FACULTY OF CIVIL ENGINEERING

Approved Special Electives for
M.S. / Ph.D. Degree Programs
(upto 25th AC 02.05.2019)
<table>
<thead>
<tr>
<th>COURSE CODE</th>
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SCE002 CORROSION ENGINEERING

1. INTRODUCTION:

2. FORMS OF CORROSION

3. CORROSIVE ENVIRONMENTS

4. CORROSION TESTING

5. CORROSION PREVENTION
REFERENCES:
NETWORKING TECHNOLOGY AND SOCIAL ASPECTS IN RURAL WATER SUPPLY

UNIT I INTRODUCTION
Social structure and Social function – Methods of Sociology – Social Organisation – Sociology and other Social Sciences – Social Effect of Technology – Role of Science and Technology on Development.

UNIT II SOCIOLOGY AND ENVIRONMENT

UNIT III SCIENCE AND TECHNOLOGY IN ENVIRONMENT

UNIT IV LAW / MANAGEMENT / ECONOMICS

UNIT V RURAL SOCIOLOGY
Rural urban Contrast – Significance of Village Communities in India – Source of Water Supply in Rural India and Rural Tamilnadu. Participation of NGO’s in Rural Water Supply System – Women Participation Women Education and Technology Adaption.

REFERENCES:

TOTAL: 45 PERIODS
UNIT I  INTRODUCTION TO WATER RESOURCES SYSTEM OPERATION  9

UNIT II  SIMULATION ANALYSIS OF CANAL SYSTEM  9
Approaches to analysis of water resources system in operation system modeling and constraints - simulation analysis for canal operation.

UNIT III  PROGRAMMING MODELS  9

UNIT IV  HEURISTIC ANALYSIS  9
Features and problems in water allocation from canals – Need for heuristic approach identification of constraints – objectives of approach – heuristic analysis.

UNIT V  MIXED INTEGER PROGRAMMING MODELS  9
Operational requirement of canals – alternative strategies – mixed integer programming in canal operation.

TOTAL: 45 PERIODS

REFERENCES:
UNIT II  O-D SURVEY  9
Need - O-D survey methods – O-D matrix- Desire line chart – Public Transport Surveys Inventory of Public Transport Buses.

UNIT III  TRAVEL DEMAND ESTIMATION  9

UNIT IV  BUS ROUTE NETWORK PLANNING  9

UNIT V  SCHEDULING  9
Policy Headways-Peak to Base Ratio – Staggered Work Hours – Marginal Ridership Approach.

TOTAL : 45 PERIODS

REFERENCE:
UNIT V  EFFICIENCY AND EFFECTIVENESS

Improvement of Efficiency and effectiveness Depot layout location –Twin depot concept Inter modal transfer facilities.

TOTAL: 45 PERIODS

REFERENCES:

Faculty of Civil Engineering  (Approved in 13th AC 20.12.2008) ITEM NO.FC 13.01

CZ040  CLIMATE CHANGE MITIGATION AND ADAPTATION  L T P C
            3 0 0 3

OBJECTIVES:
• To Provide an overview of global climatological changes, their environmental impacts and mitigative and adaptative measures using scientific and economic instruments.

UNIT I  ELEMENTS OF CLIMATOLOGY  5
Paleoclimatology, Paleo-indicators of climate, Factors affecting global, regional and local climates. Tropical, Monsoon, Polar, Desert, Mid-latitude climates and their role in global climate change.

UNIT II  GREENHOUSE GASES  10
Carbon dioxide, methane, nitrous oxide, water vapor, ozone and chlorofluorocarbons – Chemistry of greenhouse gases, sources and sinks, their cycle in atmosphere, radiative forcing, effects on plants and animals and instruments used for quantification.

UNIT III  IMPACTS OF GLOBAL CLIMATE CHANGE  15
Major environmental impacts of greenhouse gases. The greenhouse effect – ecosystems and species interactions, storms, thunderstorms, tornadoes, changes in agricultural production, droughts, spread of epidemics, wildfires and other extreme weather events. Nuclear winter.

UNIT IV  CLIMATE CHANGE AND ECONOMIC INSTRUMENTS  7
Joint implementation, clean development mechanism, emission trading, carbon credits – industrial and individual level. Case studies on the economic instruments.

