SYLLABUS

For

Master of Engineering Programmes
(M.Tech. Infrastructure Engineering)

(For admission in 2022-23 and onwards)
### Proposed Scheme of Examination of M.Tech. 2 Year Programme for Specialisation: Infrastructure Engineering

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Semester IV

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Total: 15 L, 0 T, 6 P, 17 Credits, 300 Internal Marks, 550 External Marks, 800 Total Marks
Course objectives:

From this course, students will be able to:
1. learn distinct methods of solving simultaneous equations.
2. well-versed with partial differential equations and their solutions and applications.
3. acquire the knowledge of transformation to ease the complex problems.
4. acquaintance with basics of random variables and their distribution for dealing with events by chance.
5. study different mathematical domains to deal with real-time engineering problems.

Learning outcomes:

1. Comprehend with engineering problems in different mathematical realm.
2. Learn analytical and numerical methods to deal with mathematical problems.
3. Understand how to model the engineering problems and their solutions.
4. Implement the solutions to real-time complex engineering problems.
5. Apprehend with mathematical methodology.

Course content:

Unit I: Solution of linear simultaneous equations: (8 hours)

Consistency, Iterative method, Convergence, Cholesky’s (Crout’s) method, Gauss-Jordan method, Gauss-Seidel iteration and relaxation methods, Solution of Eigenvalue problems, Smallest, largest, and intermediate Eigen values

Computer based algorithm and programme for these methods (non-evaluative)

Unit II: Partial differential equation and its applications: (10 hours)

Introduction and classification of partial differential equation, Four standard forms of non-linear partial differential equations and their solutions, linear equations with constant coefficients. Applications of partial differential equationsone and two-dimensional wave equation, one and two-dimensional heat equation, Two-dimensional Laplace’s equation.
Syllabus
Advanced Mathematics (AHT-301)

L:T:P:: 3:1:0

Credits-4

Unit III: Transform calculus-I: (8 hours)
Laplace transform, Properties of Laplace transform, Inverse Laplace transform, Applications of Laplace transform, Fourier integral theorem, Fourier transforms, Application of Fourier transform

Unit IV: Transform calculus-II: (8 hours)
Z-transform, Properties of Z-transform, Shifting theorems, Initial and final value theorem, Convolution theorems, Inverse Z-transform, Application of Z-transform

Unit V: Basic probability theory: (8 hours)
Concept and laws of probability, Discrete and continuous random variable and their distributions; Some special distributions such as Binomial, Poisson, Negative Binomial, Geometric, Continuous uniform, Normal, Exponential, Weibull, Moments, Moment generating functions, Expectation and variance

Practical demo with statistical software like R, SPSS, SAS, etc. (non-evaluative)

Text Books / References:
Course objective: To study the necessity of infrastructure & its management, finance management Fundamentals & Evaluation and managerial economics.

Course outcomes:
On the completion of this course the student will be able to:
1. Summarize the concept of Infrastructure and their status in India.
2. Outline the details of Infrastructure Planning.
3. Prepare the detailed planning process for managing a Infrastructure project.

Syllabus:

Unit- I (8 hours)
Introduction to Infrastructure: Types of infrastructure, Role of infrastructure, Infrastructure crisis, Attributes of Infrastructure, Infrastructure and Economic Growth and poverty reduction, Indian scenario and future outlook

Unit- II (8 hours)
Infrastructural Sectors and their Status in India: Overview, Characteristics, Performance, Reforms and Policies, Targets, Subsidies and Privatization, Policy Initiatives, Reforms, National policies, Regulatory Authorities in Power Sector, Water sector, Transportation Infrastructure, Telecommunications Infrastructure in India

Unit- III (8 hours)
Infrastructure Planning-Part A: Infrastructure planning steps: Problem diagnosis (Population and employment, Land use, Economic base, Transportation system, Travel patterns, Social and value factors, Financial resources, Ordinances, statutes and regulations), Goal articulation, Forecasting, Design of alternatives.

Unit- IV (8 hours)

Unit- V (8 hours)
Managing the planning process: Management summary, Project description and appraisal, Technical section (Work breakdown structure, Task sheets, Deliverables, Flow diagram, Gantt chart, Budget and cash flow), Organization section (Team's structure, Responsibility matrix, Client interface).

TEXT BOOKS / REFERENCES:
INFRASTRUCTURE PLANNING

Syllabus

INFRASTRUCTURE PLANNING CET-501

1. Infrastructure Planning, Parkin and Sharma, Thomas Telford Publications.
Syllabus

PROJECT MANAGEMENT IN CONSTRUCTION AND BIM CET-502

3T:1T:0P Credit: 4

Course objective: The objective of the course is to provide efficient communication, collaboration, and productive guidelines to achieve project goals within the estimated time with high quality. BIM helps the construction manager to gather data and information from the relevant disciplines and communicate them more effectively.

Course outcomes:
On the completion of this course the student will be able to:

1. Outline the concept of Project Management and solve the planning by application of various Network Scheduling Techniques
2. Use the concepts of Pricing, quality, safety Management regarding a Project
3. Identify factors of Quality Management
4. Learn new techniques of project management like BIM

Syllabus:

Unit- 1 (8 hours)
Introduction to Project Management: Introduction to project management, objectives of a project, Stakeholders, Phases and project organization. Introduction to resource management in construction projects. Life Cycle of a construction project.

Unit- 2 (8 hours)
Estimation and Network based project management:
Estimating quantities, estimation of project cost, rate analysis, measurement in civil engineering, Project planning, Activity time, Time management tools, progress monitoring, introduction to network analysis concepts, scheduling, PERT.

Unit- 3 (8 hours)
Contract and Quality, Safety Management: Procurement, Types of Contracts, Contract Closure, Quality control in construction, Quality assurance, quality standardization, Elements and economics of quality, Total Quality Management (TQM), Introduction to construction safety, safety management, safety guidelines.
Unit- 4  
Modern Developments in Project Management: The Current Business Model, Inefficiencies of Traditional Approaches Definition of BIM, Components of BIM, Advantages of BIM over traditional design-build process, Use of BIM, Benefits of BIM for a construction project, Importance of BIM in construction industry.

