor.
- v) Design of Bridge Structures by T.R. Jagadeesh & M.A. Jayaram
- vi) Design of Bridges by N.K. Raju
- vii) Prestressed Concrete by N.K. Raju
- viii) Advanced Reinforced Concrete Design by PC Varghese

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Course Code: BCEL - 704 (A)

Course Name: Railway, Bridge & Tunnel Engineering

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To understand the geometrical elements of railway track.
- 2) To understand the properties of good ballast.
- 3) To understand the track alignment, superelevation, turnout, yards.
- 4) To understand the principles of signalling & interlocking.
- 5) To understand bridge site investigation and planning.
- 6) To understand the Indian loading standards for bridge.
- 7) To understand the construction of tunnels.

**Syllabus:**

**Unit I Introduction:**

Tractive resistance & Permanent way, Principles of Transportation, Transportation by Road, Railways, Airways, Waterways, their importance and limitations. Route surveys and alignment, railway track, development and gauges. Hauling capacity and tractive effort.

- i) Rails- types, welding of rails, wear & tear of rails, rail creep ultrasonic Testing of Rails.
- ii) Rail fastenings- types - Fishplates, spikes bearing plates, chairs, keys, check and guard rails, Elastic Rail Clips (ERC), Vossloh fastening.
- iii) Sleepers, types & comparison, requirement of a good sleeper, sleeper density, Turnouts.
- iv) Ballast -Requirement of good ballast, various materials used as ballast, quantity of ballast, Ballast Cleaning. Different methods of plate laying, material trains, calculation of materials required, relaying of track.

**Unit - II**

Track alignment, Geometrical Design, Gradient & grade compensation, Super Elevation, Equilibrium, Cant and Cant deficiency, relationship of superelevation, gauge, speed & radius of curves, speed on curves, Limits of superelevation, Cant deficiency, Negative superelevation, curves, transition curves, necessity of points and crossing. Turnouts, Points of switches, Types of switches, crossing, calculation of turnouts, sleepers at points & crossing, Types of Track junctions. Types, locations, general equipments, layouts, marshalling yards. Definition, layout details, designs of simple turnouts.

**Unit III Stations and Yards:** Site selection for a Railway stations, Requirements of railway stations, junction station & terminals, location, layout & details, Types of signals in stations and yards, principles of signaling and inter-locking. Modern development in railways, Modernization of track for high speed, Maintenance of track, Track drainage.

**Unit - IV Bridge Site Investigation and Planning, Loading Standards & Component parts :**

Selection of site, alignment, collection of bridge design data- essential surveys, hydraulic design, scour, depth of bridge foundation, Economical span, clearance, afflux, types of road & railway bridges. Metrorail type Bridge construction, Design loads and forces, Impact factor, Indian loading standards for Railways Bridges and Highway Bridges, Bridge super structure and sub-structure, abutments, piers, wing walls, return walls, approaches, floors and flooring system, choice of super structure. Bridge bearings, Erection and maintenance of bridge.

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### Unit V Tunnels:

Selection of route, Engineering Surveys, alignment, shape and size of tunnel, bridge network, pressure relief phenomenon, tunnel approaches, shaft, pilot shafts. Construction of tunnels in soft soil, hard soil & rock. Different types of lining, methods of lining. Mucking operation, drainage & ventilation. Examples of existing important tunnels in India & abroad.

#### Course Outcomes:

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

- CO1: Explain the elements of railway like sleepers, rail, ballast, fasteners etc.
- CO2: Design various geometrical elements like track, gauge, cant, turnouts, crossing etc.
- CO3: Design signalling and interlocking systems & yards.
- CO4: Explain various principles of bridge elements.
- CO5: Design bridges as per Indian loading provisions.
- CO6: Apply the construction methods of railway tunnel.

#### Reference Books:

- i) Railway Engineering by S.C. Rangwala – Charotar Publication House, Anand
- ii) Railway Engineering by Arora & Saxena – Dhanpat Rai & Sons.
- iii) Railway Track by K.F. Antia
- iv) Principles and Practice of Bridge Engineering S.P. Bindra – Dhanpat Rai & Sons
- v) Bridge Engineering – S.C. Rangwala – Charotar Publication House, Anand
- vi) Bridge Engineering – J.S. Alagia – Charotar Publication House, Anand.

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Course Code: BCEL - 705 (A)

Course Name: Irrigation Engineering

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To understand the water requirements of various types of crops.
- 2) To understand the different types of irrigation systems.
- 3) To plan the reservoir systems as per the requirements.
- 4) To understand various types of dam.
- 5) To understand the concepts of Khosla's and Bligh's theory & its applications.
- 6) To understand river training.
- 7) To understand the concepts of Lacey's and Kennedy theory for design of canal systems.
- 8) To understand the canal regulations.

**Syllabus:**

**Unit-I Irrigation Water Requirement and Soil Water Crop Relationship:**

Irrigation, Definition, Necessity, Advantages and disadvantages, Type and methods, Irrigation development.

Soil: Types and their occurrence, Suitability for irrigation purposes, Wilting, Coefficient and field capacity, Optimum water supply, Consumptive use and its determination. Irrigation methods - surface and subsurface, Sprinkler and drip irrigation.

Duty of water, factors affecting duty and methods to improve duty, Suitability of water for irrigation, Crops and crop seasons, Principal crops and their water requirement, Crop ratio and crop rotation, Intensity of irrigation, Water logging-causes, effects & its prevention.

**Unit-II Reservoirs and Storage Works:**

Types of reservoirs, Reservoir planning, Various investigations, estimation of storage capacity by mass curve analysis, Fixing of principal levels in a storage project, Economical height of dam, Reservoir sedimentation, Suitable site for a reservoir project.

Dams: Classification- gravity, earthen, rockfill, arch, buttress, steel & timber dam, Selection of suitable type of dam at a particular location.

**Unit-III Diversion Works and River Training Methods:**

Purpose, Selection of site, Layout and functions of component parts, Types of weirs and barrages, Weir design for surface and subsurface flows, Bligh's, Lane's and Khosla's theories, Silt excluders and silt ejectors.

River training methods - objectives, Design principles of levees, Guide bands & launching aprons.

**Unit-IV Canal Irrigation:**

Types of canals, Alignment, Design of unlined and lined canals, Kennedy's and Lacey's silt theories, Typical canal sections, Canal losses, Linings-objectives, Materials used, Economics

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Unit-V

Introduction to Canal Regulation Structures: Head and cross regulators, Canal falls, Escape and outlet.

Course Outcomes:

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

C01: Analyze water requirements for different types of crops.

C02: Evaluate various types of irrigation systems.

C03: Plan storage reservoir systems as per the requirements.

C04: Apply Khosla's & Bligh's theory in pervious soil for weir & barrage & river training works.

C05: Design canal systems using Lacey's and Kennedy theory.

C06: Apply canal regulations in canal structures.

Reference Books:

- i) Irrigation & Water Power Engg. – Dr. B.C. Punmia, Dr. Pane, B.B. Lal
- ii) Irrigation, Water Resources & Water Power by Dr. P.N. Modi
- iii) Irrigation Engineering by Varshney
- iv) Irrigation Engineering by Santosh Kumar Garg
- v) Irrigation, Water Power & Water Resources Engg. By K.R. Arora.

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Course Code: BCET - 706

Course Name: Training / Internship

L	T	P	Credit
0	0	2	1

**Course Objectives:**

- 1) To develop an appreciation and importance of civil Engineering in developing the infra structure.
- 2) To develop an understanding regarding the various engineering principals to be used in the field construction activities.
- 3) To emphasize on the use of the modern tools and plants used in the construction industries.
- 4) To build the necessary practical background and exposure to the field problems.
- 5) To develop a technical skill to prepare project documents.

**Syllabus:**

1. Each candidate shall go for 1 month (4 week) on field training at different organizations' sites of his / her choice after completion of their 6<sup>th</sup> Semester exams (in summer vacations) and shall submit a detailed report after completion of training.

2) Candidates will be taken to nearby places where civil engineering works are being carried out during the semester and they shall have to submit a detailed report of their visit.

**Course Outcomes:**

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

- CO1: Observe various activities of civil construction works.
- CO2: Examine the utility of general and specific equipments for construction.
- CO3: Differentiate the construction projects individually and in team.
- CO4: Develop the writing and communication skills for various engineering problems.
- CO5: Adapt lifelong learning for benefit of society.