UNIT V  CLIMATE CHANGE MITIGATION / ADAPTATION  8
International agreements and protocols, role of fossil fuels in climate change, future use of renewable energy, Role of Governments, industries, and individuals, traditional practices to cope with climate change impacts.

TOTAL: 45 PERIODS
REFERENCES:
OBJECTIVES:
The objective of this course is to give an exposure on the preparation and characterization of nanomaterials used to destroy and detect constituents of environmental threat.

UNIT I GENERAL
Background of nanotechnology, particle size and surface area, quantum dot, converging science and technology, nanotechnology as a tool for sustainability, health, safety and environmental issues.

UNIT II SYNTHESIS AND FABRICATION OF NANOMATERIALS
Preparation of nanoscale metal oxides, metals, CNT, functionalized nanoporous adsorbents, nanocomposites - Chemical Vapour Deposition, sol gel, sonochemical, microwave, solvothermal, plasma, pulsed laser ablation, magnetron sputtering, electrospinning, Molecular imprinting.

UNIT III CHARACTERISATION OF NANOMATERIALS
AFM, STM, SEM, TEM, XRD, ESCA, IR & Raman, UV-DRS of nanomaterials for structural and chemical nature.

UNIT IV OTHER FEATURES OF NANO PARTICLES
Nanoparticle transport, aggregation and deposition, Energy applications - H₂ storage.

UNIT V ENVIRONMENTAL APPLICATIONS
Gas sensors, microfluidics and lab on chip, catalytic and photocatalytic applications, Nanomaterials for groundwater remediation, nanomaterials as adsorbents, membrane process.

TOTAL: 45 PERIODS

REFERENCES:
UNIT I  INTRODUCTION TO PROBABILITY THEORY  9

UNIT II  RESISTANCE DISTRIBUTION AND PARAMETERS  9

UNIT III  STRUCTURAL RELIABILITY AND SAFETY  9

UNIT IV  RELIABILITY BASED DESIGN  9
Determination of partial safety factors, code calibration, reliability of structural system; Applications to steel and concrete structures.

UNIT V  PERFORMANCE BASED DESIGN  9

TOTAL: 45 PERIODS

REFERENCES:
5. FEMA Documents FEMA-273 Seismic Rehabilitation Guidelines .
FC9003 RESEARCH METHODOLOGY L T P C
3 0 0 3

UNIT I

UNIT II

UNIT III

UNIT IV
DNA sequencing and Human genome project, DNA fingerprinting and its application, DNA amplification and PCR, Gene and cDNA Library. Detection of genetic diseases using DNA recombinant technology.

UNIT V

REFERENCE BOOKS
FC9004  RANDOM VIBRATIONS  L T P C  3 0 0 3

OBJECTIVE:
To study the concept of random vibrations for dynamic analysis of structural systems subjected to stochastic loading like wind, earthquake and ocean waves.

UNIT I  FUNDAMENTALS OF LINEAR DYNAMICAL SYSTEM  9
SDOF system, Free and forced vibration, Role of damping in vibration reduction, MDOF system and mode superposition.

UNIT II  PROBABILITY AND STATISTICS  9
Introduction to probability, Bayes’ theorem, Probability density function, Discrete and continuous stochastic variable, Conditional probability, Binomial, Normal, Poisson’s distribution, Auto and cross correlation.

UNIT III  FOURIER ANALYSIS AND INTEGRAL  9
Fourier analysis and transform, Forward and inverse transform, Properties of Fourier transform, Product in time domain as convolution in frequency domain and vice versa, FFT and its applications

UNIT IV  FREQUENCY DOMAIN ANALYSIS OF LINEAR DYNAMICAL SYSTEM TO RANDOM LOADING  9
Narrow wind band random processes, Response to force define as power spectral density function, Mean squared response, FRF of typical dynamic system, Frequency response function versus Impulsive response function

UNIT V  APPLICATION OF RANDOM VIBRATION PRINCIPLES TO WIND, WAVE AND EARTHQUAKE LOADING  9
Typical wind velocity spectra (Davenport, Kaimal etc.,) Aero dynamical and mechanical admittances, Mean wind – across wind – turbulence effects, Response computation of off-shore structures to wave loading, concept of response spectra in earthquake loading, Kanai – Tajimi spectra

REFERENCES:

TOTAL: 45 PERIODS
FC9005 WATER POLLUTION AND ITS HEALTH IMPACT ASSESSMENT  L  T  P  C  3 0 0 3

COURSE OBJECTIVES:
- Identify the carriers or vectors that promote the transfer of these agents from the environment to the human.
- Describe how these agents interact with biological systems, and the mechanisms by which they exert adverse health effects.
- Explain and use models for prediction of the magnitude of adverse effects in biological systems.