Unit- 5  
BIM and Smart cities: Concept and definition of Smart Cities. Understanding Smart cities and BIM. Future of BIM and its role in creating Smart Cities. Introduction to various types of sensors and ICT. Role of above modern tools in the BIM process, scan to BIM.

TEXT BOOKS / REFERENCES:


Syllabus

OPTIMIZATION METHODS   CET-503
3T:0T:0P                                                                                                    Credit: 3

Course objective: The objective of the course is to provide optimal solutions to a particular problem.

Course outcomes:

On completion of the course, the student will be able to:

1. Determine the need for optimal design in engineering, necessary and sufficient conditions of optimality.
2. Determine the optimality of constrained and unconstrained problems using classical search techniques.
3. Determine the optimality of non-linear problems and linear problems using classical optimization methods.
4. Apply evolutionary algorithms for basic problems as well as advanced engineering design problems.

Syllabus:

Unit- I                                                                                                               (8 hours)
Introduction to Optimization: Basics of engineering analysis and design, Need for optimal design, Difficulties associated with optimization problems, Problems of global and local optima, Single and multivariable problems, Necessary and sufficient condition for optimality.

Unit- II                                                                                                               (8 hours)
Classical Optimization 1: Basics of constrained and unconstrained problems, Stationary points, points of maxima, points of minima and inflection points, Exhaustive search method, Bounding phase method, Region elimination method, Interval halving method, Golden section search method, Newton-Raphson Method and Bisection method.

Unit- III                                                                                                               (8 hours)
Classical Optimization 2: Definition of descent direction, Steepest descent direction method, Newton method, Quadratic approximation of a function, Convex and concave functions, Convex optimization problem, Kuhn-Tucker conditions, Linear Programming, Simplex method and Dynamic programming.

Unit- IV                                                                                                               (8 hours)
Non-Classical and Metaheuristic Optimization Algorithms 1: Introduction to Evolutionary algorithms, Introduction to Genetic Algorithm (GA), Differential Evolution (DE), Simulated
Annealing (SA).

**Unit- V**

**Non-Classical and Metaheuristic Optimization Algorithms 2:** Particle Swarm Optimization (PSO), Firefly Algorithms (FA), Shuffled Frog Leaping Algorithm (SFLA), Invasive Weed Growth Optimization (IWO) and other metaheuristic principles of biomimicry.

**TEXT BOOKS / REFERENCES:**


systems; Adaptive step size; Stiff ODEs, Shooting method; Finite differences; Over/Under Relaxation (SOR).
Syllabus
NUMERICAL METHODS CET-504

3T:0T:0P  Credit: 3

Course objective: The objective of the course is to enhance the problem solving skills of engineering students using an extremely powerful problem solving tool namely numerical methods.

Course outcomes:
On completion of the course, the student will be able to:
1. Determine the need for numerical methods in engineering design.
2. Evaluate the linear system of equations using numerical analysis.
3. Estimate the solution to a system of algebraic equations using different iterative methods.
4. Evaluate the techniques of numerical integration and differentiation to solve complex problems.
5. Apply numerical methods to initial and boundary valued problems and formulate the finite difference forms of partial and ordinary differentials.

Syllabus:

Unit- I (8 hours)
Introduction to Numerical Methods: Introduction & Approximations, Motivation and Applications, Accuracy and precision; Truncation and round-off errors; Binary Number System; Error propagation, Error Analysis.

Unit- II (8 hours)
Linear Systems and Equations: Matrix representation; Cramer’s rule; Gauss Elimination; Matrix Inversion; LU Decomposition; Iterative Methods; Relaxation Methods; Eigen Values.

Unit- III (8 hours)
Algebraic Equations: Bracketing Methods, Introduction to Algebraic Equations, Bracketing methods: Bisection, Reguli-Falsi; Open Methods: Secant; Fixed point iteration; Newton-Raphson; Multivariate Newton’s method.

Unit- IV (8 hours)
Numerical Differentiation and Integration: Numerical differentiation; error analysis; higher order formulae, Trapezoidal rules; Simpson’s rules; Quadrature, Linear regression; Least squares; Total Least Squares; Interpolation; Newton’s Difference Formulae; Cubic Splines.

Unit- V (8 hours)
Applications of Numerical Methods: Initial Value Problems (IVP), Introduction to ODE- IVP,
Euler’s methods; Runge-Kutta methods; Predictor-corrector methods; Extension to multi-variable systems; Adaptive step size; Stiff ODEs, Shooting method; Finite differences; Over/Under Relaxation (SOR).

TEXT BOOKS / REFERENCES:

Syllabus

COMPUTATIONAL METHODS IN CIVIL ENGINEERING CET-505

3T:0T:0P  Credit: 3

Course objective: The objective of the course is to introduce students to numerical methods for solving problems in civil engineering (both for modeling and experimental work).

Course outcomes:

On completion of the course, the student will be able to:

1. Identify and formulate a solution procedure for different types of equations encountered in civil engineering curriculum.
2. Discretize the total domain of model using different techniques based on the type of equation that needs to be solved.
3. Apply different numerical techniques to solve the equations and to successfully prepare a numerical model in theory.
4. Develop models that can solve a given partial differential equation under different boundary conditions using Finite Difference Method (FDM), or Finite Volume Method (FVM), or Finite Element Method (FEM) using programming.

Syllabus:

Unit- I  (8 hours)

Unit- II  (8 hours)
Mathematical nature of PDEs, Hyperbolic, Parabolic, Elliptic Equations and flow equations. Basic Discretization techniques: Finite Difference Method (FDM), Implicit and explicit formulations of FDM, Stability criteria of the forms of equations using error minimization.

Unit- III  (8 hours)
Application of FDM to wave, Heat and Laplace equations. Linear multi-step methods; Predictor-corrector schemes, ADI methods, Grid transformations according to the appropriate boundaries. Lax-Wendroff Technique and MacCormack’s Technique.