Course Code: BCEP – 707  
Course Name: Major Project - I

L	T	P	Credit
0	0	4	2

**Course Objectives:**

- 1) To develop an appreciation of civil engineering problems & have a feel of real life situations in planning & execution of projects.
- 2) To impart training of handling various types of civil engineering problems by use of conventional methods as well as software's.
- 3) To utilize the expertise in engineering to solve industry's technological problems.
- 4) To become innovative and professional in technology development, and system implementation.
- 5) To be able to function in their profession with social awareness and responsibility.
- 6) To be able to interact with their peers in industry and society as engineering professionals and leaders & inculcate a habit of working in a group.
- 7) Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Syllabus:**

Each candidate shall work on an approved project of a public building or any other civil engineering work and shall submit design and a set of drawings.

OR

Shall submit a detailed report of report of experimental work/software package on any specific problem of importance.

**Course Outcomes:**

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

- CO1: Recognize various engineering problems and techniques to solve them.
- CO2: Reproduce the solution of the problems upon the need of society.
- CO3: Cooperate to work within group.
- CO4: Develop the writing and communication skills for various engineering problems.
- CO5: Display lifelong learning.

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Course Code: BCEI – 801

Course Name: Advanced Structural Design – II (Steel)

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To study the components of truss, loads on trusses, analysis and design of purlins and truss members.
- 2) To study the design of gantry girder, welded plate girder bridges as per standard loadings.
- 3) To study the design of trussed girder bridges, railway & highway bridges as per IRC loadings and Bridge Rules.
- 4) To study the design of water tanks.
- 5) To study the design of chimneys.

**Syllabus:**

**Unit-I**

Design of Industrial Building: Dead Load, Live Load and wind load analysis for roof trusses, Design of purlins & members of truss. Design of gantry girder.

**Unit-II**

**Plate Girder Bridges:** Railway standard loading, Design of various components of plate girders bridges for railway & highways; Bearings for bridges.

**Unit-III**

**Trussed Girder Bridges:** Design of Foot over bridge, Design of various components of railway & highway bridges (IRC & railway standard loading)

**Unit-IV**

**Steel Water Tanks:** Design of Rectangular & Circular tanks with ordinary plates, Design of elevated water tanks with suspended bottoms, Pressed steel tanks.

**Unit-V**

Design of Chimneys: Design of self supporting type and Guyed Chimney.

**Course Outcomes:**

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

- CO1: Design roof truss as per codal provisions.
- CO2: Design gantry girder as per codal provisions.
- CO3: Design plate girder bridges and bearings as per IRC loadings.
- CO4: Design trussed girder bridges as per IRC loadings.
- CO5: Design various shapes of steel water tanks as per codal provisions.

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C06: Design chimneys as per codal provisions.

Reference Books:

- i) Steel Structure By D. Ramchandra Vol. I & II.
- ii) Steel Structure By Arya & Ajmani
- iii) Essentials of Bridge Engineering by D. Johnson Victor
- iv) Design of Steel Structures by B.C. Punmia.
- v) Design of Steel Structure by S.K. Duggal
- vi) Design of Steel Structures by Daya raman
- vii) Indian standard codes.

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Course Code: BCEL – 802

Course Name: Hydraulic Structure

L	T	P	Credit
3	1	2	5

**Course Objectives:**

- 1) To study the different aspects of design of hydraulic structures.
- 2) To build the necessary theoretical background for the selection of a suitable site for a dam and a suitable dam for a given site location.
- 3) To emphasize on the basic design principle of the gravity dam & earthen dam
- 4) To carry out the stability & seepage analysis of various types of dams
- 5) To provide knowledge on various hydraulic structures such as energy dissipaters, spillways & gates & understand their designs.
- 6) To understand the design of cross drainage structures for uninterrupted water supply in natural channels and manmade canals.
- 7) To provide a basic knowledge on various types of hydropower plants and their components.

**Syllabus:**

**Unit-I Gravity dams:**

Design Criteria, forces acting on gravity dams, elementary profile, low and high gravity dams, stability analysis, evaluation of profile by method of zoning, practical profile, foundation treatment, construction joints, galleries in gravity dams.

**Unit-II Earth and Rock fill dams:**

**Earth Dams:** Types, causes of failure and design criteria, soils suitable for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes by slip circle method, pore pressures, sudden draw down, steady seepage and construction pore pressure condition.

**Rock fill dams:** Types, merits and demerits, conditions favourable for their adoption

**Unit-III Cross drainage works:**

Types, selection of suitable type, design criteria, fluming of canal- Mitra & Chaturvedi methods. Design of Different types of CD works.

**Unit-IV Spillways, Energy dissipators and gates:**

Ogee spillway and its design, details of syphon, shaft, chute and side channel spillways, emergency spillways- Principles of energy dissipation, Energy dissipators based on tail water rating curve and jump height curves, Spillway crest gates – vertical lift and radial gates, their design principles and details.

**Unit-V Hydropower Plants:**

Hydropower development, assessment of power potential, types of hydropower plants, general features of hydro-electric schemes, selection of turbines, draft tubes, surge tanks, penstocks, power house dimensions, development of micro hydel stations, tidal plants, pumped storage plants and their details.

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### Course Outcomes:

Upon completion of theory course, the students will be able to:

CO1: Evaluate various design criteria of gravity dams.

CO2: Design elements of earthen dams and carry out seepage and stability analysis.

CO3: Design different types of cross drainage works.

CO4: Design energy dissipators and spillways.

CO5: Explain various elements of hydropower plants.

Upon completion of practical course, the students will be able to:

CO1: Evaluate various design criteria of dams.

CO2: Design different types of cross drainage works.

CO3: Design energy dissipators and spillways.

### Reference Books:

- i) Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds
- ii) Hydroelectric Hand Book by Creager
- iii) Hydraulic Structures by Varshney
- iv) Irrigation & Water Power Engg. By Punmia & Pandey
- v) Water Power Engineering by Dandekar
- vi) Irrigation Engineering & Hydraulic Structure by S.K. Garg.

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Course Code: BCE1 - 803 (A)

Course Name: Industrial Waste Treatment

L	T	P	Credit
3	1	0	4

### Course Objectives:

- 1) To provide broad knowledge on various methods of sewage disposal, their effects on water pollution & also provide information on various disposal standards.
- 2) To learn the basics of sewage composition & its characteristics.
- 3) To understand the 3R concepts and how to implement them.
- 4) To provide knowledge on various waste water treatment techniques.
- 5) To provide information on various rules & regulations regarding disposal of municipal wastes.
- 6) To provide information about various existing waste treatment & management techniques of various industries.

### Syllabus:

#### Unit-I Problem of Water Pollution: ✓

Effects of wastes on streams and sewage treatment plant, natural purification of streams, oxygen sag curve, allowable organic load on streams, classification of stream, stream standards and effluent standards requirement of water for different purposes.

#### Unit-II Sampling and Analysis of Wastewater: ✓

Sampling of waste waters, Grab, Composite and Integrated samples, analysis of waste water, Biochemical Oxygen Demand, Chemical Oxygen Demand and pH value of waste water, Toxicity of waste by Bioassay method.

**Pretreatment of Wastes:** Volume and strength reduction, salvage of materials, recovery of by products, reuse of waste water.

#### Unit-III Conventional Methods of Treatment of Waste Water: ✓

Removal of suspended solids, removal of inorganic and organic dissolved solids, sludge disposal. Advance methods of treatment such as Reverse Osmosis, Ion Exchange Process, Electro Dialysis, Algal Harvesting etc

#### Unit-IV Combined Treatment of Waste Water with Sewage:

Municipal regulations, Sewer rental charges, Instrumentation in waste water treatment plants, Operation and maintenance of plants, Role of water pollution control board. **Low cost Treatment Plant Effluent Treatment Plant Design and Operation.**

#### Unit-V

**Brief study of industrial processes and treatment methods of waste water from common industries such as Textile, Dairy, Paper and pulp, Tannery & Distillery.**

Hazardous wastes-Impact handling and disposal

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### Course Outcomes:

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

CO1: Evaluate the effects of waste on streams as per the standards.

CO2: Determine various sewage characteristics.

CO3: Explain various waste treatment methods.