UNIT I WATER TRANSPORT

UNIT II WATER QUALITY MODELING

UNIT III SEWAGE DISPOSAL
Ground water and the hydrologic cycles-Ground water as a resource –Ground water contamination-Sources of contamination-Land disposal of solid wastes-Sewage disposal on Land. Ground water and geologic processes.

UNIT IV HEALTH IMPACT ASSESSMENT
Water pollution effect on health-Sampling methods-Purpose of sampling, different types of samples, collection methods-Methods involved in estimation of parameter for pollution levels – Water pollution control strategies-Importance of waste water disposal for diseases control – Role of water in the transmission and prevention of infections-Methods used during routine surveillance and monitoring-Exposure pathways and human responses to hazardous and toxic substances.

UNIT V WATER BORNE DISEASES
The microbiological social and public aspects of sanitation and water supply, the micro-organisms responsible for disease, their origins, mechanisms for elimination, and the epidemiology of waterborne and water washed disease.

TOTAL: 45 PERIODS

REFERENCES:
FC9006 GEOMATICS IN METEOROLOGY

OBJECTIVE:
- To impart knowledge in Concepts in Meteorology, Radio, and Satellite Meteorology and its Applications

UNIT I GENERAL CONCEPTS IN METEOROLOGY
Weather and Climate- composition of atmosphere- temperature and pressure Distribution- Winds over the earth’s atmosphere- scales of atmospheric processes Land/Ocean Coupling- Indian monsoons- other major weather systems of seasons- Brief introduction to Indian Climatology. Radiation transfer- radiation spectrum – Absorption and emission of radiation by molecules- Radiation laws- scattering principles. Cloud physics- Mechanism of cloud formation- Types of Clouds- Precipitation processes- warm and cold concepts and processes

UNIT II RADIO METEOROLOGY
Principles and classifications of Radar- components of Radar- Meteorological Applications. Upper air temperature exploration of the atmosphere(Radio Sonde)-Upper air wind estimation through pilot balloon- Wind estimation through Radar ( Rawin Sonde) , Doppler technique Precipitation estimation through Radar and problems associated with it – Precipitation Radar ( PR ) on-board satellites such as Tropical Rainfall Measuring Mission ( TRMM ), Global Precipitation Measurement ( GPM ) , Ozone soundings – general principle and special satellite measurements of ozone – Aerosol soundings Tracking of weather systems such as Thunderstorms, Tropical cyclones, Tornadoes through Radar – Structure of weather systems as observed by Radars –Hydro meteorological Applications of Radar. Applications to aviation meteorology

UNIT III INTRODUCTION TO SATELLITE METEOROLOGY

UNIT IV METEOROLOGICAL APPLICATIONS

UNIT V APPLICATIONS TO STORM SURGE
Identification – Tracking of weather systems – Derivation of cloud motion vector Dvorak’s technique of cyclone intensity estimation – T number and current intensity No. – Applications to storm surge estimation. Satellite soundings – TIROS Operational and Vertical sounder – Retrieval methods and algorithms

TOTAL: 45 PERIODS
REFERENCES:

Faculty of Civil Engineering (Approved in 17th AC (Ad hoc) 27.04.2012) ITEM NO. FC 17.02(3)

FC9007 HUMAN FACTORS IN ROAD ACCIDENT OCCEURENCE L T P C 3 0 0 3

OBJECTIVES:
• Helps in identifying the reasons for road accidents and scientific investigation.
• Helps to improve the present accident situations in highway and transport sectors.

UNIT I CAUSES OF ACCIDENTS 9
Road accidents data - Causes of road accidents – Four important factors - Human, Road, Vehicle and environment – Vehicles and Bus Accidents – Accident rates – Prevention methods.

UNIT II HUMAN FACTORS 9

UNIT III LICENSING PRACTICES 9
Indian Practices – Practices in Other Countries – Driver Training for light and heavy vehicles – Age, Qualification, Physical fitness etc., - Syllabus for driver training- Cancellation and Renewal of Licenses- Modern trends in Licensing- Smart card.