Unit- IV  (8 hours)
The Finite Volume Method (FVM) and conservative discretization. Analysis and Application of

**Unit- V**  
(8 hours)

Basics of the Finite Element Method (FEM) and the Galerkin formulations. Basics of the computations of the differential equations using the three methods (FDM, FVM and FEM) in MATLAB, Python etc.

**TEXT BOOKS / REFERENCES:**

Syllabus

URBAN FLOODING AND DISASTER MANAGEMENT CET-506

3T:0T:0P  

Credit: 3

Course objective: To impart knowledge and skills relevant to water management in the context of urbanization and relate engineering principles to storm water and wastewater management, along with Policy, Planning, and Economic evaluation issues in urban areas.

Course outcomes:

On the completion of course student will be able to:

1. Determine the importance of watershed management and analyse the precipitation data.
2. Critique the types of disaster management and mitigation methods.
3. Evaluate the natural disaster types with related cases of urban flooding.
4. Analyse the variability of climate change and its corresponding impact on urban flooding.
5. Design the watershed systems with policies and planning according to the economic issues in urban areas.

Syllabus:

Unit- I  
Basic Concepts of hydrological phenomena: Course overview, Introduction, Why watershed hydrology & management? Water cycle, Precipitation and Interception: Formation, Intensity and types, plant canopy Interception and through fall, Measurements, Precipitation data analysis and statistical analysis of data.  

Unit- II  

Unit- III  
Natural Hazards Risk Management and Urban flooding: Types of natural disaster, Meaning of urban flooding, Use of GIS in hazard risk management, Disaster Risk management in different parts of India: case study of different states, Disaster Risk management in different parts of world: case study.

Unit- IV  
Climate Variability & Disaster Risk and Urban-Rural Risk Management: Climate change,
Effect of climate change on Urban flooding, Future sustainability study due to climate change on urban flooding.

**Unit- V**

Watershed modelling and management: Watershed modelling and analysis: Selection, calibration and validation, Watershed management: Policy, Planning, and Economic evaluation issues in urban areas.

**TEXTBOOKS/REFERENCES:**

Course objective: To educate the students on economical treatment of water and wastewater, design of water mains, distribution system and sewer networks

Course outcomes:
On the completion of course student will be able to:

1. Determine the different conditions of water demand according to the areas of urbanization.
2. Analyse the basis of water distribution networks and determine the different treatment methods.
3. Evaluate the cases of transients in water distribution systems and remediation’s to control the transients.
4. Validate the different wastewater collection systems and design the collection systems
5. Examine the water quality using traditional and modern methods of testing.

Syllabus:

Unit- I  (8 hours)

Introduction: Components of water supply systems, Water use and demand estimation, Surface water and Groundwater sources, Water quality and drinking water standards, Determination of reservoir capacity. Design period, population data and flow rates for water supply systems, Factors affecting water consumption and variation in demand.

Unit- II  (8 hours)


Unit- III  (8 hours)

Design of Water distribution networks: Transient cases of sudden closure of valves pump failures and initialization of pumps, Methods of analysis for optimal distribution network design, Air valves, pressure relief valves and surge tanks and their optimal locations. Types of reservoirs and design parameters and methods; Design of water pumping stations.
Unit- IV  
(8 hours)

Wastewater collection systems: Design principles, separate, combined and semi-combined sewers, Estimation of dry weather flows, Sewer Materials and Sewer Appurtenances, Sewer pipe hydraulics: sizing of pipes and design, Manhole chambers and storm water overflows.

Unit- V  
(8 hours)

Maintenance of water supply and wastewater systems: Cleaning of water towers (Overhead Tanks), Analysis of wastewater – determination of solids, COD, BOD, nutrients, heavy metals and their significance, BOD progression and its formulations. Pumping stations, screens and inverted screens, Regular checks of leakages from sewer lines, monitoring wells near the potential source locations.

TEXTBOOKS / REFERENCES:

Course objective: To make the students understand the basics of water resources system, Urban storm water management.

Course outcomes:

On the completion of course the student will be able to:

1. Understand the need for systems approach for water resources.
2. Solve different problems of reservoir operation using linear programming principles.
3. Analyse different problems of multiple reservoirs and capacity planning using dynamic programming principles and genetic algorithms.
4. Evaluate the effect of time series analysis for the assessment of risk in hydraulic designs.
5. Systematize the types of water resource systems and perform analysis related to social and economic impact.

Syllabus:

Unit- I  
Basic concepts of systems need for systems approach in water resources, system design techniques, problem formulation.

Unit- II  
Introduction to Optimization, Optimization techniques, Linear Programming, Graphical Method, Simplex Method, Dual Simplex Problem, Reservoir operation and Reservoir sizing using Linear Programming.

Unit- III  
Non-Linear Programming, Dynamic programming, genetic algorithm, sensitivity analysis, capacity expansion, reservoir operation problems, simulation, case studies, Multi reservoir operation.
Syllabus
WATER RESOURCES SYSTEM: PLANNING AND MANAGEMENT  CET-508

3T:0T:0P  
Credit: 3

Unit- IV  
(8 hours)

Unit- V  
(8 hours)
Planning, role of a planner, River basin planning and management, Water distribution system, Groundwater system, Flood plain Management, Urban storm water management, National water policies, public involvement, social impact, economic analysis.

TEXTBOOKS/REFERENCES:

Course objective: To make the students understand the basics of different software to solve the civil engineering projects related problems.

Course outcomes:
On completion of the course, the students will be able to:
1. To plan, schedule and control the construction of the project.
2. To use project planning tools.
3. To carry out cost analysis and project updating.
4. To study risk analysis and resource allocation at site.

EXPERIMENTS:
1. Introduction to MS Project, Quick Access Tool Bars and Ribbon Customization, opening a File Template, Import from Excel.
3. Resources and Adding a Work Resources, Material Resources, Cost Resources and Assigning, Duration Work and Unit, Assigning Resources to Task, Overallocation.
4. Effort Driven Scheduling, Modifying Resources, Replacing Resources, choosing a View, Table Setting: (Column and Its Setting, Multi Windows Feature), Timeline, Sorting Tasks and Resources, Group Filter and Highlight, Formatting Bars and Text.


4. Working with Layouts, Grouping and Sorting and Filtering, Customizing Layout, Customizing Report, Printing Layout and Reports, Exporting Data from XER, XML and MS Project Formats, Importing Data from XER, XML and MS Project Formats.

TEXT/REFERENCE BOOKS:
- Paul E Harris, 2015, Planning and Control Using Oracle Primavera P6 Versions 8.1 to 15.1 PPM Professional.
- Jongpil Nam, 2016, Construction Scheduling With Primavera P6, AuthorHouseUK.
Course objective: To impart knowledge and skills relevant to programming allows implementing new inventions, projects and ideas much faster and easier, which streamlines the job for engineers.

Course outcomes:

On the completion of this course the student will be able to:
1. Determine the different data types and their specificity of application to problems
2. Analyse the importance of loops, algorithms and pseudo codes along with their applications to engineering problems
3. Construct the formulation of mathematical partial differentials into numerical methods of programming using FDM and FVM techniques
4. Solve a given minimization problem using meta heuristic principles

EXPERIMENTS:

1. Introduction to data types, numbers, strings, lists, arrays, vector and tensor arrays
2. Introduction to Python Math, Numpy and Scipy
3. Introduction to for loop, if else condition, while loop and function definitions
4. Conversion of Problems in mathematical form to programming language form
5. Algorithms, Flow charts and pseudo codes for problem examples
6. Practicing iterative optimization and numerical methods of problem-solving using Python
7. Finite difference (FDM) and finite volume (FVM) formulations of Partial Differential Equations (PDEs)
8. Discretization of space and time to solve the different PDEs of Engineering problems
9. Writing a code to solve a given PDE using FDM or FVM techniques
10. Writing a code to write a metaheuristic algorithm (Genetic Algorithm) to solve any optimization problem.

Books,
1. Al Sweigart Automate the Boring Stuff with Python, 2nd Edition
2. Charles Severance Python for Everybody: Exploring Data in Python 3
Syllabus

Open Elective-1
(Optional)

CET-623

3L:0T:0P

Credit: 3

Course objective: To make the students understand the key concepts in disaster risk reduction and humanitarian. Summarize basics of disaster, Illustrate disaster risk reduction and humanitarian response policy and practice from multiple responses. Describe an understanding of standards of humanitarian response and practical relevance in perspectives.

Course outcomes:
1. Ability to summarize basics of disaster
2. Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Ability to develop the strengths and weaknesses of disaster management approaches

Syllabus:

Unit- I (8 hours)
INTRODUCTION Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Unit- II (8 hours)

Unit- III (8 hours)
DISASTER PRONE AREAS IN INDIA: Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

Unit- IV (8 hours)
DISASTER PREPAREDNESS AND MANAGEMENT: Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.
Open Elective-1
(Peripheral)
3L: 0T:0P
Credit: 3

Unit- V (8 hours)
RISK ASSESSMENT: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

REFERENCES
Open Elective-1
(Optional) URBAN ENVIRONMENTAL MANAGEMENT(CET-523)
3L: 0T:0P Credit: 3

Course objective: To educate the students to prevent pollution, meet compliance obligations and enhance conditions of the environment, and its allied problems.

Course outcomes:

On the completion of course student will be able to:

1. Explain planning of a city and identify various urban environmental issues
2. Prepare project Plans to integrate urban water resource
3. Explain water resource management using available water resources
4. Develop sustainable wastewater management concepts comparing with successful models followed in developed nation
5. Apply the principles of solid waste management

Syllabus:

Unit- I (8 hours)

Unit- II (8 hours)
Urban Waste Resources Management: Water in urban ecosystem – urban water resources planning and organization aspects storm water management practices-types of storage-magnitude of storage-storage capacity of urban components - percolation ponds - temple tanks- rainwater harvesting.

Unit- III (8 hours)

Unit- IV (8 hours)
Open Elective-1
(Optional  URBAN ENVIRONMENTAL MANAGEMENT(CET-523)

3L: 0T:0P  
Credit: 3

Unit- V  
(8 hours)


TEXTBOOKS/REFERENCES:

Technical Writing and Presentation Skills (AHT-303)

Course Objectives:
- To develop effective writing and presentation skills in students.
- To develop textual, linguistic and presentation competencies in students appropriate for their professional careers.

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

CO1: Write clearly and fluently to produce effective technical documents.

CO2: Demonstrate an appropriate communication style to different types of audiences both orally and written as per demand of their professional careers.

CO3: Communicate in an ethically responsible manner.

Course Contents:

WRITING SKILLS

Unit-I (4 hours)
Technical Writing-Basic Principles: Words-Phrases-Sentences, Construction of Cohesive Paragraphs, Elements of Style.

Unit-II (4 hours)
Principles of Summarizing: Abstract, Summary, Synopsis

Unit-III (6 hours)
Technical Reports: Salient Features, Types of Reports, Structure of Reports, Data Collection, Use of Graphic Aids, Drafting and Writing

PRESENTATION SKILLS

Unit-IV (6 hours)

Unit-V (8 hours)

References:
Syllabus

FINANCING INFRASTRUCTURE PROJECTS (CET 509)

3L:0T:0P Credit:3

Course objective: Students should have a basic knowledge of financing of different civil engineering projects.

Course outcomes:

On the completion of course student will be able to:

1. Differentiate the concept of Infrastructure financing from general financing and illustrate various types of project agreements
2. Relate to various types of risks in infrastructure projects
3. Demonstrate various financial structures of infrastructure projects and compare between various financial support options.
4. Differentiate the concept of Infrastructure financing from general financing and illustrate various types of project agreements
5. Relate to various types of risks in infrastructure projects
6. Demonstrate various financial structures of infrastructure projects and compare between various financial support options

Syllabus:

Unit- I (8 hours)
Introduction to Infrastructure Financing: Introduction to infrastructure financing; Elements of a project-finance structure, Benefits of Project finance, Sponsors and other investors, Procurement of infrastructure projects, Commercial banks, Bonds

Unit- II (8 hours)
Project Agreement: Types of project agreement (BOT, BTO, BOOT, BOO), Offtake contract, Concession agreement, Other ‘PPP-like’ contracts, Aspects of project agreements, Compensation events, Relief events, Termination of project agreement

Unit- III (8 hours)
Risks in Infrastructure Projects: Commercial risks, Analysis of commercial risks, Macro-Economic Risks, Time value of money, discounted cash Flow, Internal rate of return, Inflation, Regulatory and Political Risks, Change in law, Investment risks, Risk evaluation and Allocation

Unit- IV (8 hours)
Financial Structuring: Investors analysis and equity structure, Debt cover ratios, Debt: Equity ratio, Debt service profile, Interest rate and fees, Additional costs, optimizing the financial structure

Unit- V (8 hours)
Financial Support: Indirect and direct Public-sector financial support, Gap Financing, Credit Guarantee Finance, Capital Grant, Viability-Gap Funding, Minimum Revenue Guarantee, Tariff
Syllabus

FINANCING INFRASTRUCTURE PROJECTS (CET 509)

Subsidy, Export Credit Agencies, Multilateral Development-Finance Institutions

Text books:
2. Infrastructure Planning and Management: An Integrated Approach, Virendra Proag Springer Publications.

Reference books:
Syllabus

CONSTRUCTION METHODS & EQUIPMENT MANAGEMENT (CET 510 )

3L: 0T:0P                                                                                                                            Credit:3

Course objective: To study the Initiation, Planning and Design, Construction and Execution, Monitoring and Control, Completion.

Course outcomes:

On the completion of course student will be able to:

1. Explain Equipment Economics and perform Ownership and operating costs calculation
2. Classify various types of equipment and calculate their capacities along with productivity
3. Assess appropriate type of equipment to be employed in a construction activity

Syllabus:

Unit- I  (8 hours)

Introduction to Equipment Economics: Planning Process for Equipment and Methods; Cost of Owning and Operating Construction Equipment - Ownership cost, Depreciation, Operating cost, and Ownership and operating costs calculation methods; Replacement Decisions, Rent and Lease Considerations

Unit- II  (8 hours)


Unit- III  (8 hours)


Unit- IV  (8 hours)

Trucks and Hauling Equipment, Asphalt Mix Production and Placement: Capacities of Trucks and Hauling Equipment, Calculating Truck Productivity, Truck Performance Calculations;

Paving Equipment, Sweeper, Asphalt Distributors, Haul Trucks, Asphalt Pavers, Compaction Equipment

Unit- V  (8 hours)

Concrete Equipment and Pile-Driving Equipment: Batching Concrete Materials, Mixing and
Syllabus

CONSTRUCTION METHODS & EQUIPMENT MANAGEMENT (CET 510 )

3L: 0T:0P Credit:3

Placing Concrete, Consolidating Concrete, Finishing and Curing Concrete. Driving Piles, Pile Hammers, Supporting and Positioning Piles During Driving, Spudding and Preaugering.

Text books:


Reference Books:

Course objective: To study the necessity of infrastructure & its management, finance management Fundamentals & Evaluation and managerial economics.

Course outcomes:
On the completion of course student will be able to:
1. Describe the phases of soil investigation in depth and identify the plan for soil investigation
2. Identify various methods of soil investigation and soil sampling
3. Illustrate various field test of soils and rocks
5. Work with relevant instrumentation required for characterizing the soil

Syllabus:

Unit- I

Unit- II
Methods of investigations and Sampling: Trial pits/Trenches, Borings/drilling, Auger boring, Wash boring, Percussion drilling, Rotary drilling, Sample Disturbance, Disturbed Sample, Undisturbed Samples, Sampling by standard split spoon, Sampling by thin-wall tube, Sampling by Piston sampler.

Unit- III
Geotechnical investigation (Semi-direct methods): Vane Shear test, Standard Penetration Test, Pressure meter Test, Cone Penetration Test, Dilatometer test, Rock core drilling, Sampling of rock, Core stacking, Rock Quality Designation (RQD), Total Core Recovery (TCR).

Unit- IV

Unit- V
Soil Exploration Report and Field Instrumentation: Components of Soil Exploration Report, Drafting of Reports, Graphic Presentations of Bore Log, Study of Sample Reports, Field Instrumentation: Pressure meters, Piezometer, Pressure cells, Sensors, Inclinometers, Strain gauges etc.

Text books:
Syllabus

SUBSURFACE INVESTIGATION AND INSTRUMENTATION (CET 511)

3L:0T:0P Credit:3

1. Principles of Geotechnical Engineering, Braja M. Das, Cengage
2. Basic and applied Soil Mechanics, Rajan & Rao, New Age International Publishers

Reference books:
2. Latest version of relevant IS codes for various tests.
Syllabus

GROUND IMPROVEMENT TECHNIQUES (CET 512)

3L:0T:0P                                                                                                                                         Credit:3

Course objective: The objectives of the course are for the students to improve bearing capacity and reduce settlement of soft ground, prevent earthquake liquefaction, control groundwater, stabilize excavation bottom, prevent deformation of surrounding ground, or clean up contaminated ground.

Course outcomes:
After the completion of this course, the student will be able to:
1. Identify the necessity of ground improvement.
2. Understand the different types of ground modification can be done depending upon the site condition, type and purpose of structure to be constructed.
3. Understand the functions of geosynthetics and soil nailing in engineering constructions.

Syllabus:

Unit- I (8 hours)
PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES: Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

Unit- II (8 hours)
DEWATERING: Dewatering Techniques - Well points – Vacuum and electroosmotic methods – Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.

Unit- III (8 hours)

Unit- IV (8 hours)
EARTH REINFORCEMENT: Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.
Unit-V

Syllabus

GROUND IMPROVEMENT TECHNIQUES (CET 512)

3L:0T:0P Credit:3


Text books:

Reference books:
Syllabus

EARTH RETAINING STRUCTURES (CET 513)

3L: 0T:0P Credit:3

Course objective: To understand lateral earth pressure theories and pressure theories and design of retaining walls. To design anchored bulkheads by different methods. To understand pressure envelops and design of various components in braced cuts and cofferdams. To understand stability of earth dams and its protection and construction.

Course outcomes:

On the completion of course student will be able to:

1. Analyze the earth retaining structures for their stability against earth pressure.
2. Apply engineering knowledge for the designing of earth retaining structures in various site conditions.
3. Evaluation of retaining structures using appropriate design methods, factors of safety, earth pressure diagrams and check their stability.
4. Determine the required depth of penetration and embedment of free and fixed sheet pile walls in cohesion and cohesionless soils.
5. Evaluate anchored sheet pile walls in free and fixed earth support conditions, spacing between bulkheads and anchors, resistance of anchor plates.

Syllabus:

Unit- I (8 hours)
Earth Pressure: Introduction to earth pressure – basic concepts, Earth Pressure Types, Rankine’s theory, backfill features – soil type, surface inclination, loads on surface, soil layers, water level, Coulomb’s theory, Effects due to wall friction and wall inclination, Graphical methods and their interpretations.

Unit- II (8 hours)

Unit- III (8 hours)
Sheet Piles and Bulkheads: Sheet Piles and Bulkheads in Granular and Cohesive Soils - Materials Used for Sheet Piles – Free Earth and Fixed Earth Support Methods, Cantilever sheet
piles, Anchored bulkheads, moment reduction factors, anchorage, Braced Excavation Types, Construction methods, Pressure distribution in sands and clays.

Unit- IV  
(8 hours)

Syllabus

Seepage Analysis: seepage control in embankments and foundations, seepage analysis, stability

EARTH RETAINING STRUCTURES (CET 513 )

3L: 0T:0P  
Credit:3

analysis: upstream and down-stream for steady seepage, rapid draw down, end of construction, method of slices and Bishop’s method, Coffer dams: Braced coffer dams – walls and supports, bottom heave and piping, Arching in Soils - Soil Pressures on Braced Walls and their Design.

Unit- V  
(8 hours)


Text books:


Reference books:

Syllabus

ADVANCED CONCRETE ENGINEERING (CET - 514)

3L:0T:0P Credit:3

Course objective: To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

Course outcomes:

On the completion of course student will be able to:
1. Understand the physical and chemical properties of cement.
2. Understand the various properties of concrete.
3. Understand, Analyze and Evaluate the Concrete mix design.
4. Understand the various special concrete and its uses.

Syllabus:

Unit- I (8 hours)
Materials and Their Properties: Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and surface area and grading, gap graded and aggregates. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin & GGBS in concrete. Introduction to prestressed concrete.

Unit- II (8 hours)

Unit- III (8 hours)
Permeability and durability of concrete: Permeability and Durability of concrete, Parameters o
Syllabus
ADVANCED CONCRETE ENGINEERING (CET - 514)

3L:0T:0P                                                                                                                                    Credit:3

Unit- I                                                                                                                                   (8 hours)
Durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing, Hot weather and cold weather concreting, Guniting (Shotcreting).

Unit- IV                                                                                                                                   (8 hours)
Concrete Mix Design: Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria, Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test.

Unit- V                                                                                                                                   (8 hours)

Text books:
2. Concrete Technology, Gambhir M.L, Tata McGraw Hill

Reference books:
1. Concrete Technology, M.S. Shetty, S. Chand & Company New Delhi
2. Concrete microstructure, properties & materials, P. Kumar Mehata, Paulo & J.M.
3. Monteiro,Light Weight Concrete, Short & Kenniburg, Asia Publishing House, Bombay.
Syllabus

URBAN ENVIRONMENTAL MANAGEMENT (CET-515)

3L: 0T:0P Credit:3

Course objective: To study the urban growth and environmental problems from the management and planning perspectives to contribute to the development of sustainable, inclusive and resilient cities.

Course outcomes:

On the completion of course student will be able to:

1. Explain planning of a city and identify various urban environmental issues
2. Prepare project Plans to integrate urban water resource
3. Explain water resource management using available water resources
4. Develop sustainable wastewater management concepts comparing with successful models followed in developed nation
5. Apply the principles of solid waste management

Syllabus:

Unit- I (8 hours)

Urban Environmental Issues: Urbanization- Population growth scenario migration-Pollution of surface water resources rivers, tanks, channels ground water exploitation - wastewater - characteristics - pollution problems - Solid waste - air pollution -CPCB norms. Urban master plans- Planning and Organizational aspects.

Unit- II (8 hours)

Urban Waste Resources Management: Water in urban ecosystem – urban water resources planning and organization aspects storm water management practices-types of storage-magnitude of storage-storage capacity of urban components - percolation ponds - temple tanks- rainwater harvesting.

Unit- III (8 hours)


Unit- IV (8 hours)

Urban Waste Water Management: Sewage generation - storm drainage estimation-industry contribution-wastewater collection system-separate and combined system - hydraulic design of sewer and storm drain -waste water treatment-disposal methods-concept of decentralization- 3R concepts.
Syllabus

URBAN ENVIRONMENTAL MANAGEMENT (CET-515)

3L: 0T:0P                                                                                                                              Credit:3


Text books:


Reference books:

ADVANCE STRUCTURAL DESIGN (CET 516)

3L: 0T:0P  Credit: 3

Course objective: To develop the conceptual understanding of the advanced concrete design

Course outcomes:
On the completion of course student will be able to:
1. The students will be able to effectively analyse and design the structures for seismic forces.
2. Students will have the understanding of basic concepts, behaviour and design of various reinforced concrete structures
3. Students will be conversant with various IS code provisions of reinforced concrete design and reinforced detailing
4. Students can assess the ductility requirement of design and detailing
5. Students will be well aware about yield line analysis of slabs and prestressed concrete.

Syllabus:

Unit- I  (8 hours)
Modelling of Reinforced Concrete and Masonry buildings, response spectrum for with special emphasis on Code spectrum, Equivalent static Analysis, Seismic design philosophy, concept of strength, over strength, ductility and capacity design

Unit- II  (8 hours)
Seismic Design of Building Components: Seismic resistant properties of reinforced concrete; Seismic behavior and design of linear reinforced concrete elements; Seismic behavior of planar reinforced concrete elements, code provisions

Unit- III  (8 hours)
Design of slabs; One-way slab, Two-way slab, Flat slab and Waffle slab; Yield Line Analysis of slab

Unit- IV  (8 hours)
Design of Columns; Design of Column section under axial load, axial load and uni-axial moment, axial load and bi-axial moments; Design of short and slender column elements; Ductile reinforcement detailing of column

Unit- V  (8 hours)
Prestressed concrete and design of prestressed concrete structural elements

Text books:
1. RCC Design, S.N. Sinha, Tata MacGraw Hill
2. Design of RCC, Pillai and Menon, Tata MacGraw Hill
Syllabus

ADVANCE STRUCTURAL DESIGN (CET 516)

3L: 0T:0P Credit:3

3. Design of Prestressed Concrete, Krishna Raju, Tata MacGraw Hill

Reference Books:
Syllabus

RISK MANAGEMENT IN CONSTRUCTION (CET-317)

Course Objectives:
- To train the students with the latest and the best in the rapidly Risk management in the fields of Construction Engineering.
- To understand the concept of construction risks.
- How to recognize potential risks.
- To know how to quantify the likelihood and potential impact of risks.
- Analyze potential risks and create strategies.

Course Outcomes: On the completion of course student will be able to:
1. Demonstrate knowledge of the range of financial and financial related risks facing organizations.
2. Understand the approach to risk management through risk identification, risk measurement and risk management (or mitigation).
3. Understand reputational risk.
4. Be able to apply theoretical and practical aspects of risk management techniques to achieve project goals.
5. Be able to apply knowledge and skills of modern construction practices and techniques.

Syllabus:

UNIT-I
Introduction: Concept risk management in construction, types of risks in risk management in construction, Importance of construction safety management, safety policy in construction. Study of safety policies, methods, equipment, training provided on any ISO approved construction Company, safety in office, working on sites of high-rise construction, deep excavation.

UNIT-II
Risk analyses: Tools and techniques, impactPotential impacts in risk, risk impact charts mind tools, risk prioritization, probability and risk response strategies. Execute risk management in plan, involves member of the teams.

UNIT-III
Construction safety management: Role of various parties, duties and responsibilities of top management, site managers, supervisors etc. role of safety officers, responsibilities of general employees, safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety checklists and inspection reports.

UNIT-IV
Safety in construction operations: Safety of accidents on various constructions sites such as buildings, dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures. Safety in use of construction equipment e.g. Vehicles, cranes, hoists and lifts etc.

UNIT-V
Safety of scaffolding and working platforms: Safety while using electrical appliances. Explosives used,
various safety equipment and gear used on site. First aid on site, safety awareness program, labor laws, legal
requirement and cost aspects of accidents on site, incentive for safety.

Text Book:

Reference books:
2. ISI for safety in Construction – Bureau of Indian Standrads.
Syllabus

ENVIRONMENTAL IMPACT ASSESSMENT (CET-318)

3L:0T:0P Credit:3

Course Objectives:
- To study the importance of EIA
- To know the role of public in EIA studies
- Understand phenomena of impacts in the environment
- Know the impact quantification of various projects on the environment

Course Outcomes:
1. Identify the objectives and scope of EIA
2. Explicate the concept of EIA
3. Illustrate the necessity of public participation in EIA studies
4. Summarize the importance of Environmental Attributes
5. Explain the phenomena of Impacts on environment
6. Quantify impacts for various developmental projects

Syllabus:

UNIT-I
INTRODUCTION TO EIA: Definition, Evaluation of EIA in INDIA, Rapid and Comprehensive EIA, EIA, EIS, FONSI and NDS. Need for EIA studies, Baseline data, Step-by-step procedure for conducting EIA, Advantages and Limitations of EIA, Hierarchy in EIA, Statutory requirements in EIA, MoEF guidelines in siting Developmental Projects.

UNIT-II
OBJECTIVES AND SCOPE OF EIA: Contents of EIA, Methodologies and Evaluation Techniques of EIA, Selection for specific projects.

UNIT-III

Syllabus

ENVIRONMENTAL IMPACT ASSESSMENT (CET-318)

3L:0T:0P Credit:3

UNIT-IV


UNIT-V

ENVIRONMENTAL IMPACT CASE STUDIES: Case studies on Human impact on Himalayan Ecosystem, Urban solid waste management with reference to Hyderabad City, Irrigation impacts of Upper Thunga Project (UTP) at Shimoga, Impact on air quality due to cement making – A case study of ACC limited, Madhukkarai, Coimbatore, Bhopal Gas tragedy.
Impact quantification study on - Water resource Developmental projects, Hazardous waste disposal sites, Sanitary land filling, Mining projects, Thermal/Nuclear power plant and Pharmaceutical industries

Text Book:

Reference books:
1. Guidelines for EIA of Developmental Projects, MoEF, GOI
2. Environmental Quality management, south asian publishers pvt ltd., Bindu N. Lohani
Syllabus

INDUSTRIAL SAFETY  (CET-319 )

Course Objectives:
- To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods

Course Outcomes:
By the end of the course the students will be able to
1. Analyze the effect of release of toxic substances
2. Understand the industrial laws, regulations and source models.
3. Apply the methods of prevention of fire and explosions.
4. Understand the relief and its sizing methods.

Syllabus:

UNIT-I
Industrial safety:
- Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II
Fundamentals of maintenance engineering:
- Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III
Wear and Corrosion and their prevention:

UNIT-IV
Fault tracing:
- Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V
Periodic and preventive maintenance:
- Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Text Book:

Reference books:
Syllabus

Subsurface Investigation and Instrumentation (Lab) CEP-503

0L:0T:3P Credit:1

Course objective: To make the students understand the basics of a subsurface exploration to describe the geometry of the soil, rock, and water beneath the surface; and to determine the relevant engineering characteristics of the earth materials using various field tests and/or laboratory tests.

Course outcomes:
On completion of the course, the students will be able to:
1. Perform various soil investigation tests
2. Plan a soil investigation survey according to the structure and the sub-soil
3. Choose the appropriate field instrumentation for a particular test

EXPERIMENTS:
1. Study of various boring tools and techniques
2. Study of various sampling tools
3. Vane Shear test
4. Standard Penetration Test
5. Cone Penetration Test
6. Pressure meter Test
7. Dilatometer Test
8. Seismic refraction Test
9. Electrical resistivity Test
10. Study of Field Instrumentation

TEXTBOOKS:

REFERENCE BOOKS:
2. Latest version of relevant Indian and International codes for various tests.
2. Syllabus

SURVEYING FOR INFRASTRUCTURE PROJECT (CEP-504)

0L:0T:3P
Credit:1

Course objective: To determine the relative position of any objects or points of the earth. To determine the distance and angle between different objects. To prepare a map or plan to represent an area on a horizontal plan. To develop methods through the knowledge of modern science and the technology and use them in the field. To solve measurement problems in an optimal way.

Course outcomes:

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

1. Perform layout the building bridge and curve.
2. Estimate the height and length of inaccessible object.
3. Perform the stake out using total station.

EXPERIMENTS:

1. Taking longitudinal and cross-sectional levelling profile of a road using Auto level.
2. Setting out the horizontal curve using Rankine’s method
3. Setting out the horizontal curve using Two theodolite method
4. Setting out works for buildings & pipe lines
5. Setting out work for bridges
6. Trigonometric Leveling - Heights and distance problem
7. Heights and distance using Principles of tacheometric surveying
8. Determination of remote height using total station.
9. Stake out using total station.
10. Distance, gradient, dif, height between two inaccessible points using total station.

TEXTBOOKS:


REFERENCES BOOKS:

5. 2007
Syllabus

Air Pollution Control Engineering

3L:0T:0P Credit:3

FOR OPEN ELECTIVE

Course objectives:
1. To provide general understanding of quality of air and impact on local and global effects of air pollution on human, materials, properties and vegetation.
2. To study the fate and transport of air pollutants and its measurement techniques.
3. To discuss the various types of air pollution control equipment and their design principles and limitation

Course outcomes:
At the end of the course student will be able
1. Classify and identify the sources of air pollutants and predict the effects of air pollutant on human health and environment.
2. Apply and relate the significance of various air pollution dispersion models.
3. Analyze the air quality and relate with air pollution regulation
4. Design various air pollution control equipment and evaluate its use.

Syllabus:

Unit- I (8 hours)

Air Pollution Control, Air Pollution Effects, Effects of Air Pollution on Human Health Air Pollution Control Laws and Regulations, Emission Standard, Air Quality Standard

Unit- II (8 hours)

Emission Estimates, Concentration Determination, Averaging, Standard Analytical Methods,
Syllabus

Air Pollution Control Engineering

3L:0T:0P                                                                                                                Credit:3

isokinetic Sampling, Meteorology, Horizontal and Vertical Motion in the Atmosphere, Atmospheric Stability

**Unit- III** (8 hours)
Fixed-Box, Diffusion model, Gaussian Plume Derivation, Plume Rise, Pollutant Creation and Decay in the Atmosphere Air Pollution Control, Process Change, Pollution Prevention, Downstream Pollution Control Device
Syllabus

Air Pollution Control Engineering(CET-624)

3L:0T:0P                                                                                                                            Credit:3

Unit- I V (8 hours)
Fluid Velocities in Air Pollution Control Equipment, Minimizing Volumetric Flow Rate and Pressure Drop, Calculations on Inert Flow rates, Combustion, Combustion Kinetics, Mixing in Combustion Reactions, Volume and Composition of Combustion Products, Nature of Particulate Pollutants, Settling Velocity and Drag Forces, Stoke Law, Particle Size Distribution Functions, Control of Primary Particulates, Wall Collection Devices, Working and designing of Centrifugal Separators, Electrostatic Precipitators (ESP), Surface Filters, Depth Filters, Scrubbers for Particulate Control, Control of Volatile Organic Compounds(VOCs), Control by Prevention, Substitution, Process Modification, Leakage Control - Control by Concentration and Recovery

Unit- V (8 hours)
Reduction chemistry of Sulfur, Absorbers and Strippers, Removal of SO2 from Rich and Lean Waste Gases, Control of Nitrogen Oxides,Zeldovich Kinetics of Thermal NO Formation, Air Pollution from Motor Vehicles, Tailpipe Emissions, Lean Operation, Exhaust Gas Recirculation (EGR), Reduce Flame Quenching, Speed the Warm-up,Catalytic Treatment of Combustion Products, Air Pollutants and Global Climate, Global Warming, Greenhouse Gases

Text books:


Reference books:
Syllabus

Air Pollution Control Engineering (CET-624)

3L:0T:0P                                                                                                                            Credit:3

Course Objectives: Students will be able to:

1. To understand the fundamentals of research in today’s world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Outcomes:

1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student’s competence to discover new inventions.

Syllabus Contents:

UNIT 1: FUNDAMENTAL OF RESEARCH

Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for research problem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

UNIT 2: RESEARCH DESIGN AND DATA COLLECTION

Research design: Types of research design- exploratory, descriptive, diagnostic and experimental; Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non-Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

UNIT 3: REPORT WRITING AND ITS INTERPRETATION


UNIT 4: RESEARCH ETHICS AND SCHOLARLY PUBLISHING
Syllabus
Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0

Credits-2

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)


Reference Books:

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”