CO4: Apply municipal regulations in operation & maintenance of waste water treatment plant

CO5: Illustrate waste management methods of different industries.

### Reference Books:

- i) Liquid Waste of Industries – Theories, Practice and Treatment – N.L. Nemerow, Wesley Publishing Co.
- ii) Treatment of Industrial Waste – E.B. Besselièvre & Max Graw Hill Bok Company
- iii) Waste Water Engg. – Treatment Disposal & Reuse – Metcalf & Eddy – Tata Mc Graw Will, New Delhi
- iv) Waste Water Treatment – Arceivala – Tata Mc Graw Will, New Delhi
- v) Industrial Pollution Control hand book – Lund H.F. Tata Mc Graw Will, New Delhi

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Course Code: BCEI - 803 (B)  
Course Name: Construction Techniques

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To understand various techniques in construction of pile foundations, coffer dams etc.
- 2) To understand various types of formworks.
- 3) To understand various techniques of steel construction works.
- 4) To understand the prefabrication in construction.
- 5) To understand the concept of prestressing methods in construction.
- 6) To understand various advanced pavement construction methods.

**Syllabus:**

**Unit-I**

**Foundations:** Techniques of construction of piles, Caissons, Wells, Cofferdams and diaphragms. Drilling, blasting, Underpinning, Shoring and shuffling of foundations.

**Unit-II**

**Formwork:** Design and construction of different types of formworks and temporary structures. Stationary and slip formwork techniques. Formwork of special structures eg. Shells, Bridges, Towers etc.

**Steel Construction:** Fabrication and erection, Shop and on site construction techniques. Different connections, Clearances and tolerances, Erection of steel structures like bridges, Chimneys and trusses.

**Unit-III**

**Prefabrication:** Applications in construction. Modular coordination and standardization, joints and tolerances. Special equipments and plants for industrial production of prefabricated components. Pre-engineered Building.

**Unit-IV**

**Prestressing:** Concept, Materials and Prestressing methods. Special equipments and plants for industrial production of prestressed components. Prestressing of bridge girders, Water tanks and special structures.

**Unit-V**

**Advanced pavement construction Techniques:** Pavement construction using bitumen hot mix plant, Concrete road construction, Fibre reinforced pavement construction, Low cost road construction techniques, Pavement quality control.

**Course Outcomes:**

1. on completion of the course, the students will be able to

CO1: Apply various techniques in construction of pile foundations, coffer dams etc.

CO2: Evaluate various types of formworks.

CO3: Apply various techniques of steel construction works.

Course Code: BCEL – 804 (A)

Course Name: Building Environment & Services

L	T	P	Credit
3	1	0	4

**Course Objectives:**

- 1) To develop an understanding about the acoustics of a building.
- 2) To understand the fundamental concepts of ventilation in a building.
- 3) To understand about various preventive measures to be taken for corrosion & cracks in building & plan accordingly the building maintenance system.
- 4) To understand the concepts of illumination and plan accordingly the lighting system in building.
- 5) To understand the concepts of air conditioning, elevators & lifts installation, thermal insulation & stair case design for a building.
- 6) To understand the requirements of fire fighting in a building and plan accordingly.
- 7) To plan the sanitation system of a building.

**Syllabus:**

**Unit-I Acoustics and Ventilation**

Characteristics of sound, Behaviour of sound, Defects of sound, Acoustic design, Sound absorption materials and techniques, Noise control in Building, Sound insulation of floors, walls, roof etc.

Functional requirements of ventilation, System of Ventilation, Factors and various considerations for improved natural ventilation. Artificial Ventilation (mechanical Ventilation), use of topography in improving ventilation.

**Unit II**

**Building Maintenance**

Causes of deterioration of Buildings. Approach to maintenance, reliability of maintenance system, pest control, Preventive maintenance in building and electric installations, checklist for inspection, Cracks in building (causes and effect), Maintenance of floors & roofs, Maintenance of brick masonry, Corrosion in Reinforced concrete members, Prevention of leakage in building, Maintenance of windows, Doors and external Joinery (Timber), Building services required in building complexes.

**Unit-III**

**Electrification & Illumination**

System of distribution of electrical energy in building, Methods of wiring, System of wiring, Selection of wiring, conductor & insulators, Methods of earthing, Energy calculation, Fuses, electrical safety precautions.

Illumination, terminology, Different source of light Design of lighting scheme, Street lighting flood lighting, Lighting calculations, Various types of electrical circuits used in building i.e. Stair case wiring corridor wiring, Connection of Fan, Bulb socket in circuit.

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## Unit - IV

### Services in Building

Staircase design, Elevators, Escalators, Air Conditioning, Essentials of Air Conditioning Systems, Thermal insulation of building (wall, roof, floor etc.), Methods of thermal insulation, Lifts and its types, Power requirement of lifts, Traffic analysis, Quality and quantity of service of lift operations, Lift installation.

## Unit-V

### Fire Fighting & Sanitation

Causes of fire, Classification of fire, Modes of fire, Fire load, Modes of fire fighting, Types of fire extinguishers, provisions in building from fire safety angle, Additional requirement for multi-storied building, Municipal rules & laws, Fire alarm, Fire hydrants.

Water seal and traps, sanitary noise and control, maintenance of water tanks & sewer lines, leakage in building and its prevention, Hot water supply in building, Basic principles of design of water supply system, Sanitary piping, troubles and causes, House - keeping in water and sanitary installation.

### Course Outcomes:

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

- CO1: Evaluate acoustics & ventilation of a building.
- CO2: Develop building maintenance.
- CO3: Develop system of distribution of electrical energy in buildings & illumination in buildings.
- CO4: Plan various services like air condition, thermal insulation & lift installation in a building.
- CO5: Plan fire safety for a building.
- CO6: Develop sanitation system in a building.

### Reference Books:

- (i) Building Construction by B.C. Punmia
- (ii) Building Construction by S.C. Rangwala
- (iii) Building Services in High rise building by V.K. Jain
- (iv) Maintenance of Building by A.C. Panchdhari
- (v) Water Supply and Sanitary Installations by A.C. Panchdhari
- (vi) Electrical Installations Estimating and Costing by J.B. Gupta



Course Code: BCEP 805

Course Name: Major Project - II

L	T	P	Credit
0	0	12	6

**Course Objectives:**

- 1) To develop an appreciation of civil engineering problems & have a feel of real life situations in planning & execution of projects.
- 2) To impart training of handling various types of civil engineering problems by use of conventional methods as well as software's.
- 3) To utilize the expertise in engineering to solve industry's technological problems.
- 4) To become innovative and professional in technology development, and system implementation.
- 5) To be able to function in their profession with social awareness and responsibility
- 6) To be able to interact with their peers in industry and society as engineering professionals and leaders & inculcate a habit of working in a group.
- 7) Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Syllabus:**

Each candidate shall work on an approved project of a public building or any other civil engineering work and shall submit design and a set of drawings.

OR

Shall submit a detailed report of report of experimental work/software package on any specific problem of importance.

**Course Outcomes:**

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

- CO1: Recognize various engineering problems and techniques to solve them.
- CO2: Reproduce the solution of the problems upon the need of society.
- CO3: Cooperate to work within group.
- CO4: Develop the writing and communication skills for various engineering problems.
- CO5: Display lifelong learning.

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**510301 (A) Infrastructure Project Management**

L	T	P	Credit
3	1	0	4

**Unit-I**

Nature & Type of Infrastructure Projects: Characteristics, Scope and Status of Infrastructure Projects in India.

**Unit-II**

Issues of Developing, Funding, Financing Infrastructure Projects, Various Construction Procurement Options.

**Unit-III**

Uncertainties & Risks in Large Scale Construction Projects.

**Unit-IV**

Development of sustainable Infrastructure: Environmental Impact assessment of Infrastructure projects.

**Unit-V**

Management of Infrastructure projects: Role of I.T. in Infrastructure development.

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## 510302 (A) Urban Hydrology & Waste Management

L	T	P	Credit
3	1	0	4

### Unit-I

Utilization of industrial waste in construction industry, Flyash as building material, ceramic insulator scrap as aggregate in concrete. Use of cement stabilized soil block as an alternative to burnt clay brick, urban solid waste and sludge as building material. Cement and building material from industrial waste, I-IG brick. Pollution free production of innovative building materials and component. Concrete aggregate from demolition waste. Structural concrete using industrial waste.

### Unit-II

Industrial Waste: Problem associated with industrial waste. Equalization, neutralization, volume reduction. House keeping method and Advanced treatments like adsorption, ion exchange, Chemical oxidation, Phosphorus removal, Nitrification, chemical precipitation, Reverse-osmosis, Electrodialysis.

### Unit-III

Wastewater Treatment: Waste water generation, Collection, Construction of sewer lines, Sewer appurtenances, Disposal of wastewater & refuse, Recycling and reuse.

### Unit-IV

Surface & Subsurface Hydrology: Hydrological cycle & its application in engineering. Precipitation, its types, forms & measurements, Rainfall data, DAD curve. Methods of average rainfall and losses.

Ground Water: Aquifer properties, groundwater properties, types and problems, well hydraulics, well losses, ground water investigation.

### Unit-V

Hydrographs: Run off-discharge measurement, stage discharges, runoff computation, runoff simulation model, concept of hydrograph, component of hydrograph, unit hydrograph and its derivation, S-hydrograph, IUH hydrograph and its derivation, Synthetic unit hydrograph, Flood estimation techniques.

### Reference Books:

- i) Engineering Hydrology by K. Subramanya - Tata Mc Graw Hill Publ. Co
- ii) Hydrology & Water Resources Engineering by S. K. Garg - Khanna Publishers
- iii) Sewage Disposal & Air Pollution Engineering by S. K. Garg - Khanna Publishers.
- iv) Waste Water Engineering, Treatment, Disposal & Reuse by Metcalf & Eddy - TMH Publishers.

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530301 (A) Principles and Design of Biological Treatment Systems

L	T	P	Credit
3	1	0	4

Unit-1

Principles- Objectives of Biological Treatment, significance, aerobic and anaerobic treatment kinetics of biological growth, factor effecting growth- attached and suspended growth.

Types of wastewater, Constituents of wastewaters- Sources, Significant parameter- Fundamentals of Process- Kinetics, Zero order, First order, Second order Reactions, Enzyme kinetics

Unit-2

Bio reactors: Types, Classification, Design principles, Design of wastewater treatment systems, Primary, secondary and tertiary treatments, Evaluation of Biokinetic Parameters

Unit-3

Biological Nitrification and denitrification, Suspended Growth process- Activated Sludge process: Introduction, Modifications, Membrane bioreactors, Waste stabilization ponds and Lagoons, Aerobic pond, facultative pond, anaerobic ponds, aerated Lagoons

Unit-4

Attached Growth Biological Treatment Systems: Trickling Filters, Rotating Biological Contactors, Anaerobic processes -Process fundamentals, Standard, high rate and hybrid reactors.

Unit-5

Anaerobic filters, Expanded /fluidized bed reactors, Up flow anaerobic sludge blanket reactors, Expanded granular bed reactors, Two stage/phase anaerobic reactors, Sludge Digestion, Sludge disposal.

Reference Books:

1. Benefield, L.D. and Randall C.W. Biological Processes Design for wastewaters, Prentice-Hall, Inc. Eaglewood Cliffs, 1982.
2. Grady Jr. C.P.L. and Lin H.C. Biological wastewater treatment: Theory and Applications, Marcel Dekker, Inc New York, 1980.
3. Metcalf & Eddy, Inc. Wastewater Engineering, Treatment and Reuse, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
4. Quasim S.R. Wastewater Treatment Plant, Planning Design & Operation, Technomic Publication, New York 1994.
5. Manual on "Sewerage and Sewage Treatment CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

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## 530302 (A) Urban Hydrology & Waste Management

L	T	P	Credit
3	1	0	4

### Unit-I

Utilization of industrial waste in construction industry. Flyash as building material, ceramic insulator scrap as aggregate in concrete. Use of cement stabilized soil block as an alternative to burnt clay brick, urban solid waste and sludge as building material. Cement and building material from industrial waste, Fal-G brick. **Pollution free production of innovative building materials and components.** Concrete aggregate from demolition waste. Structural concrete using industrial waste.

### Unit-II

Industrial Waste; Problem associated with industrial waste. Equalization, neutralization, volume reduction. House keeping method and **Advanced treatments like adsorption, ion-exchange, Chemical oxidation, Phosphorus removal, Nitrification, chemical precipitation, Reverse-osmosis, Electrodialysis.**

### Unit-III

Wastewater Treatment. Waste water generation. **Collection, Construction of sewer lines, Sewer appurtenances.** Disposal of wastewater & refuse. Recycling and reuse.

### Unit-IV

Surface & Subsurface Hydrology; Hydrological cycle & its application in engineering. Precipitation, its types, forms & measurements; Rainfall data DAD curve. Methods of average rainfall and losses.

Ground Water: Aquifer properties, groundwater properties, types and problems, well hydraulics, well losses, ground water investigation.

### Unit-V

Hydrographs: Run off-discharge measurement, stage discharges, runoff computation, runoff simulation model, concept of hydrograph, component of hydrograph, unit hydrograph and its derivation, S hydrograph, U/H hydrograph and its derivation. Synthetic unit hydrograph. Flood estimation techniques.

### Reference Books:

- (i) Engineering Hydrology by K. Subramanya - Tata Mc Graw Hill Publ. Co.
- (ii) Hydrology & Water Resources Engineering by S. K. Garg - Khanna Publishers.
- (iii) Sewage Disposal & Air Pollution Engineering by S. K. Garg - Khanna Publishers.
- (iv) Waste Water Engineering, Treatment, Disposal & Reuse by Metcalf & Eddy - TMH Publishers.

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A. K. Jais  
M. S. F.  
100

Course Code: 100205  
Course Name: Basic Civil Engineering & Mechanics

L	T	P	Credit
4	1	2	6

**Course Objectives:**

1. To understand the utility of various types of building materials.
2. To understand the location, construction detail and suitability of various building elements.
3. To determine the location of object on ground surface.
4. To stabilize the position of various object.
5. To understand the effects of system of forces on rigid body in static conditions.
6. Analysis of determinate structure (beam & truss)

**Syllabus:**

**Unit-I**

**Building Materials:** Stones, bricks, cement, timber - types, properties, test & uses, Introduction of concrete properties & Laboratory tests on concrete, curing of concrete and mortar Materials.

**Unit- II**

**Surveying & Positioning:** Introduction to surveying, Survey stations, Measurement of distances- conventional and EDM methods, Measurement of directions by different methods, Measurement of elevations by different methods, reciprocal leveling.

**Unit- III**

**Mapping & Sensing:** Mapping details and contouring, Plane tables and related devices. Introduction of theodolite. Measurement of areas and volumes, application of measurements in quantity computations, Introduction of remote sensing and its applications.

**Unit- IV**

**Forces and Equilibrium:** Graphical and Analytical Treatment of Concurrent and non-concurrent coplanar forces, free body Diagram, Force Diagram and Bow's notations, Application of Equilibrium Concepts: Analysis of plane Trusses, method of joints, method of Sections. Frictional force in equilibrium problems.

**Unit -V**

**Centre of Gravity and moment of Inertia:** Centroid and Centre of Gravity, Moment of Inertia of Composite section, Radius of Gyration, Introduction to product of Inertia and Principle Axes.  
**Support Reactions:** Shear force and bending moment diagram for cantilever & simply supported beam with concentrated, distributed load and Couple.

**Course Outcomes:**

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

- CO 1: Explain concepts and terminologies of building materials, surveying and mechanics.
- CO 2: Apply various methods for surveying and mechanics.
- CO 3: Determine the location, area and volume of objects on ground surface.

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CO 4: Solve the problems of surveying and mechanics by using various methods.

CO 5: Analyse the effects of system of forces on rigid bodies in static conditions.

### Text Books:

1. Surveying, Vol - 1, Punmia B.C., Laxmi Publications, 17<sup>th</sup> edition, 2016
2. Building Material, B. C. Punmia, Laxmi Publications, 2016
3. A textbook of Engineering Mechanics, D. S. Kumar, Katsons Publications, 2013

### Reference Books:

1. Basic Civil Engineering, S. Ramamurtam & R. Narayan, Dhanpat Rai Pub., 3<sup>rd</sup> edition, 2013
2. Applied Mechanics, Prasad I.B., Khanna Publication 17<sup>th</sup> edition, 1996
3. Surveying, Duggal, Tata McGraw Hill New Delhi, 4<sup>th</sup> edition, 2013
4. Engineering Mechanics - Statics & Dynamics, R.C. Hibbler, Pearson Publications, 14<sup>th</sup> edition, 2015
5. Engineering Mechanics - statics dynamics, A. Borezi & Schmidt, Cengage learning, 1<sup>st</sup> edition, 2008.
6. Applied Mechanics, R.K. Rajput, Laxmi Publications, 3<sup>rd</sup> edition, 2016

### List of Experiments:

1. Study of various types of chain and tapes.
2. Measurement of distance involving direct and indirect ranging.
3. Chain and tape survey of given area
4. Study of prismatic and surveyors compass
5. Measurement of direction by prismatic compass
6. Calculation of distance between two inaccessible points by prismatic compass
7. Study of dumpy level, levelling staff and level field book
8. Exercise of differential levelling and flying levelling
9. Study of various types of a transits theodolite
10. Measurements of horizontal angle by repetition method.
11. Determining the resultants force of coplanar concurrent and non-concurrent system of forces by graphical method
12. Determine forces in members of a perfect frame by graphical method.

Upon completion of the practical course, the students will be able to:

CO 1: Follow the guidelines for field surveying.

CO 2: Follow the working principles of survey instruments for measurements.

CO 3: Measure the horizontal distances, difference in elevation and angles of various points

CO 4: Detect measurement errors and accordingly suggest corrections

CO 5: Interpret survey data and compute areas

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MANAGEMENT THEORY - 611CCM / MCTL 911  
(510101)

**Unit-I**

**Special Features of Construction Industry:** Significance and importance of construction VIS AVIS other industry Importance of construction industry in National economy. Recognition of construction as industry. Significant differences between construction & other manufacturing. Production and process industry with special reference to planning. Execution finance and other aspects.

**Unit-II**

**Management Principles:** Concepts and theory. Historical developments. Management functions and processes. Forecasting, Planning Organizing. Directing coordinating, Motivating. Controlling and evaluating. Problems of construction industry influencing management process.

**Unit-III**

**Behavioral Sciences:** Principles. Historical development. Individual and group behavior. Group dynamics, Motivational theories, Leadership.

**Unit-IV**

**Organization Theory:** Introduction. Historical development, Growth of various models. Type of construction organization. Design of organization. Organization systems. Goals, Culture & environment. Developing and self learning organizations.

**Unit-V**

**Different Management Requirements:** Entrepreneurship. Corporate planning, SWOT and Goal analysis.

**Unit-VI**

**Construction Management:** Principles of Purchase and Marketing. Stores and site management on construction projects.

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## QUANTITATIVE METHODS

613CCM / MCTL 913 / MSTL 912 (N) / MENL 913  
(510103)

### Unit-I

**System Engineering:** System theory & principles; Decision theory & analysis; Decision under uncertainty & certainty, Risk analysis, Optimization theory for constrained and unconstrained & its techniques.

### Unit-II

**Theory of Probability:** Definition of probability; Theorems of probability; Statistical methods; Probability distribution functions & its applications e.g. Normal, Log normal, Beta, Gamma, Pearson and Poisson's distribution; Introduction to correlation and regression; Simple & Multiple regression, Bivariate and Multivariate correlation.

### Unit-III

**Programming Techniques-I:** Linear programming & applications, Graphical methods, Simplex method; Modified simplex method, Transportation problem; Assignment Problem.

### Unit-IV

#### Programming Techniques-II:

Goal Programming; Integer Programming; Dynamic Programming; Non - Linear Programming.

### Unit-V

**System Models:** Deterministic models; Probabilistic Models; Queuing model, Game theory; Simulation (Monte Carlo's Simulation).

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*Aravind*

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04/03/14

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**MATERIALS AND EQUIPMENTS (CORE)**

612CCM / MCTL 912 / ~~MSTL 914~~

MSTL 914 / MENL 912 (510102)

**Unit-I**

**General Properties of Construction Materials:** Physical properties like strength, Durability, Thermal effect, Sound insulation, Fire resistance, Corrosion resistance and radiation shielding.

**Unit-II**

**Concrete:** Ingredients and their properties, Design and production of concrete, Details of various steps of manufacture of concrete eg. Batching, Mixing, Transporting, Placing compacting and curing, Design and production of high strength Ready mix concrete.

**Unit-III**

**New Construction Materials:** Polymeric materials, Polymer concrete, Additives and admixtures in concrete, Light weight, Heavy and no fine concrete, Ferro cement and fiber reinforced concrete, high performance concrete and composite materials, roller compacted concrete.

**Unit-IV**

**Material Testing:** Laboratory and field testing of construction materials, Indian standard code requirements and procedures, Non destructive testing, Reporting and evaluating the experimentation.

**Unit-V**

**Construction Equipments:** Planning of construction equipments, Equipment characteristics, Operation and selection, Equipment cost. Different types of construction equipments eg. Power shovels, drag lines, Scraper, Bulldozer, Tractor, Rippers, Motor graders, aggregate processing and batching plants, Cycle time and capacity ratings, Sizing and matching, Hot Mix plant, RMC Plant.

**Reference Books:**

1. V. Shantha Kumar, Concrete, Oxford University press.
2. A.M. Neville, Properties of concrete, Pearson
3. M.L. Gambhir, Concrete Technology, Tata Mc Graw Hill Pub. Co.
4. R.L. Peurifoy & C.L. Schexnaydev, Construction Planning, Equipment and methods, Mc-Graw Hill Higher Edition.
5. Construction equipment, its planning and application by Dr. Mahesh Verma, Pub. Metropolitan Book Co.(P) Ltd.

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*Aswari*



*Amal*  
04/03/14

# CONTRACT MANAGEMENT

614CCM / MCTL 914  
(510104)

## Unit-I

**Quantity Surveying:** Basic principles of estimating. Construction costs. Different methods and stages of estimating. Specification of construction items and method of statement. Principles of rate analysis and valuation.

## Unit-II

**Claims and Arbitration:** Indian contract act and arbitration reconciliation act. Variations in work and conditions. Claims and disputes. Liquidated damages. Rights. Responsibilities and duties of client (Owner). Architect. Engineer. Contractor etc. Purchase order as contracts insurance contract and claims.

## Unit-III

**Legal Frame Work of Construction:** Contract labors act 1970 and other acts and laws relating to labors management. Wages. Bonus and Industrial disputes.

## Unit-IV

**Construction Contracts:** International contract rules and regulation.

## Unit-V

**Contract Conditions:** Important contract clauses. Terms of payments. Retention. Acceptance and final payment. Time of completion. Extension of time. Maintenance period etc.

## Unit-VI

**Special Contracts:** BOT projects, Variation in BOT projects. Infra structural projects.

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*Abisau*



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04/03/14

# Functional Planning Building Services & Maintenance Management

W.E.F. JULY 2014

(Elective) CCM-631/ MCTL 931 / MCTL 915 (N) /  
MSTL 915 (N) / MENL 915 / 570 / 05

Importance of building services, type of services required to keep facility usable, planning of services. Organization structures of services management. Role and administrative functions of supervisors.

### Fire Fighting:

Fire load, classification of fire, class of fire, Basic requirement of the works for fighting system, various components of the fire fighting system. Maintenance required of the system, fire fighting in high-rise buildings, commercial/industrial complexes. Public buildings, checklist for fire safety.

### Lifts/Elevators, Escalators:

Legal formalities for elevators, various types of lifts, working mechanisms of lift and escalators. Indian standard codes for planning & installations of elevator, inspection & maintenance of lifts.

### Plumbing Services:

Basics of Plumbing systems. Requirement of Plumbing works, Agency, Activity flow chart for plumbing work. Quality, checking of materials.

### Water Supply System:

Water supply and distribution system in high-rise building & other complexes, pumps and pumping mechanisms. Operation & maintenance of fittings & fixtures of water supply & sanitary. Do's & Don'ts for water pipe networks.

Electrical network & appliances. Basics of single phase & three phase electrification, precautions and safety measures during electrification. Indian standard codes for electrical appliances & wiring operations & maintenance of network & appliances. Landscaping & Horticulture. Building maintenance management, applications of computer in service management.

### Air-Conditioning and Heating:

Flowcharts of air conditioning & heating. Centralised systems, monitoring and working of the equipments, Checklist of inspection, Performance testing. Water proofing. Damp proofing & Termite proofing. Working procedure & stages of work of water proofing for W.C., Bathrooms, Terrace, sloping roof, Basements, tanks. Use of chemicals for water proofing treatment. Role of consultants. Damp proof course. Causes and precautions for Dampness. Anti-termite treatment at pre-construction and post-construction. Routine treatment and precautions.

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04/03/14

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## CONSTRUCTION TECHNIQUES

621CCM / MCTL 921 / MSTL 921

### Unit-I

**Foundations:** Techniques of construction of piles, Caissons, Wells, Cofferdams and diaphragms, Drilling blasting, Underpinning, Shoring and shuttering of foundation.

### Unit-II

**Formwork:** Design and construction of different types of formworks and temporary structures, Stationary and slip formwork techniques, Formwork of special structures eg. Shells, Bridges, Towers etc.

**Steel Construction:** Fabrication and erection, Shop and insitu construction techniques, Different connections, Clearances and tolerances, Erection of steel structures like bridges, Chimneys and trusses.

### Unit-III

**Prefabrication:** Application in construction Modular coordination and standardization, joints and tolerances; Special equipments and plants for industrial production of prefabricated components, Pre-engineered Building.

### Unit-IV

**Prestressing:** Concept, Materials and Prestressing methods; Special equipments and plants for industrial production of prestressed components, Prestressing of bridge girders, Water tanks and special structures.

### Unit-V

**Advanced pavement construction Techniques:** Pavement construction using bitumen hot mix plant, Concrete road construction, Fibre reinforced pavement construction, Low cost road construction techniques, Pavement quality control.

### Reference Books:

1. Soil Mechanics by Gopal Ranjan, New Age Publishers.
2. Mahesh Verma, Construction Equipment, its planning & Application, Metropolitan Book Co.(P) Ltd.,
3. Foundation Design Manual by Narayan V. Nayak
4. Prestressed concrete by Rajagopalan
5. Prestressed concrete by T.Y. Lin
6. Highway Engg by Justo and Khanna

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04/03/19

# CONSTRUCTION COST MANAGEMENT

623CCM / MCTL 923

## Unit-I

### Project Cost Controlling

Development of Network, Development of Cost/Schedule Control System Criteria (C/SCSE), Monitoring of Project Cost, Cost Schedule Algorithms.

## Unit-II

### Cost Time Trade – off Analysis:

Cost time trade – off curves, Non – convex discontinuous and discrete cost time trade – off curves, Crashing of projects, Heuristic methods, Siemen's method of project cost curve, Trade-off problems.

## Unit – III

### Multi criteria Decision Making Methods:

Analytical Hierarchy Process, and its application in planning and management, Introduction to Fuzzy Set Theory and its Application in MCDM.

## Unit-IV

### Value Engineering:

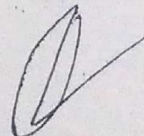
Principles of value engineering in Project Management, Value engineering technique, Job Plans, Life cycle costing and its applications.

## Unit-V

**Productivity in Construction:** Definition of Productivity. Productivity measurements. Productivity of production components, Labors, Equipment and Material Capital Productivity. Planning, Designing and execution processes.

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04/03/14

## PROJECT MANAGEMENT

624CCM / MCTL 924 / MENL 924

### Unit-I

**Waste Management:** Introduction to waste and waste management. The concepts of waste productivity and its interrelationship with productivity. System concept of waste. Complementarity of waste and resource management.

### Unit-II

**Quality Management:** Concept of quality management. Product vs. system quality. Quality assurance. Quality circles. Total quality management. ISO-9000 series and construction project.

### Unit-III

**Materials & Inventory Management:** Material management. Requirements and purchases. Different methods of inventory management. Mathematical modeling. Suitable inventory model for construction.

### Unit-IV

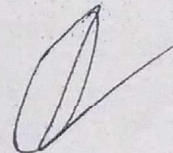
**Risk Management:** Decision theory, Decision under certainty. Probability and uncertainty, Decision risks. Risks involved in decisions pertaining to construction industry. Risk management, Insurance against risks.

### Unit-V

**Management Information System:** Principles of management information systems. Necessity and importance. Requirements of a good M.I.S. as a tool of data collection and dissemination. Use of tables and charts. Artificial intelligence. Expert systems. Decision support systems.

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24/03/14



# Project Planning, Scheduling and Controls

CCM 618 / MCTL 925

## Unit - I

### Project Planning:

Introduction to Project Planning Process. Types of Project Plans-Project feasibility plan, Project preliminary plan, Project construction plan. Introduction to network techniques - CPM, PERT and Precedence network.

Project Work Breakdown - Levels of Project work breakdown. Identification of construction activities by work breakdown structure. Identification of building construction activities using CI/SfB Manual. Activity duration and methods of estimating activity duration - One time estimate three time estimates, trapezoidal distribution estimate. Duration estimation procedure.

## Unit - II

### Project Network Analysis:

Elements of Network, development of network, Numbering of events, Event times - Earliest events time and latest event time. Slack, critical events. Activity times - Earliest start time, Latest finish time, Float and critical activities. Network critical path and its significance. Network analysis by CPM - Defining scope of work, determining activities, establishing work package logic, preparation of network logic program and draft network. Development of structured network using network drawing rules, Numbering of events and computation of critical path. Numerical problems.

## Unit-III

### Network Analysis by PERT & PN:

Modeling PERT Network. Estimation of expected activity duration and computation of critical path. Uncertainty in project duration estimation.

Precedence Network Analysis - Modeling procedure analysis of time in PN. Use of PN in repetitive works network. Difference between PN and CPM. Application of Network techniques and their limitations.

## Unit-IV

### Resource Planning:

Planning construction Manpower, Scheduling Construction site workers. Planning Construction Materials Materials quantity estimation. Constrained and unconstrained resource scheduling. Resource usage profile, Resource smoothing, Resource leveling.

## Unit-V

### Cost Control: Project cost:

Direct and indirect, slope of direct cost curve, Total project cost and optimum duration, Contracting the network for cost optimization. Escalate & Variation in prices.

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04/03/14

M.Tech. (Environmental Engineering )  
Environmental Chemistry & Microbiology MENL 911 / 530101

Unit - I

Composition of pure & impure water, anomalous behavior of water, analysis & interpretation of quality parameters, gas laws, law of mass action, solubility product, ionic reaction, redox reaction etc. chemical equilibrium, inorganic impurities, conductance, pH, buffering capacities & ionic impurities, carbonate equilibrium, acidity alkalinity.

Unit-II

Colloidal chemistry, coagulation, effect of alkalinity, organic impurities, BOD, COD, TOC, DO, gaseous impurities, DO, nitrogen, hydrogen, sulfur, ammonia, chlorine.

Unit-III

Micro-organism & their classification, cell structure, eukaryotes, prokaryotes, viruses nutrition & growth condition - temperature, pH, oxygen, nutritional requirements for selective microbes, metabolic classification of microbes, phototrophs, chemotrophs.

Unit-IV

Energy generation in cell, metabolism, aerobic & anaerobic of carbohydrates, proteins, lipids, nucleic acid, hydrocarbon, control of metabolic reactions, kinetics of bacterial growth, substrate utilization, cell growth.

Unit-V

Nuisance organisms - algae, fungi, protozoa, indicator organisms, bacteriological tests.

Books :

- 1) C.N. Sawyer, P.L. Mc Carty and G.F. Parkin, Chemistry for Environmental Engineering and Sciences, Tata McGraw Hill, Fifth edition, New Delhi, 2003
- 2) G.W. Vanloon and S.J. Duffy "Environmental chemistry - a global perspective, Oxford University press, New York., 2000.
- 3) Tortora. G.J. B.R. Furke, and C.L. Case, "Microbiology - An Introduction" ( 4<sup>th</sup> Ed.), Benjamin/ Cummings Pub. Co., Inc. California, 1992.
- 4) R.E. McKinney, "Microbiology for Sanitary Engineers", Mc Graw Hill Book Company, 1962.
- 5) W.G. Walter and R.H. McBee, "General Microbiology", East West Edition, 1969.

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Arwan



M.Tech. (Environmental Engineering )

**MATERIALS & EQUIPMENTS**

MENL 912 / 530102

**1. Concrete I:**

Ingredients, their properties and effect on concrete, Admixtures and additives, steps in production of concrete, e.g. Batching, mixing, Transporting, placing, compaction, finishing and curing.

**2. Concrete II :**

Statistical quality control of concrete, Principles of proportioning, introduction to various Mix Designing methods, I.S. method of Mix designing, Mix Designing for flexural strength, Mix designing for pumpable concrete, Mix designing for higher strength, Testing of concrete

**3. New Constructional Materials:**

Ferro cement, Light weight concrete, High Density concrete, Self levelling concrete. High performance concrete, shotcrete or gunitting, Polymer concrete, Fiber reinforced concrete, Jet cement concrete, Waste material based concrete, No fine concrete, Rollar compacted concrete, Ready mix concrete, Hollow / solid concrete blocks, aerated concrete / foam concrete, ACP, Types of glasses (sheet, float, frosted, wired, Tempered, sandwiched insulating, bullet resistance, glare reducing, reflecting, intelligent) Plastics (poly carbonate, PVC, PVC Foam sheet, window / door pannel & frame).

**4. Construction Techniques / materials :**

Water proofing, Damp proofing, Basic components & requirement of water proofing, water proofing types and their applications, Smart building materials and structures, Applications of smart materials, Alternate roofing materials, Geosynthetics.

**5. Construction Equipments:**

Mechanization in construction: Mechanized vis a vis Labor intensive construction techniques, Equipment selection & operation, Power shovels, drag line, Scrapper, Bulldozer, Rippers, Motor grader, their cycle time & capacity rating. Sizing and matching.

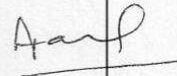
Reference Books:

- A.M. Neville 'Properties of Concrete', ELBS, London, \*A.M. Neville, 'Concrete Technology', E.I.B.S, London.
- M.L. Gambhir, 'Concrete Technology', Tata Mc Graw Hill, \* National Building Code, 1983.
- Peurifoy R.L. 'Construction Planning, Equipment & Methods', Mc Graw Hill book Co, Inc.
- Verma Mahesh, "Construction Equipments and its Planning & Application", Metropolitan Book Company, N. Delhi.
- M.L. Gambhir & Neha Jamwal " Building materials" Tata Mc Graw Hill, New Delhi.
- M.S. Shetti, " Concrete Technology " S. Chand Publications

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M.Tech. (Environmental Engineering )  
QUANTITATIVE METHODS

MENL 913 / 530103

**Unit-I**

**System Engineering:** System theory & principles; Decision theory & analysis; Decision under uncertainty & certainty, Risk analysis, Optimization theory for constrained and unconstrained & its techniques.

*Unit-II*

**Theory of Probability:** Definition of probability; Theorems of probability; Statistical methods; Probability distribution functions & its applications e.g. Normal, Log normal, Beta, Gamma, Pearson and Poisson's distribution; Introduction to correlation and regression; Simple & Multiple regression, Bivariate and Multivariate correlation.

**Unit-III**

**Programming Techniques-I:** Linear programming & applications, Graphical methods, Simplex method; Modified simplex method, Transportation problem; Assignment Problem.

**Unit-IV**

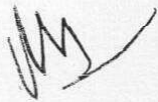
**Programming Techniques-II:**

Goal Programming; Integer Programming; Dynamic Programming; Non – Linear Programming.

**Unit-V**

**System Models:** Deterministic models; Probabilistic Models; Queuing model, Game theory; Simulation (Monte Carlo's Simulation).

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Abisari



M.Tech. (Environmental Engineering )

Solid Waste Management MENL 914 / 530104

Unit - I

Functional Elements of Solid Waste Management , Objective of Solid Waste Management, Principles of Municipal Solid Waste Management . Classification of solid waste, composition, physical, chemical & biological properties of municipal solid waste. Quantity of solid waste. Sampling & analysis of solid waste.

Unit-II

Collection, conveyance, separation & recycling of solid waste: Types of collection system, collection routes, equipments, transfer station, transport methods, material separation & recycling of MSW.

Unit-III

Disposal of solid waste - by land fill method: Classification, type, method, site consideration composition and control of gases, Leach ate control in land fills, surface water management, landfill operation & care. Remediation of old landfill sites.

Unit-IV

Disposal of solid waste by other methods: Thermal conversion technologies, Incineration, Pyrolysis, Gasification, environmental control system. Biological & Chemical conversion technologies aerobic composting, anaerobic digestion, other biological and chemical transformation.

Unit-V

Solid waste Management - legislative trend and planning issues: Major legislations, government agencies, future trend in planning. Hazardous solid waste management handling & Disposal. Disposal of Biomedical Waste, Demolition waste, Rubber, & Plastic Waste etc.

Books :

- 1) Solid waste management in developing countries By A.O. Bhide
- 2) Hilary Theisen and Samuel A, Vigil, George Tehobanoglous, Integrated Solid Waste Management Mc Graw- Hill Yew York, 1993.
- 3) CPHEEO, Manual on Municipal Solid Waste management, Central Public Health and Environmental Engineering organization, Government of India, New Delhi, 2000
- 4) Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
- 5) Vesilind P.A., Worrell W and Reinhard, Solid waste Engineering, Thomson Learning Inc., Singapore, 2003
- 6) Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.

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Asiwari

M.Tech. (Environmental Engineering )  
Functional Planning Building Services  
&  
Maintenance Management

MENL 915 / 530105

Importance of building services, type of services required to keep facility usable, planning of services. Organization structures of services management. Role and administrative functions of supervisors.

**Fire Fighting:**

Fire load, classification of fire, class of fire, Basic requirement of the works for fighting system, various components of the fire fighting system. Maintenance required of the system, fire fighting in high-rise buildings, commercial/industrial complexes. Public buildings, checklist for fire safety.

**Lifts/Elevators, Escalators:**

Legal formalities for elevators, various types of lifts, working mechanisms of lift and escalators. Indian standard codes for planning & installations of elevator, inspection & maintenance of lifts.

**Plumbing Services:**

Basics of Plumbing systems. Requirement of Plumbing works, Agency, Activity flow chart for plumbing work. Quality, checking of materials.

**Water Supply System:**

Water supply and distribution system is high-rise building & other complexes, pumps and pumping mechanisms. Operation & maintenance of fittings & fixtures of water supply & sanitary. Do's & Don'ts for water pipe networks.

Electrical network & appliances. Basics of single phase & three phase electrification, precautions and safety measures during electrification. Indian standard codes for electrical appliances & wiring operations & maintenance of network & appliances. Landscaping & Horticulture. Building maintenance management, applications of computer in service management.

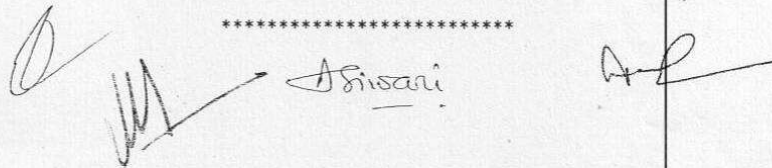
**Air-Conditioning and Heating:**

Flowcharts of air conditioning & heating. Centralised systems, monitoring and working of the equipments, Checklist of inspection, Performance testing. Water proofing. Damp proofing & Termite proofing. Working procedure & stages of work of water proofing for W.C., Bathrooms, Terrace, sloping roof, Basements, tanks. Use of chemicals for water proofing treatment. Role of consultants. Damp proof course. Causes and precautions for Dampness. Anti-termite treatment at pre-construction and post-construction. Routine treatment and precautions.

**Books:**

1. Hand book of Designing & installations of Services in High rise building complexes: By V.K. Jain Khanna Publishers.
2. Water Supply & sanitary installation, by A.C. Panchadhari, Willey eastern limited
3. Maintenance of Building, A.C. Panchadhari, New Age International Ltd.
4. Building Construction, by S.C. Rangwala, Khanna Publishers

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M.Tech. (Environmental Engineering )  
Air Pollution and Noise Pollution - MENL- 921 / 530201

**Unit - I**

**Air pollution its Sources & effects**

Definition of air pollution, Sources & Classifications of air pollutants Meteorology & air pollution, atmosphere layers & stability, Stack Plume behavior, Dispersion, Dispersion models, effects of air pollution on human animals, plants, and Economic effects. Acid rain, global warming, ozone layer depletion. Indoor Air pollution & occupational diseases.

**Unit-II**

**Sampling and analysis of air pollutants:**

Methods & Equipments for sampling, stack sampling, analytical methods for pollutant measurement, instrumental methods, Air pollution due to automobile, PCM, PAN, Major air pollution Episodes.

**Unit- III**

**Air pollution Control Equipments**

Objectives, types of Equipments, Settling chambers, separators, cyclones, traps, filters, ESP, Scrubbers/ wet collectors, towers, choice of equipments, Gaseous pollutant control equipment, odour & its control. Stake Monitoring kit, Auto exhaust analyser.

**Unit - IV**

**Air pollution prevention & Control Acts**

Air pollution survey, Air pollution Indices, Air pollution standards, Air quality & emission standards, Air pollution from major industrial operations, Air pollution control & Strategies, process changes, substitution of materials, zoning, Air pollution in Indian cities.

**Unit -V**

**Noise Pollution:**

Scale of noise, Measurement of sound, Noise Standards, Meter control and prevention of noise pollution, Properties of sound, Intensity and sound level, colorization of noise effect of noise on people, Noise rating system, Community noise sources and criteria, Transmission of outdoor sound, Traffic noise and its reduction, sound level meter

**Books:**

Air pollution - By Stern & Stern  
Air pollution - Hanery Perkinson  
Air pollution - M.N. Rao and A. V. N. Rao  
Noise pollution - By Chatier

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M.Tech. (Environmental Engineering )  
Advance Treatment Process – I (Water Supply Engg.)  
MENL - 922 / 530202

UNIT – I

*Components of a distribution system,*  
Water Supply Principles and design of distribution system, Equivalent pipe method, Hardy cross and section method, Electrical Network analogy method, Maintenance of distribution system, corrosion and methods of control, computer applications in distribution network analysis.

UNIT-II

Quality of water: Factors affecting water quality in various sources, protection of water quality, classification of natural water with reference to the best use. Bacteriological quality of water, effect on health, standards of water for various uses, water quality index, *Minimal National Standards (MINAS), their significance in relation to industrial pollution control.*

UNIT – III

**Preliminary Treatment and Sedimentation :** Degree of treatment required, various operation and flow sheet, preliminary treatment methods such as screening , coagulation , perikinetic and orthokinetic flocculation, *velocity gradient, coagulants and coagulant aids, polyelectrolyte,* Sedimentation, class I and class II clarification, column settling test, zone and compression settling, *floatation,* design of sedimentation tank- various types and their working. Tube settlers. *and their design .*

UNIT- IV

**Filtration and Disinfection :** Slow and rapid sand filters, theory of filtration, design, operation, performance and evaluation of filter, pressure filter, multi-media filter, diatomaceous earth filter, disinfection of water, free and combined chlorine, fixed bed disinfectors.

UNIT-V

*kinetics, amount of chemicals required for disinfection*  
Non – conventional treatment units: Water softening, methods of *softening, Application of Membrane Process.* removal of fluorides, iron and manganese, taste and odour removal, Industrial water conditioning, *Reverse* demineralization, *scale and corrosion control,* Langlier saturation index, management of water *Operate* treatment plant residues, design of complete water treatment scheme.

*Electrochemical*

Books:

1. Water Supply Engineering : By S.K. Garg
2. Water & Wastewater Technology by Mark J. Hammer (John Wiley & Sons Inc., 1986)
3. Water Supply Engineering by H.E. Babbitt & J.J. Donald
4. Water & Wastewater Engg. Vol.I & II by G.M. Fair & J.C. Geyer (John Wiley & Sons, New York)
5. Manual on Water supply and Treatment – Expert Committee of G.O.I., Ministry of Urban Development New Delhi.
6. Water Supply & Sanitary Engineering by S.K. Husain (Oxford & IBH Publishing Co. New Delhi, India )

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M.Tech. (Environmental Engineering )  
Advance Treatment Process – II (Sanitary Engg. )  
MENL-923 / 530203

UNIT – I

Waste Water collection : Estimation of sewage flow, fluctuations, self – cleansing velocity, storm water quantity, systems of sewerage. Design of sanitary and storm sewer,, sewer materials and appurtenances, construction of sewer line and its maintenance.

UNIT-II

Wastewater flow and characteristics: Estimate of domestic waste water flow, fluctuations, storm water and runoff, Characteristics of wastewater, oxygen requirement.

UNIT-III

**Conventional treatments units:** Units operations for treatment, preliminary, primary and biological methods, hydraulic design of screens, grit chamber, sedimentation and skimming tank, performance and evaluation. Trickling filters, flow sheet, loading rates, kinetics of BOD removal, design, construction and performance, conventional units, types and design, of stabilization ponds, aerated lagoons, oxidation ditch, septic and imhoff tank. Biological contractor, anaerobic filters, conventional and high rate anaerobic digester, sludge drying beds, thickening of sludge, vacuum filter Design of complete wastewater treatment plant.

UNIT-IV

Non-conventional units: Nitrogen conversion and removal, removal of phosphorous chemical oxidation, removal of dissolved inorganic substances.

UNIT-V

Disposal: Disposal by dilution, natural purification of streams, oxygen sage curve, maximum allowable loading, stream and effluent standards, standards of effluent for various purposes, **sewage farming construction and maintenance of sewage farm.**

Books:

- i) Waste water Engineering (Treatment, Disposal, Reuse), By- Metcalf & Eddy, TMH Publication
- ii) Waste Water Treatment for pollution Control and Reuse by Soil. J. Arceivable & Shyam R Asdak , MC Graw Hill
- iii) Waste Water treatment y MH Rao & A.K. Datta, Oxford & IBH Publication
- iv) Waste Water Engienering (Concept & Design approach) by G.L. Karia & RA Christian PHI learning PVT Ltd.

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# PROJECT MANAGEMENT

530204/624CCM/MCTL 924 /MENL 924

## Unit-I

**Waste Management:** Introduction to waste and waste management. The concepts of waste productivity and its interrelationship with productivity. System concept of waste. Complementarity of waste and resource management.

## Unit-II

**Quality Management:** Concept of quality management. Product vs. system quality. Quality assurance. Quality circles. Total quality management. ISO-9000 series and construction project.

## Unit-III

**Materials & Inventory Management:** Material management. Requirements and purchases. Different methods of inventory management. Mathematical modeling. Suitable inventory model for construction.

## Unit-IV

**Risk Management:** Decision theory, Decision under certainty. Probability and uncertainty, Decision risks. Risks involved in decisions pertaining to construction industry. Risk management, Insurance against risks.

## Unit-V

**Management Information System:** Principles of management information systems. Necessity and importance. Requirements of a good M.I.S. as a tool of data collection and dissemination. Use of table and charts. Artificial intelligence. Expert systems. Decision support systems.

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Books:-

- (1) Construction Project Management - ~~By K.K. Chitkara & K.K. Chitkara~~  
By K.K. Chitkara, TMH
- (2) Construction and Project Management - By Prof. K. G. Krishnamurthy & S.V. Ravindar, CBS publishers
- (3)

UB

M.Tech. (Environmental Engineering )  
Environmental Impact Assessment and Ethics  
MENL - 925 / 530205

**Unit - I**

**Evolution of EIA:** Concepts, Methodologies, Screening, Scoping, Base line studies, Mitigation, Matrices, Check list. Methods for impact assessment : Background information, interaction matrix methodologies, network methodologies etc, environmental setting various factors, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment.

**Unit - II**

**Prediction and assessment of impact for air and noise environment:** Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

**Unit - III**

**Prediction and assessment of impact for water and soil environment :** Basic information of water quality ( Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.

**Unit - IV**

**Prediction and assessment of impact on cultural and socioeconomic environment :** Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

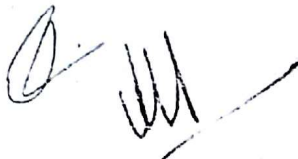
**Unit - V**

**Environmental Ethics,** Objectives of ethics, Ethical theories, Code of Ethics, Importance and limitations of ethics, Environmental Ethics in India, List of prevalent Environmental Acts, Brief description related to the purpose with at least five important provisions Water (Prevention and control of pollution) Act 1974, Air (Prevention and control of pollution) Act 1981, Environmental Protection Act, 1986.

**Reference Books:**

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Petter Watten (Eds.)- ' Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988).

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