UNIT IV STATISTICAL ANALYSIS 9

UNIT V TOOLS AND TECHNIQUES TO STUDY HUMAN FACTORS 9
Reaction Tester – Eye Tester – Driving Simulator – Various testing and training methods in simulators-RFID Technique for Driving Test – Interview Techniques and Analysis

TOTAL: 45 PERIODS
REFERENCES:

Faculty of Civil Engineering (Approved in 17th AC (Ad hoc) 27.04.2012)  **ITEM NO. FC 17.02(4)**

FC9008  LAND USE TRANSPORTATION MODELLING  L T P C
3 0 0 3

OBJECTIVE:
- To study the interaction between the Land use and the travel pattern in cities and its entailment on the process of the strategic policy decision making.

UNIT I  LAND USE TRANSPORTATION PLANNING AND MODELLING  7

UNIT II  MODELLING AND DECISION MAKING  9
Decision – making styles - Choosing modelling approaches - Issues in transport modeling - General modeling issues - Aggregate and disaggregate modeling - Cross – section and time series - Revealed and stated preferences - The structure of the classic transport model - Continuous transport planning - Theoretical basis versus expedience.

UNIT III  TRIP GENERATION MODELLING  10

UNIT IV  TRIP DISTRIBUTION MODELLING  10
Definitions and notation - Growth – factor methods - Uniform growth factor - Singly constrained growth – factor methods - Doubly constrained growth factors - Advantages and limitations of growth – factor methods - Synthetic or gravity models - The gravity distribution model - Singly and doubly constrained models - The entropy – maximizing approach -
Entropy and model generation - Generation of the gravity model - Properties of the gravity model - Calibration of gravity models - Calibration and validation - Calibration techniques.

UNIT V THE LAND USE TRANSPORT MODEL

REFERENCES:
1. Integrated Land-Use and Transportation Models Behavioural Foundations. Martin Lee-Gosselin (Universite Laval, Quebec, Canada), Sean Doherty, Publication date: 01 Jul 2005 Imprint: Elsevier Science Ltd SBN: 9780080446691
2. The Geography of Transport Systems By Jean-Paul Rodrigue, Claude Comtois, Brian Slack. Published May 18th 2009 by Routledge – 352 pages

Faculty of Civil Engineering
(Approved in 18th AC (Ad hoc) 09.08.2014) ITEM NO. FC 18.03 (1)

FC9009 INSTRUMENTATION IN GEOTECHNICAL ENGINEERING L T P C 3 0 0 3

OBJECTIVE:
This course introduces concepts, technologies, procedures and applications of instrumentation in Geotechnical Engineering.

UNIT I BASICS OF INSTRUMENTATION
Introduction - Instrument systems-Mechanic- Hydraulic- Pneumatic and Electric, Electronic, Magnetic and Electro Magnetic type of instrument and measurements of load, pore water pressure, earth pressure, ground movement strain and Temperature.
UNIT II  STATIC MEASUREMENTS
Static load application methods with reference to model testing Transducers and Instrumentation for Measurement of Force, Pressure, Strain, Displacement, Data Acquisition Systems.

UNIT III  VIBRATION MEASUREMENTS

UNIT IV  FIELD INSTRUMENTATION
Reason- Selection of Instruments-Applications-- design of instrumentation pattern for monitoring during and after construction – Installation of instruments to measure ground motions- Pore-water pressure Earth pressure cells-Pressure cells –calibration and monitoring-interpretation of results-Case studies.

UNIT V  NON DESTRUCTIVE TESTING METHODS

REFERENCES
UNIT III MAINTENANCE AND REPAIR STRATEGIES
Demolition techniques for structures-Maintenance, repair and rehabilitation, Facets of Maintenance, importance of maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT IV REHABILITATION TECHNIQUES
Rust eliminators and polymers coating for rebars during repair, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, Mud jacking grout through slab foundation - micropiling for strengthening floor and shallow profile - pipeline laying - underpinning, crack stabilization techniques.

UNIT V STRENGTHENING AND PROTECTION OF STRUCTURES

REFERENCES:
REFERENCE BOOKS:

Faculty of Civil Engineering (Approved in 18th AC (Ad hoc) 09.08.2014) ITEM NO. FC 18.03 (4)

FC 9012 CLIMATE CHANGE AND CLIMATE MODELLING L T P C 3 0 0 3

OBJECTIVE:
• To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

UNIT I CLIMATE CHANGE AND CLIMATE VARIABILITY

UNIT II IPCC SRES SCENARIOS
Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

UNIT III GLOBAL CLIMATE MODEL (GCM) AND REGIONAL CLIMATE MODEL (RCM)
Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, SimCLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

UNIT IV DOWNSCALING GLOBAL CLIMATE MODEL - AN OVERVIEW
Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

UNIT V ANALYSIS /POST PROCESSING
Model Evaluation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS - Climate change Impact - Vulnerability studies.

TOTAL: 45 PERIODS
REFERENCES:
OBJECTIVES:

- To understand the wind energy fundamentals & Wind Measurements
- To understand the fundamentals of noise and noise measurement techniques
- To model and analysis the Noise data from wind turbine

UNIT I   WIND ENERGY FUNDAMENTALS & WIND MEASUREMENTS  9

UNIT II  NOISE  9
Sound and decibels, basic math and weighting’s sound power and sound pressure (A, C, etc.) – sound levels and human hearing – human response to noise – industrial and transportation sources of noise – sound propagation — basics of noise from wind turbines - Control methods and reduction strategies for noise.

UNIT III ACOUSTIC NOISE MEASUREMENT TECHNIQUES  9
Instrumentation-acoustic instruments, non – acoustic instruments, traceable calibration, Measurements and measurements procedures – measurement positions, acoustic measurements, non-acoustic measurements, data reduction procedures – wind speed, correction for background noise, apparent sound power levels, one-third octave band levels, tonality, directivity.

UNIT IV MODELING AND ANALYSIS OF DATA  9

UNIT V STANDARDS AND ENVIRONMENTAL POLICIES  9

TOTAL: 45 PERIODS

OUTCOMES

- Understand the fundamentals and measurements of wind energy.
- Able to model and analysis the noise data from wind turbine.
REFERENCES:
7. CPCB “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
FC9014 ENERGY ECONOMICS L T P C 3 0 0 3

AIM:
- To inculcate knowledge about the energy market, economic factors involved energy planning and energy - economy - environment interaction.

OBJECTIVES:
- To explore basic concepts of economics and planning of energy systems.
- To provide students with relevant techniques needed for techno-economic analysis, planning and execution of energy projects.

UNIT I INTRODUCTION

UNIT II ENERGY FORECASTING

UNIT III ENERGY ANALYSIS

UNIT IV ENERGY POLICY

UNIT V PROJECT MANAGEMENT

OUTCOME:
- Students will be able to comprehend theories, skills and techniques needed for energy analysis, policy planning, econometric analysis and execution of energy related projects.

REFERENCES:
SCE001 APPLICATIONS OF NANOMATERIALS IN CIVIL ENGINEERING

UNIT I NANOMATERIALS IN CONCRETE

UNIT II NANO STEEL

UNIT III NANO COMPOSITES
Introduction to composites – Various types of macro composites and importance – Properties – Polymer nanocomposites – Potential applications of nanocomposites – Case studies.

UNIT IV DAMAGE IN HYDRAULIC STRUCTURES

UNIT V SUSTAINABILITY AND ENVIRONMENT

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVE:

- To impart knowledge on various constitutive models proposed by several researchers to describe various aspects of soil behavior in detail and also to apply such models in soil modelling for geotechnical engineering applications.

UNIT I BOUNDARY VALUE PROBLEMS IN CONTINUUM MECHANICS 10


UNIT II CONSTITUTIVE MODELLING OF REVERSIBLE SOIL BEHAVIOR 08


UNIT III CONSTITUTIVE MODELLING OF IRREVERSIBLE SOIL BEHAVIOR 12


UNIT IV ADVANCED CONSTITUTIVE MODELS 09


UNIT V DISTURBED STATE CONCEPT 06


TOTAL : 45 PERIODS

OUTCOMES:

- Students are able to achieve a basic understanding of conventional continuum mechanics approaches to constitutive modelling, which can serve as a foundation for exploring more advanced theories. The advantages, disadvantages and limitations of modelling different aspects of complex soil behavior using constitutive models is understood.
TEXTBOOKS:

REFERENCES: