ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS AFFILIATED COLLEGES
M.E. SOIL MECHANICS AND FOUNDATION ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M.E. Soil Mechanics and Foundation Engineering will

PEO1 Gain knowledge and skills in Soil Mechanics and Foundation Engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations

PEO2 Become consultants in Soil Mechanics and Foundation Engineering and solve complex real life issues related to analysis, design and maintenance of structures under various environmental conditions.

PEO3 Contribute to the enhancement of knowledge in Soil Mechanics and Foundation Engineering by performing quality research in institutions of international repute or in Research organizations or Academia.

PEO4 Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.

PEO5 Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation

2. PROGRAMME OUTCOMES (POs):

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<th>PO #</th>
<th>Programme Outcomes</th>
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<tbody>
<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems.</td>
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<tr>
<td>2</td>
<td>An ability to write and present a substantial technical report/document</td>
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<tr>
<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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3. PROGRAM SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Soil Mechanics and Foundation Engineering will be able to

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<tr>
<th>PSO #</th>
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<tr>
<td>PSO1</td>
<td>Knowledge of Soil Mechanics and Foundation Engineering discipline</td>
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<td>Acquire in-depth knowledge of Soil Mechanics and Foundation Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge in the structural design.</td>
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<td>PSO2</td>
<td>Critical analysis of Soil Mechanics and Foundation Engineering issues and innovation</td>
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<td>Critically analyze complex Soil Mechanics and Foundation Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.</td>
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<td>PSO3</td>
<td>Conceptualization and evaluation of Engineering solutions to Geotechnical Design issues</td>
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<td>Conceptualize and solve Soil Mechanics and Foundation Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio cultural factors</td>
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## MAPPING OF COURSE OUTCOMES AND PROGRAMME OUTCOMES

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<th>COURSE NAME</th>
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M.E. SOIL MECHANICS AND FOUNDATION ENGINEERING  
REGULATIONS 2021  
CHOICE BASED CREDIT SYSTEM  
I TO IV SEMESTERS CURRICULA AND SYLLABUS  
SEMESTER I

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* Audit Course is Optional

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*Audit Course is Optional
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### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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**TOTAL CREDITS 2**

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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### SUMMARY

Name of the Programme: M.E SOIL MECHANICS AND FOUNDATION ENGINEERING

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OBJECTIVES:
- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I  LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

UNIT II  FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

UNIT III  CALCULUS OF VARIATIONS
- Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV  CONFORMAL MAPPING AND APPLICATIONS

UNIT V  TENSOR ANALYSIS

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

| CO1 | Application of Laplace and Fourier transforms to the initial value, initial–boundary value and boundary value problems in Partial Differential Equations. |
| CO2 | Maximizing and minimizing the functions that occur in various branches of Engineering Disciplines. |
| CO3 | Construct conformal mappings between various domains and use conformal mapping in studying problems in physics and engineering, particularly fluid flow and heat flow problems. |
| CO4 | Understand tensor algebra and its applications in applied sciences and engineering and develops the ability to solve mathematical problems involving tensors. |
| CO5 | Competently use tensor analysis as a tool in the field of applied sciences and related fields. |
REFERENCES:

COs- PO’s & PSO’s MAPPING

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SF4101 PROPERTIES AND BEHAVIOUR OF SOILS

OBJECTIVES:
- To impart knowledge on the various factors governing the Engineering behaviour of soils and the suitability of soils for various Geotechnical Engineering applications.

UNIT I ORIGIN OF SOILS AND CLAY MINERALS

UNIT II PHYSICAL AND PHYSIO CHEMICAL BEHAVIOUR OF SOILS

UNIT III SWELL - SHRINK AND COMPACTION BEHAVIOUR OF SOILS
UNIT IV  COMRESSIBILITY, SHEAR STRENGTH AND PERMEABILITY BEHAVIOUR OF SOILS

Engineering properties - Compressibility, shear strength and permeability behaviour of fine and coarse grained soils – mechanisms and factors influencing engineering properties – basics of soil liquefaction – causes and consequences – case studies.

UNIT V  CONDUCTION PHENOMENA AND PREDICTION OF SOIL BEHAVIOUR


TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

| CO1 | Classify of soil based on index properties |
| CO2 | understanding of the clay mineralogy and its intricacies and consequences. |
| CO3 | Understand the volume change with response to compaction and seasonal moisture variations. |
| CO4 | interpret the engineering behaviour of soils such as compressibility, permeability and shear strength with index properties so as to design the safe foundation system. |
| CO5 | understand the various geotechnical applications of conduction phenomenon which are of great significance in the case of ground contamination and decontamination, ground improvement methods and land reclamation projects |

REFERENCES:

COs- PO’s & PSO’s MAPPING

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OBJECTIVES:
- To impart knowledge to characterize stress-strain behaviour of soils, the failure criteria and to evaluate the shear strength and compressibility parameters of soils.

UNIT I  SHEAR STRENGTH OF COHESIONLESS SOILS
Introduction-Shear strength of soil-cohesion-angle of internal friction-Shear strength of granular soils
- Direct shear - Triaxial Testing- Drained and undrained Stress-strain behaviour - Dilation, contraction
and critical states - Liquefaction and cyclic mobility of saturated sands. Factors influencing stress –
strain characteristics – shear strength.

UNIT II  SHEAR STRENGTH OF COHESIVE SOILS
Shear strength of normally consolidated and over consolidated clays - Stress-strain behaviour - Total
stress and effective stress approach - Triaxial testing and stress path plotting - pore pressure
parameters of Skempton and Henkel - shear strength of partially saturated clay in terms of stress
state variables. Factors influencing stress – strain characteristics – shear strength.

UNIT III  FAILURE THEORIES
Concepts of yield and failure in soils- Failure theories of Von Mises, Tresca and their extended form,
their applicability to soils - Detailed discussion of Mohr - Coulomb failure theory.

UNIT IV  CONSTITUTIVE MODEL AND DEFORMATION MODULUS OF SOILS
Constitutive law for soil – linear, non linear model- hyperbolic idealisation – Mohr-Columb model-
Hardening law-Hardening soil model- Hardening soil model with small strain stiffness- Soft soil - Soft
soil model - limitation of all models- Deformation modulus for different type of loadings – Poisson’s
ratio.

UNIT V  CRITICAL STATE SOIL MECHANICS
The critical state line- Roscoe’s surface- Hvorslev’s surface- Behavior of sand- Effects of dilation-
Limitations of Taylor model- Elastic and plastic deformation-Cam clay critical state model- Modified
Cam clay model- Parameters for design

OUTCOMES:
On completion of the course, the student is expected to be able to

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<th>Select the shear strength parameters of cohesionless soil based on mode of shear, drainage conditions and differentiate the cyclic stress – strain behaviour of cohesionless soil due to earthquake loading.</th>
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<td>CO2</td>
<td>Select the shear strength parameters of cohesive soil based on mode of shear, drainage conditions, degree of saturation and degree of consolidation</td>
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<tr>
<td>CO3</td>
<td>Apply different failure criteria and its applicability based on drainage conditions and type of soil.</td>
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<tr>
<td>CO4</td>
<td>Apply constitutive failure criteria and its applicability based on drainage conditions and type of soil.</td>
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<tr>
<td>CO5</td>
<td>Explain critical state behaviour, modelling of soils and to select the respective design parameters.</td>
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</table>

REFERENCES:
3. Atkinson J.H. and Brandsby P.L. "Introduction to critical state soil mechanics" McGraw Hill,
1978.

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**OBJECTIVES:**
- Students are expected to understand the importance of site investigation, planning of subsurface investigation, interpretation of investigated data to design suitable foundation system.

**UNIT I PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS**
Scope and objectives, planning of exploration program - methods of exploration - exploration for preliminary and detailed design, spacing and depth of bores, data presentation. - Geophysical exploration and interpretation - reflection, refraction and resistivity: Spectral analysis of surface waves (SASW), Multichannel Analysis of Surface Waves (MASW), cross hole – up hole - down hole methods.

**UNIT II EXPLORATION TECHNIQUES**
Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, offshore drilling, limitations of various drilling techniques, stabilization of boreholes, bore logs.

**UNIT III SOIL SAMPLING**
Sampling Techniques – quality of samples – factors influencing sample quality - disturbed and undisturbed soil sampling advanced sampling techniques, offshore sampling, shallow penetration samplers, preservation and handling of samples.

**UNIT IV FIELD TESTING IN SOIL EXPLORATION**
Field tests, penetration tests, Field vane shear, In-situ shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test – monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.
UNIT V INSTRUMENTATION

Instrumentation in soil engineering, functional components of data acquisition system - strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

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<tr>
<td>CO1</td>
<td>Plan the subsurface investigation program for a given project also capable of extending consultancy service for real time Soil Mechanics and Foundation Engineering problems</td>
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<tr>
<td>CO2</td>
<td>Apply the knowledge of different methods of exploration to select appropriate method of boring for investigating real field condition.</td>
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<td>CO3</td>
<td>Apply the knowledge of different sampling techniques to collect, store and transport soil samples from onshore and offshore to meet specified needs and also to characterise the soil.</td>
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<td>CO4</td>
<td>Carryout appropriate field test to arrive at required soil parameters for the design of geotechnical structures considering all the influential parameters</td>
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<td>CO5</td>
<td>Plan the instrumentation programme, execute the same in the field and monitor the performance of geotechnical structures to ensure its stability during its life time. Also conduct research pertinent to soil mechanics and foundation engineering as well as engage in independent life-long learning</td>
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REFERENCES:


COs- PO's & PSO's MAPPING

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OBJECTIVES:
- To impart knowledge required for computing stress and settlement at any point in the semi-infinite elastic soil medium, anisotropic medium and layered deposits due to foundation loads and evaluation of stability of foundations, slopes, cuts and retaining structures both for the conditions of undrained and drained loading through theorems of plastic collapses. Also, to impart knowledge on reliability based design in geotechnical engineering.

UNIT I       THEORY OF ELASTICITY

UNIT II       STRESS AND DISPLACEMENT

UNIT III       THEORY OF PLASTICITY

UNIT IV       FLOW THROUGH POROUS MEDIA

UNIT V       RISK ANALYSIS IN GEOMECHANICS
Spatial variability and random field theory - soil variability and uncertainty quantification- Simple probabilistic methods for reliability analysis in geotechnical engineering - Reliability based design in geotechnical engineering.

TOTAL: 60 PERIODS

OUTCOME:
- On completion of the course, the student is expected to be able to

| CO1 | Explain the basic concept of elasticity, understand the mechanics of continuum and solve field problems |
| CO2 | Analyse stress distribution and displacement in homogeneous, non-homogeneous and anisotropic soil medium under the given loading conditions |
| CO3 | Explain the basic concept of plasticity, understand the mechanism of collapse and solve field problems |
| CO4 | Understand the liquid flow theory, analyse the flow of liquid in different soil medium and verify the stability of geotechnical engineering problems |
| CO5 | Analyse various parameters using probabilistic methods and perform reliability based design in geotechnical engineering related problems |

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RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN 6
Overview of the research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentations.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL:30 PERIODS
SF4111 ADVANCED SOIL MECHANICS LABORATORY – I

OBJECTIVES:
- At the end of the course student attains adequate knowledge in assessing index properties, compaction, CBR, Compressibility, Swell characteristics and permeability of soils by conducting laboratory tests.

LIST OF EXPERIMENTS

UNIT I INDEX TESTS
Specific gravity of soil solids-Grain size distribution (Sieve analysis and Hydrometer analysis) - Liquid limit and Plastic limit tests - Shrinkage limit and Differential free swell tests

UNIT II CHEMICAL TESTS
Chemical analysis – pH – Conductivity – quantification of CEC through flame Photometer – Determination of organic, sulphate and chlorite content.

UNIT III COMPACTION AND CBR TESTS
Field density Test - Compaction tests - Determination of moisture – density relationship – Influence of compaction energy – CBR Test.

UNIT IV CONSOLIDATION AND PERMEABILITY TESTS
One dimensional consolidation test, determination of consolidation parameters, permeability of soil – constant and falling head methods.

UNIT V SWELL TESTS
Determination of percent swell – swell pressure, constant volume method; Expanding volume method – double odometer test.

TOTAL: 60 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to

| CO1 | Classify soils based on assessing the index properties of soils |
| CO2 | Evaluate the chemical properties of soils |
| CO3 | Evaluate the compaction characteristics and CBR of soils |
| CO4 | Evaluate the engineering properties of soils by conducting appropriate tests |
| CO5 | Determine the swelling characteristics of soils by conducting appropriate tests |

REFERENCES:
11. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

COs- PO’s & PSO’s MAPPING

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SF4201 DEEP FOUNDATIONS

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OBJECTIVES:
- The student will be exposed to the design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions.

UNIT I PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE

UNIT II AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS
- Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results – pile integrity test - Settlement of piles and pile group – IS codal provisions and IRC and API guide lines

UNIT III LATERAL AND UPLIFT LOAD CAPACITIES OF PILES

UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS
- Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps – pile subjected to vibration – IS codal provision.

UNIT V CAISSONS

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to

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<tr>
<th>CO</th>
<th>Explain the importance of pile foundation and various functions and responsibilities of geotechnical engineer and contractor, in addition to the piling equipments.</th>
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<tr>
<td>CO2</td>
<td>Determine the vertical load carrying capacity of pile and pile group- keeping the settlement of pile as an important criteria based on field practices and codal provisions.</td>
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<td>CO3</td>
<td>Apart from vertically loaded piles, the structures are exposed to the peculiar pile subjected to lateral and uplift load with reference to codal provision and case studies.</td>
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<td>CO4</td>
<td>Understand the design of pile and pile caps, considering the wind and seismic loads.</td>
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<td>CO5</td>
<td>Explain the importance of caisson foundation and checking the stability of caissons based on codal provisions.</td>
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SF4202 EARTH AND EARTH RETAINING STRUCTURES

OBJECTIVES:
- At the end of this course, students are expected to analyse and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.

UNIT I EARTH PRESSURE THEORIES
State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann’s method) – Active and passive cases – Earth pressure due to external loads.
UNIT II  STABILITY OF RETAINING STRUCTURES  8
Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain
softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining
structure both for regular and earthquake forces.

UNIT III  SHEET PILE WALLS  8
Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth
support method – fixed earth support method. Design of anchor systems - isolated and continuous.

UNIT IV  SUPPORTED EXCAVATIONS  9
Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth
pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning – Basic design concepts
- Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm
walls – stability Analysis.

UNIT V  STABILITY OF SLOPES  9
Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices,
Bishop’s method, Janbu’s method etc. Special aspects of slope analysis, stability charts. Role of
geosynthetics in stabilization of slopes.

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Analyse the earth pressure acting on retaining structures by applying classical theories
considering all influencing parameters and suggest the earth pressure to be considered for the
design of retaining structures.
CO2 Apply the knowledge of engineering and earth pressure to analyse and design rigid retaining
structures considering effect of compaction, wall flexibility, pore water pressure and earth
quake forces.
CO3 Apply the knowledge of engineering and earth pressure to analyse and design flexible earth
retaining walls and also acquire the knowledge of design of anchors
CO4 Apply the knowledge on lateral earth pressure behind and around excavation to analyse and
design braced excavations, slurry supported excavations and underground utilities.
CO5 Analyse the stability of infinite and finite slopes through total stress and effective stress
analysis by considering the actual shape of failure surface expected in the field.

REFERENCES:
1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures,
2000.
Hill, 1999.
Delhi, 1993.
SF4203  GROUND IMPROVEMENT TECHNIQUES  L T P C  3 0 0 3

OBJECTIVES:
- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

UNIT I  HYDRAULIC MODIFICATIONS
Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.

UNIT II  MECHANICAL MODIFICATIONS
Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation - design and relative merits of various methods – Soil liquefaction mitigation methods - Case studies.

UNIT III  PHYSICAL MODIFICATION

UNIT IV  MODIFICATION BY INCLUSIONS
Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

UNIT V  CHEMICAL MODIFICATION

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to

CO1  identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications

CO2  improve the ground characteristics by mechanical modifications using various method and design the system
CO3 improve the ground characteristics by physical modifications using various method and design the system
CO4 improve the characteristics of soils by various reinforcement techniques and design
CO5 Analyse the ground and decide the suitable chemical method for improving its characteristics

REFERENCES:
1. Pappala, A.J., Huang, J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
11. Han, J., Principles and Practice of Ground Improvement, John Wiley and Sons, New Jersey, Canada 2015.

COs- PO’s & PSO’s MAPPING

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SF4204 SHALLOW FOUNDATIONS L T P C 3 0 0 3

OBJECTIVES:
- To impart knowledge to select, analyse, geotechnical and structural design of shallow foundation depending on ground conditions.

UNIT I FOUNDATION DESIGN DECISIONS 6
Types of foundation – Types of Shallow foundation, their applicability – Selection of type of foundation – conceptual design principles – General and additional considerations – Depth of foundations – IS codal provisions.

UNIT II BEARING CAPACITY 9
UNIT III SETTLEMENT AND ALLOWABLE BEARING PRESSURE 9

UNIT IV INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS 12

UNIT V FOUNDATION FOR SPECIAL CONDITIONS 9

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

CO1 Differentiate various type of shallow foundations, their selection, design principles for different ground conditions
CO2 Apply appropriate bearing capacity theory and factors for different type of loading and ground conditions
CO3 Decide the design bearing pressure based on settlement, mode of loading and ground conditions
CO4 Perform interactive analysis for different types of shallow foundation and ground conditions
CO5 Perform analysis for different types of special foundation and special ground conditions

REFERENCES:
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SF4211  ADVANCED SOIL MECHANICS LABORATORY - II  L T P C

OBJECTIVES:
- At the end of the course student attains adequate knowledge in assessing Shear Strength, dynamic properties of soil and shear strength, indirect tensile strength and compressive strength of Rocks. Student learns to assess the different properties of geosynthetics. Student is trained to gain knowledge in assessing the properties of soils through field tests and also by conducting model tests.

UNIT I  SHEAR STRENGTH TESTS  12
Direct shear – Triaxial compression (UU and CU) test – Unconfined compression test – Vane shear test - Cyclic triaxial test.

UNIT II  SUCTION TESTS  8
Soil water characteristic curves of soil by Pressure Plate apparatus – Filter paper technique.

UNIT III  TEST ON GEOSYNTHETICS  12
Opening size of Geotextiles – Tensile strength of Geosynthetic materials – Interfacial friction – Permeability

UNIT IV  TEST ON ROCKS  12

UNIT V  MODEL AND FIELD TESTS (demonstration only)  16
Model test on foundation elements – measurement of strains and deflections - Field tests - Plate load test – static cone penetration test – standard penetration test – pressure meter test - Block vibration test.

TOTAL: 60 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to;

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<td>CO1</td>
<td>assess the shear strength of soils by conducting appropriate tests</td>
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<tr>
<td>CO2</td>
<td>analyse the soil water characteristic curves of different soils</td>
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<tr>
<td>CO3</td>
<td>analyse and assess the characteristics of soils using the geosynthetics</td>
</tr>
<tr>
<td>CO4</td>
<td>evaluate the strength characteristics of rocks</td>
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<td>CO5</td>
<td>Understand the concept of conducting model tests and use data acquisition system for conducting model test in laboratory</td>
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REFERENCES:
11. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

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SF4311 DESIGN STUDIO

OBJECTIVES:
- Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.

SYLLABUS:
Students have to work individually with software packages for simulating and analyzing the various geotechnical engineering problems:
- Soil – structure interaction such as Foundations and Retaining walls
- Ground improvement related problems.
- Analyze and design real challenging problems - deep excavation – impact on adjacent structures
- Stability analysis of slope and embankment - surcharge adjacent to an existing structure
- A detailed report on the work done should be submitted by individual students at least 10 days before the last working day of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:
- On completion of the course, the student is expected to be able to

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<tr>
<td>CO1</td>
<td>use software programs for arriving solutions to various practical design problems in Geotechnical Engineering</td>
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<td>CO2</td>
<td>develop numerical model tool with the use of software to arrive solutions for geotechnical problems</td>
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<tr>
<td>CO3</td>
<td>Communicate the numerical model concept and interact with geotechnical engineering community</td>
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TOTAL: 60 PERIODS
REFERENCES:

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SF4312
PRACTICAL TRAINING (2 WEEKS)

OBJECTIVES:
- To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out Soil Mechanics and Foundation engineering tasks. To develop skills in facing and solving the geotechnical engineering field problems.

Syllabus Content:
- Students individually undertake training in reputed Soil Mechanics and Foundation Engineering Companies during the summer vacation for a specified period of two weeks.
- Students allowed to get field exposure and effectively interact with geotechnical engineers
- At the end of training, a detailed report on the work done should be submitted to the course coordinator
- Students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:
- On completion of the course, the student is expected to be able to

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<td>CO1</td>
<td>Understand the real field problem and compare the theoretical knowledge with field</td>
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<td>CO2</td>
<td>Solve Soil Mechanics and Foundation engineering problems in the field either individually or in team.</td>
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<td>Understand the professional ethics</td>
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<td>CO4</td>
<td>Work in a team to obtain the solution for various field problems</td>
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Articulation Matrix

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SF4313
PROJECT WORK I

OBJECTIVES:
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
• To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:
• At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

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SF4411 PROJECT WORK II L T P C 0 0 24 12

OBJECTIVES:
• To solve the identified problem based on the formulated methodology.
• To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:
The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOME:
• On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

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PROFESSIONAL ELECTIVE COURSES

SF4001  ENVIRONMENTAL GEOTECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES:
- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

UNIT I  SOIL – WASTE INTERACTION  9
Role of Geoenvironmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure - factors influencing soil-pollutant interaction – modification of index, chemical and engineering properties – physical and physio-chemical mechanisms- Environmental laws and regulations

UNIT II  CONTAMINANT TRANSPORT AND SITE CHARACTERISATION  9

UNIT III  WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES  9

UNIT IV  LANDFILLS AND SURFACE IMPOUNDMENTS  9

UNIT V  STABILISATION OF WASTE  9
Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potential reuse – utilization of waste and soil stabilization – case studies.  TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to:

| CO1 | Understand the various causes and consequences of waste interaction with soil and their modification. |
| CO2 | Understand the various mechanism of transport of contaminants into the subsurface and characterization of contaminated sites and their risk analysis. |
| CO3 | Understand on how to decontaminate the site so as to reuse the site for human settlement |
| CO4 | Understand how to safely dispose the waste through different containment process. |
| CO5 | Expose on how to convert the waste into a resource material through soil waste stabilization techniques with or without chemical stabilization. |

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SF4002 GEOLOGY FOR GEOTECHNICAL APPLICATIONS

OBJECTIVES:
- To impart knowledge and skills in assessing the quality of foundation rocks, their aggregates and building materials derived from rocks and assess the geological suitability of sites for engineering projects.

UNIT I ENGINEERING PROPERTIES OF ROCKS AND MINERALS

UNIT II SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS
Surface investigations: Bed rock attitudes - Strike and dip of rocks-Field mapping- thickness, calculation of True thickness and vertical thickness of bed rock-pitting and trenching-Subsurface investigations: electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, applications of GPR in subsurface strata studies.

UNIT III LOGGING AND CORE SAMPLING TECHNIQUES
Core logging techniques – Resistivity log, Neutron log, Sonic log, Gamma log etc. Bore logging methods, interpretation. Drilled core sections – rocks and soil sampling methods. Description of discontinuities-Fence diagrams, RQD and RMR.

UNIT IV CLAY MINERALS IN GEOTECHNICAL INVESTIGATIONS
Physical, chemical and thermal properties of clays-identification-effects of clay minerals-classification and types of clays- plasticity, clay behaviour under natural and hydrated conditions.

UNIT V GEOLOGICAL INVESTIGATIONS FOR FOUNDATION SITES
Ground stability studies - Scour and erosion studies-stability of slopes: Geological information for slope stabilization and geological solution for slope stability in landslides areas-Overview of rocks of TamilNadu.

TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course, the student is expected to be able to:

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<td>CO1</td>
<td>Identify various rock types and understand the strength and durability of different rock types.</td>
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<td>CO2</td>
<td>Map the surface and subsurface geological formations using geological and geophysical exploration techniques.</td>
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<tr>
<td>CO3</td>
<td>Explore and analyse the subsurface rocks and their discontinuities for design and construction of major Civil engineering structures.</td>
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<tr>
<td>CO4</td>
<td>Understand the geological characteristics of clay minerals and their effect</td>
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<tr>
<td>CO5</td>
<td>Analyse the slopes and decide the suitable methods for improving slope stability and manage unstable slopes efficiently.</td>
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SF4003 FINITE ELEMENT METHOD IN GEOTECHNICAL ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
- Students are focused on acquiring the basic knowledge and computational skills in terms of finite element formulation with respect to various kinds of Geotechnical Engineering problems.

UNIT I BASIC CONCEPTS 9
Basic concepts - discretization of continuum, typical elements, the element characteristic matrix, element assembly and solution for unknowns – applications. Variational principles, variational formulation of boundary value problems, variational methods of approximation such as Ritz and weighted residual (Galerkin) methods.

UNIT II DISPLACEMENT MODELS 9
UNIT III  ISOPARAMETRIC FORMULATION

Isoparametric element - Local and Natural Co-ordinates systems, Line, Triangular, Quadrilateral and Tetrahedral Element-Interpolation - Displacement Models Formulation of Isoparametric - Finite element matrices in Local and Global Coordinate system – refined elements – numerical integration techniques.

UNIT IV  GEOTECHNICAL CONSIDERATION


UNIT V  APPLICATION IN GEOTECHNICAL ENGINEERING

Use of FEM to problems in soils – description and application to consolidation – seepage - FEM to simulate soil – structure interaction problems – finite element theory for simulating and analyzing the real foundation problem such as footing, pile foundation and deep excavations.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student is expected to be able to

| CO1 | understand the basic concept involved in finite element method using variational principles |
| CO2 | differentiate various types of displacement models, select suitable finite element model and able to solve geotechnical problems |
| CO3 | understand the basic concept of isoparametric finite element formulation and its use in solving geotechnical related problems |
| CO4 | consider the various geotechnical concept in the finite element formulations including interfacial behaviour |
| CO5 | develop finite element formulation for different geotechnical engineering related problems |

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SF4004  SOIL STRUCTURE INTERACTION  L  T  P  C  3 0 0 3

OBJECTIVES:
- Focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.

UNIT I  SOIL RESPONSE MODELS OF INTERACTION ANALYSIS  9

UNIT II  INFINITE AND FINITE BEAMS ON ELASTIC FOUNDATIONS  9
Infinite beam, General solution of the elastic line – concentrated and distributed loads on beams – Idealization of semi-infinite and finite beams. Classification of finite beams, different end conditions and loads – solutions - General method.

UNIT III  PLATE ON ELASTIC MEDIUM  9

UNIT IV  ANALYSIS OF PILE AND PILE GROUPS  12
Elastic analysis of single pile – Solutions for settlement and load distribution – Simplified method for constructing load settlement curve to failure – Analysis of group settlement – Two pile interaction Analysis, Analysis of general groups – Theoretical solutions for free standing groups – Settlement of groups caused by compressible underlying strata – Use of design charts – Surface settlement around a group – Observed and predicted group behaviour.

UNIT V  LATERALLY LOADED PILE  6
Load - deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Analysis of pile group, pile raft system, solutions through influence charts.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to;

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<tr>
<td>CO1</td>
<td>Select appropriate soil response model for interactive analysis.</td>
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<td>CO2</td>
<td>Differentiate and perform interactive analysis for different beams.</td>
</tr>
<tr>
<td>CO3</td>
<td>Differentiate and perform interactive analysis for different plates.</td>
</tr>
<tr>
<td>CO4</td>
<td>Perform interactive analysis for single pile, two pile and multiple groups</td>
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<td>CO5</td>
<td>Perform interactive analysis for single pile and multiple groups subjected to lateral loading.</td>
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SF4005 MECHANICS OF UNSATURATED SOILS L T P C 3 0 0 3

OBJECTIVES:
- To impart knowledge in assessing both physical and engineering behaviour of unsaturated soils, measurement and modeling of suction – water content and suction – hydraulic conductivity of unsaturated soils.

UNIT I STATE OF UNSATURATED SOIL 6

UNIT II PHYSICS OF SOIL WATER SYSTEM 9

UNIT III STRESS STATE VARIABLES AND SHEAR STRENGTH 12
UNIT IV   STEADY AND TRANSIENT FLOWS 9

UNIT V   MATERIAL VARIABLE MEASUREMENT AND MODELLING 9

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

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<tr>
<th>CO</th>
<th>Explain stress state variables, material variables and constitutive law of unsaturated soil</th>
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<td>CO2</td>
<td>Explain the physics of soil-water mechanism, relationship of models.</td>
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<tr>
<td>CO3</td>
<td>Explain and determine the soil-water characteristic curve and the shear strength of unsaturated soil</td>
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<tr>
<td>CO4</td>
<td>Explain the principles of vapour flow, air diffusion, pore liquid flow and rate of infiltration in unsaturated soil</td>
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<td>CO5</td>
<td>Measure the material variables and select the suitable soil models.</td>
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SF4006 DYNAMICS OF SOILS AND FOUNDATIONS L T P C
3 0 0 3

OBJECTIVES:
- To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods.
UNIT I  THEORY OF VIBRATION  9
Nature of dynamic loads – vibrations of single degree freedom system – free vibrations of spring –
mass systems – forced vibrations – viscous damping, Transmissibility – Principles of vibration
measuring instruments effect of Transient and Pulsating loads – vibrations of multi degree freedom
system.

UNIT II  DYNAMIC SOIL PROPERTIES AND BEHAVIOUR  9
Dynamic stress – strain characteristics – principles of measuring dynamic properties – Laboratory
Techniques – Field tests – Factors affecting dynamic properties - Typical values- Dynamic bearing
capacity – Dynamic earth pressure.

UNIT III  FOUNDATIONS FOR RECIPROCATING MACHINES  9
Types of Machines and Foundations – General requirements – Modes of vibration of a rigid
foundation, block method of analysis – Linear Elastic weightless spring method – Elastic half – space
method – Analog models ; Design of Block foundation - Codal Provisions

UNIT IV  FOUNDATION FOR IMPACT AND ROTARY MACHINES  9
Dynamic analysis of impact type machines – Design of Hammer foundations – use of vibrator
Absorbers – design – Codal recommendation. Special consideration for Rotary machines – Design
criteria – Loads on Turbo Generator Foundation – method of analysis – Design; Dynamic soil –

UNIT V  INFLUENCE OF VIBRATION AND REMEDIATION  9
Mechanism of Liquefaction–Influencing factors -Evaluation of Liquefaction potential based on SPT-
Force Isolation – Motion Isolation – use of spring and damping materials – vibration control of existing
machine foundation – screening of vibration – open trenches – Pile Barriers – salient construction
aspects of machine Foundations.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to;

| CO1 | Differentiate different type of dynamic loads and theory of vibration of different systems |
| CO2 | Select different dynamic properties from different testing principles and applications |
| CO3 | Perform analysis and design of reciprocating machines based on different methods. |
| CO4 | Perform analysis and design of impact and rotary machines based on different |
| CO5 | Asses influence of vibration from different dynamic source and design suitable remediation |

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SF4007 GEOTECHNICAL EARTHQUAKE ENGINEERING

OBJECTIVES:
- To understand the dynamics of earth and its response, effect on earth structure and measures to mitigate the effects.

UNIT I ELEMENTS OF EARTHQUAKE SEISMOLOGY 6

UNIT II THEORY OF VIBRATION 9

UNIT III GROUND MOTION CHARACTERISTICS 10
Strong Motion Records -characteristics of ground motion - Factors influencing ground motion - Estimation of frequency content parameters - Seismic site investigations - Evaluation of Dynamic soil properties.

UNIT IV DESIGN GROUND MOTION 10

UNIT V SEISMIC STABILITY ANALYSIS 10

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

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<td>CO1</td>
<td>Explain interior structure of earth, different causes, location and quantification of earthquake</td>
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<tr>
<td>CO2</td>
<td>Differentiate different type of dynamic loads and theory of vibration of different systems</td>
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<tr>
<td>CO3</td>
<td>Evaluate dynamic properties of soils and ground motion characteristics</td>
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<td>CO4</td>
<td>Estimate the design ground motion based on the ground response analysis</td>
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Analyze and design different types of foundations, slopes and retaining walls for seismic loading and assess liquefaction potential and mitigation of liquefaction induced damage.

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SF4008  EARTHQUAKE RESISTANT DESIGN OF FOUNDATIONS  L T P C

OBJECTIVES:
- Focus is mainly on identifying the different kinds of loading induced on the foundation due to earthquake and soil - foundation interaction analysis with reference to various design parameters that including liquefaction of soil due to earthquake.

UNIT I  BASIC DESIGN PARAMETERS
Dynamic properties of soils and its evaluation, strength and deformation characteristics of soils under earthquake loading, liquefaction hazard evaluations and remedial measures, geotechnical failure of foundations during earthquake, provision of IS 1893 and IS 13920

UNIT II  SHALLOW FOUNDATION

UNIT III  DEEP FOUNDATION
UNIT IV  SEISMIC DESIGN OF RETAINING WALL  
Seismic passive lateral earth pressure, behaviour of retaining wall during earthquakes, modification of Coulomb’s Theory, Modified Culmann’s Theory, displacement analysis, Indian standard code of practice.

UNIT V  STRUCTURAL DESIGN OF FOUNDATION  
Loads acting on foundations during earthquake – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to;

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<td>CO1</td>
<td>Evaluate the dynamic properties of soils and relevant design parameters</td>
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<td>CO2</td>
<td>Design the shallow foundation subjected to earthquake loading by including the effect of soil liquefaction</td>
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<td>CO3</td>
<td>Analyse and design the deep foundation by considering various earthquake forces</td>
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<tr>
<td>CO4</td>
<td>Analyse and design the retaining wall by incorporating earthquake forces</td>
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<td>CO5</td>
<td>Perform structural design of foundations subjected to both static and dynamic loading</td>
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OBJECTIVES:
- Students are expected to classify, understand stress-strain characteristics, failure criteria, and influence of in-situ stress in the stability of various structures and various technique to improve the in-situ strength of rocks.

UNIT I  CLASSIFICATION OF ROCKS  9
Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations.

UNIT II  STRENGTH CRITERIA OF ROCKS  9
Behaviour of rock under hydrostatic compression and deviatoric loading - Modes of rock failure - planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hoek and Brown Strength criteria for rocks with discontinuity sets.

UNIT III  INSITU STRESSES IN ROCKS  9
Insitu stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks - case studies.

UNIT IV  SLOPE STABILITY AND BEARING CAPACITY OF ROCKS  10
Rock slopes - role of discontinuities in slope failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks – case studies

UNIT V  ROCK REINFORCEMENT  8
Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, installation methods - case studies.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

| CO1 | Classify the Rock mass and rate the quality of rock for tunnelling and foundations works and suggest the safer length of tunnelling and stand up time. |
| CO2 | Apply the knowledge of engineering and understand the stress – strain characteristics and failure criteria of rock and apply them to arrive at the shear strength parameters of rocks to be used for the design of structures resting on rock and also for the design of underground excavation in rocks. |
| CO3 | Apply the knowledge of engineering and assess the influence of in-situ stress in the stability of various underground excavations and also acquire the knowledge of design of opening in rocks. |
| CO4 | Apply the knowledge on rock mechanics and analyse the stability of rock slopes and arrive at the bearing capacity of shallow and deep foundations resting on rocks considering the presence of joints. design the foundations resting on rocks. Able to carryout suitable foundation for the structure resting on rock. |
| CO5 | Improve the in-situ strength of rocks by various methods such as rock reinforcement and rock support. Able to select suitable support system considering the interaction between rock and support. Also capable of executing the same in the field. |

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SF4010
EARTH AND ROCK FILL DAMS
L T P C 3 0 0 3

OBJECTIVES:
- Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes.

UNIT I DESIGN CONSIDERATION
Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.

UNIT II SLOPE STABILITY AND SEEPAGE ANALYSIS

UNIT III HYDRAULIC FRACTURING

UNIT IV FAILURE AND DAMAGES
Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersive piping.

UNIT V SLOPE PROTECTION MEASURES
Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of Geosynthetic materials in filtration. Treatment of rock foundation, Construction Techniques, Quality control and performance measurement

TOTAL: 45 PERIODS
OUTCOMES:

On completion of the course, the student is expected to be able to

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<tr>
<td>CO1</td>
<td>Assess the causes of failure and damage of embankments and slopes.</td>
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<tr>
<td>CO2</td>
<td>Apply the knowledge of engineering and analyse the stability of slopes for various seepage conditions and apply the concept in the design of earth and rock fill dams.</td>
</tr>
<tr>
<td>CO3</td>
<td>Apply the knowledge of engineering and assess the stability of dam against hydraulic fracturing and suggest suitable remedial measure.</td>
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<tr>
<td>CO4</td>
<td>Understand the nature of failures and damages in earth and rock fill dams and apply the concept in field to avoid distress.</td>
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<td>CO5</td>
<td>Recommend suitable remedial measures to protect the slopes and implement quality control and monitor its performance.</td>
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REFERENCES:


Articulation Matrix

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SF4011 GEOTECHNICS OF UNDERGROUND STRUCTURES L T P C 3 0 0 3

OBJECTIVES:

- Students mainly focused in visualizing and critically analyzing the behavior of underground structures with reference to various supporting systems under different loading conditions due to induced earth pressure on the underground structures.

UNIT I GROUND MOVEMENTS AND ITS EFFECTS 9
Understanding of the ground – Building response to ground movements – concept of limiting tensile strain – strains in simple rectangular beams – ground movement due to tunneling and excavation - lateral supporting systems – retaining walls – factors influencing on the selection of the retaining system – case history.

UNIT II ANALYSIS OF UNDERGROUND SUPPORTING SYSTEMS 9
UNIT III  DESIGN OF UNDERGROUND SUPPORTING SYSTEMS  9
Principles of retaining wall design – types of wall support systems - design of structural elements –
Permanent situations – bottom-up/top-down construction sequences – Props – Tied systems – Soil
berms – Design of ground anchors – Retaining wall as part of complete underground structure –
resistance to vertical and lateral actions

UNIT IV  DESIGN OF TUNNEL  10
Longitudinal and transverse profile of tunnel structure - tunnel protection against fire - advanced
systems of anti-water insulation of underground structures - loading types of shallow and deep
tunnels, rock mass classification - mining technologies of deep excavation - shield technology,
execution technology of shallow underground structures, sewerage objects - trenchless
technologies.

UNIT V  PROTECTION OF ADJACENT BUILDINGS  8
Protection of building using the behaviour of excavation and tunneling induced deformation – building
protection by auxiliary methods – construction defects and remedial measures – building rectification
methods.

TOTAL: 45 PERIODS

OUTCOMES:
• On completion of the course, the student is expected to be able to

| CO1   | Understand various types of supporting systems used for excavations and analyse
|       | ground movement due to various activities like excavations |
| CO2   | Analyse underground supporting system using mathematical, analytical and
|       | numerical methods |
| CO3   | Design various underground supporting systems using mathematical and numerical
|       | approach |
| CO4   | Understand the concept of tunnelling, analyse and design the tunnel in different
|       | methods. |
| CO5   | Protect the adjacent building due to underground construction using various
|       | methods. |

REFERENCES:
3. Terzaghi, K. and Peck, R. B, Soil Mechanics in Engineering Practice, John Wiley & Sons,
7. Hoek, E., Brown, E.T., Underground excavations in rock, The Institution of Mining and
8. Goel, R.K. and Dwivedi, R.D., A Short-Term course on Underground Engineering, Central
   Institute of Mining and Fuel Research Regional Centre, Roorkee, 2010.
9. Megaw T. M., and Bartlett, J.V., Tunnels: planning, design, construction. Ellis Horwood,
   1983.
10. Kolymbas, D., Tunnelling and tunnel mechanics: A rational approach to tunnelling, 2nd
11. Lunardi, P., Design and construction of tunnels, Springer – Verlag Berlin Heidelberg, Italy,
    2008.
12. John Burland, Tim Chapman, Hilary Skinner and Michael Brown, ICE manual of
Articulation Matrix

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SF4012  GEOSYNTHETICS AND REINFORCED SOIL STRUCTURES  L T P C
3 0 0 3

OBJECTIVES:
• To understand the mechanism of the reinforcement, its influence in the shear strength and
design concept for various applications in geotechnical engineering.

UNIT I  PRINCIPLES AND MECHANISMS OF SOIL REINFORCEMENT  9
Historical Background – Principles - Concepts and Mechanisms of reinforced earth – Soil –
Geosynthetics interaction mechanism – interface resistance – Factors influencing interaction – Strain
compatability.

UNIT II  REINFORCING MATERIALS AND THEIR PROPERTIES  9
Materials used in reinforced soil structures, fill materials, reinforcing materials metal strips,
Geotextile, Geogrids,Geomembranes, Geocomposites and Geojutes, Geofoam, Natural fibers -
facing elements – Influence of environmental factors on the performance of Geosynthetic materials –
Physical – Mechanical – Hydraulic and Endurance properties testing.

UNIT III  DESIGN FOR SOIL REINFORCEMENT AND SEPARATION  9
Reinforcing the soil - Geotextiles and Geogrids –Retaining wall – embankment - unpaved roads –

UNIT IV  DESIGN FOR FILTRATION, DRAINAGE AND CONTAINMENT  9
Geotextile filter – Filtration Mechanism – Factors affecting filter behaviour – Filtration design – Drains –
Drainage in embankments – erosion control silt fences – Containment ponds – Reservoirs and
Canals – Hydraulic tunnels – River bed and bank protection.

UNIT V  DESIGN OF REINFORCED SLOPES  9
Type and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability
analysis – Design aspects – Embankments – Basal reinforcement – seismic aspects - General
construction aspects.

TOTAL : 45 PERIODS

OUTCOMES:
• On completion of the course, the student is expected to be able to

<table>
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<tr>
<th>CO</th>
<th>Objective</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Explain various principles and mechanism of soil reinforcement.</td>
</tr>
<tr>
<td>CO2</td>
<td>Select different reinforcing materials based on functions to determine their properties</td>
</tr>
<tr>
<td>CO3</td>
<td>Design geosynthetics as a reinforcement and/or a separator for different reinforced structures.</td>
</tr>
<tr>
<td>CO4</td>
<td>Design geosynthetics as a filter, drainer and as a containment for</td>
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<tr>
<td>CO5</td>
<td>Analyze and design reinforced slopes for static and seismic loading.</td>
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SF4013 MARINE GEOTECHNIQUES L T P C
3 0 0 3

OBJECTIVES:
- Students mainly focused in understanding the physical and engineering properties of marine soil deposits and select suitable marine foundation as per project requirements.

UNIT I MARINE SOIL DEPOSITS
Marine environment, Physical and engineering properties of marine soils - Specific problems related to marine soil deposits.

UNIT III BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING
Effect of wave loading on foundations of marine structures, Behavior of marine deposits under cyclic loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods

UNIT II SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS
Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits.

UNIT IV FOUNDATIONS IN MARINE SOIL DEPOSITS
Different offshore and nearshore foundations, Gravity platforms, Jack-up rigs, pile foundations, caissons, spudcans.

UNIT V MARINE FOUNDATIONS SUBJECTED TO WAVE LOADING
Cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

TOTAL: 45 PERIODS
OUTCOMES:
- On completion of the course, the student is expected to be able to

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<th>CO</th>
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<tbody>
<tr>
<td>CO1</td>
<td>Understand the physical and engineering properties of marine soil deposits</td>
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<tr>
<td>CO2</td>
<td>explain the effect of wave loading on physical and engineering properties of marine soil deposits</td>
</tr>
<tr>
<td>CO3</td>
<td>execute investigation program for marine soil deposits</td>
</tr>
<tr>
<td>CO4</td>
<td>design suitable marine foundation as per project requirement</td>
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<tr>
<td>CO5</td>
<td>develop numerical model and design marine foundation subjected to wave loading</td>
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SF4014 PAVEMENT ENGINEERING

OBJECTIVES:
- Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions of roads.

UNIT I BASIC CONCEPTS
Historical development of pavements – types, classification, components and principle of load transfer – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading–Stresses and deflections in layered systems.

UNIT II FLEXIBLE PAVEMENT
Factors affecting flexible pavements – material characterization for analytical pavement design – AASHO, CBR, group index methods – Importance of Resilient modulus – Fatigue subsystem – failure criteria for bituminous pavements – IRC design guidelines.

UNIT III RIGID PAVEMENT
Factors affecting rigid pavements - Design procedures for rigid pavement – Slab thickness, dowel bar, tie bar, spacing of joints – IRC guidelines – Airfield pavements – Comparison of highway and airfield pavements.

UNIT IV PAVEMENT EVALUATION AND REHABILITATION
Pavement evaluation – surface and structural - causes and types of failures in flexible and rigid pavements – Presents serviceability index of roads – Overlay design - pavements maintenance, management and construction – Drainage and its importance in pavements.
UNIT V  STABILIZATION OF SOILS FOR ROAD CONSTRUCTIONS  

TOTAL: 45 PERIODS

OUTCOME:
On completion of the course, the student is expected to be able to

<table>
<thead>
<tr>
<th>CO</th>
<th>Explain different types of pavements, wheel load, serviceability and design strategies of pavement.</th>
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<tbody>
<tr>
<td>CO2</td>
<td>Design flexible pavements based on different guidelines.</td>
</tr>
<tr>
<td>CO3</td>
<td>Design rigid pavements based on different guidelines.</td>
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<tr>
<td>CO4</td>
<td>Explain the various types of failure in different components of pavement and</td>
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<tr>
<td>CO5</td>
<td>Select suitable stabilizers based on mechanism and requirements for construction with quality control in the field.</td>
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AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING 2000

OBJECTIVES
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

UNIT III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES
OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III 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 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.

UNIT V 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

TOTAL : 30 PERIODS

OUTCOMES
CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES
OBJECTIVES
Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

UNIT IV ORGANS OF GOVERNANCE
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

UNIT VI ELECTION COMMISSION
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

OUTCOMES
Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

- The Constitution of India, 1950 (Bare Act), Government Publication.
UNIT I

1. வழிபாட்டியைக் கன்சியமும் (புத்தகி) - கவிதை, உரை, பாடல்
2. தமிழன் (82)
3. தினகௌன்பொருள் தமிழகப் புருணம்
4. பொருளையம் (95, 195)
   - புகளியாறியால் வகுப்பு

UNIT II

1. அந்தர்வேலியக்கூறுகள்
   - அருவி, விளக்கம், முப்புருணம், பங்கு, பதில்
2. புரோசைகல் - தந்தையுற்றுக்கொண்டு
   - வடம, விளக்கம், விளக்கம், விளக்கச் சுருக்கம்
     (உபுரப்புப்புப்புப்புப்பு போன்று)

UNIT III

1. கணக்கிப்படுத்தல்
   - தேர்வுமாறு கூறுகளுள்
     கூறுகளுக்கும் முறையுறுக்கொண்ட்
   - கூற்றுக்கும் முறையுறுக்கொண்ட்

UNIT IV

1. புரோசைகல்
   - வாழ்க்கையைப் புரோசைகல்
     புரோசைகல்களுக்கும் முறையுறுக்கொண்ட்
     புரோசைகல்களின் கூறுகளுக்கும்
     வாழ்க்கை புரோசைகல்
2. குறிப்பிட்டு
   - தேவாலயக் குறிப்பிட்டு
3. சிற்றுறை (617, 618)
   - தேவாலயக் குறிப்பிட்டு
4. சுருக்கப்பொருள் வழங்கநூறு
5. புறநூறு
   - குறிப்பிட்டு
6. குறிப்பிட்டு (4)
   - வருகை
     குறிப்பிட்டு (11)
     குறிப்பிட்டு (11)
     புறநூறு, புறநூறு
     அவை (50 (27)) - புறநூறு
     புறநூறு புரோசைகல் வழங்கநூறு
UNIT V நவீனதமிழிலக்கியம்

1. உகரநகடத்
   - நொடகம்
   - பயண
   - கட்டுகர
   - முதல்புதினம்
   - முதல்சிறுககத

2. நொட்டுவிடுதகலப்பொரொட்டமும்தமிழ்இலக்கியமும்
3. முதொயவிடுதகலயும்தமிழ்இலக்கியமும்
4. தபணோவிடுதகலயும்விளிம்புநிகலயினரின்பமம்பொட்டில்தமிழ்இலக்கியமும்
5. அறிவியல்
6. இகணயத்தில்
7. சுற்றுசூழல்

TOTAL: 30 PERIODS

தமிழ் இலக்கியத்திலேயே பெற்ற உயிரியல் / புத்தகங்கள்

1. தமிழ்விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
2. தமிழ்விக்கிப்பீடியொ (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ்விக்கிப்பீடியொ
4. வொழ்வியல்களஞ்சியம் - தமிழ்ப்பல்ககலக்கழகம், தஞ் ஊவூர்
5. தமிழ்விக்கிப்பீடியொ (Tamil Virtual University) - www.tamilvu.org
6. அறிவியல்களஞ்சியம் - தமிழ்ப்பல்ககலக்கழகம், தஞ் ஊவூர்
OPEN ELECTIVES

OIC431  BLOCKCHAIN TECHNOLOGIES  L T P C

3 0 0 3

COURSE OBJECTIVES:

- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I  INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN  9
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II  BITCOIN AND CRYPTOCURRENCY  9

UNIT III  INTRODUCTION TO ETHEREUM  9
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  10

UNIT V  BLOCKCHAIN APPLICATIONS  8
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After the completion of this course, student will be able to

CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Build and train RNNs, work with NLP and Word Embeddings.
- The internal structure of LSTM and GRU and the differences between them.
- The Auto Encoders for Image Processing.

UNIT I  DEEP LEARNING CONCEPTS  6

UNIT II  NEURAL NETWORKS  9

UNIT III  CONVOLUTIONAL NEURAL NETWORK  10

UNIT IV  NATURAL LANGUAGE PROCESSING USING RNN  10

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING  10

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc. 2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress, 2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND, 2017
OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT I
BASICS OF VIBRATION

UNIT II
BASICS OF NOISE
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT III
INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT IV
INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT V
METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:
OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat.
- To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement.

UNIT I ENERGY SCENARIO

UNIT II HEATING, VENTILATION & AIR CONDITIONING

UNIT III LIGHTING, COMPUTER, TV

UNIT IV ENERGY EFFICIENT BUILDINGS

UNIT V ENERGY STORAGE TECHNOLOGIES
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:

OME433 ADDITIVE MANUFACTURING

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION

POWDER BASED PROCESS:

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES

REFERENCES:

OME434 ELECTRIC VEHICLE TECHNOLOGY

UNIT I NEED FOR ELECTRIC VEHICLES 9
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges

UNIT II ELECTRIC VEHICLE ARCHITECHTURE 9
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE 9
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV ELECTRIC DRIVES AND CONTROL 9
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V DESIGN OF ELECTRIC VEHICLES 9

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT

UNIT II OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION & TESTING

UNIT V INDUSTRIAL DESIGN & PROTOTYPING

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for new product design and develop new products.

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006
COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS


UNIT II screen the BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY

Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV FINANCING SMALL BUSINESS

Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES

CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES

3. Journal articles on SME’s.
COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I  INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II  PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III  STATUTES

UNIT IV  STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V  MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.
UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology-ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

ET4251 IoT FOR SMART SYSTEMS
COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT
5. To familiarize the different platforms and Attributes for IoT

UNIT I INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE
UNIT III       PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT

PROTOCOLS:
NFC, SCADA and RFID, Zigbee    MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe    GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV      IOT PROCESSORS

Services/Attributes: Big-Data Analytics for IOT, Dependability,Interoperability, Security, Maintainability.

Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPPERRY PI and Arduino.

UNIT V      CASE STUDIES

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IOT
CO3: Explain different protocols and communication technologies used in IOT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

REFERENCES:

ET4072       MACHINE LEARNING AND DEEP LEARNING

COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I          LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II         NEURAL NETWORKS

UNIT III        MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV        DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V          DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:
OBJECTIVES:
To impart knowledge on
- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy systems

UNIT I
INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO₂ Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II
SOLAR PHOTOVOLTAICS

UNIT III
PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV
WIND ENERGY CONVERSION SYSTEMS

UNIT V
OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

OUTCOMES:
After completion of this course, the student will be able to:
CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources

REFERENCES:
COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I  INTRODUCTION TO SMART GRID
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II  SMART GRID TECHNOLOGIES
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III  SMART METERS AND ADVANCED METERING INFRASTRUCTURE
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV  POWER QUALITY MANAGEMENT IN SMART GRID

Unit V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS
Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

TOTAL : 45 PERIODS

COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES
COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have thorough understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I  SYSTEM SECURITY  9
Model of network security – Security attacks, services and mechanisms – OSI security architecture

UNIT II  NETWORK SECURITY  9

UNIT III  SECURITY MANAGEMENT  9

UNIT IV  CYBER SECURITY AND CLOUD SECURITY  9

UNIT V  PRIVACY AND STORAGE SECURITY  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES
MP4251 CLOUD COMPUTING TECHNOLOGIES  L T P C  3 0 0 3

COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE  6

UNIT II CLOUD PLATFORM ARCHITECTURE  12

UNIT III AWS CLOUD PLATFORM - IaaS  9

UNIT IV PAAS CLOUD PLATFORM  9

UNIT V PROGRAMMING MODEL  9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.
REFERENCES

IF4072 DESIGN THINKING L T P C 3 0 0 3

COURSE OBJECTIVES:
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE 8

UNIT II CONTEXTUAL INQUIRY 10

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

UNIT IV UX GOALS, METRICS, AND TARGETS 8

UNIT V ANALYSING USER EXPERIENCE 10

SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.
Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS


Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS


Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS


Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.
Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

DS4015 BIG DATA ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
• To understand the basics of big data analytics
• To understand the search methods and visualization
• To learn mining data streams
• To learn frameworks
• To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA

UNIT II SEARCH METHODS AND VISUALIZATION

UNIT III MINING DATA STREAMS

UNIT IV FRAMEWORKS
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation
UNIT V  R LANGUAGE  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

REFERENCE:

NC4201  INTERNET OF THINGS AND CLOUD  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I  FUNDAMENTALS OF IoT  9

UNIT II  PROTOCOLS FOR IoT  9

UNIT III  CASE STUDIES/INDUSTRIAL APPLICATIONS  9
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV  CLOUD COMPUTING INTRODUCTION  9
UNIT V  IoT AND CLOUD
TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies.
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073  MEDICAL ROBOTICS

COURSE OBJECTIVES:
• To explain the basic concepts of robots and types of robots
• To discuss the designing procedure of manipulators, actuators and grippers
• To impart knowledge on various types of sensors and power sources
• To explore various applications of Robots in Medicine
• To impart knowledge on wearable robots

UNIT I  INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization
Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II  MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems
Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study
UNIT IV  REHABILITATION AND ASSISTIVE ROBOTS  9
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V  WEARABLE ROBOTS  9
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

COURSE OBJECTIVES:
• To learn about the process involved in the design and development of real-time embedded system
• To develop the embedded C programming skills on 8-bit microcontroller
• To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
• To learn about the tools, firmware related to microcontroller programming
• To build a home automation system

UNIT I  INTRODUCTION TO EMBEDDED C PROGRAMMING  9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools
UNIT II  AVR MICROCONTROLLER  9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features: Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT III  HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS  9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Converters - Interfacing Digital To Analog Converters - LED Displays: Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT IV  VISION SYSTEM  9

UNIT V  HOME AUTOMATION  9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

COURSE OUTCOMES:
On successful completion of this course, students will be able to
CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

REFERENCES:
UNIT III  SIGNIFICANCE OF BIODIVERSITY  9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV  POLLUTION IMPACTS  9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V  ENVIRONMENTAL ECONOMICS  9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES
UNIT I  BASICS OF NANOCOMPOSITES

UNIT II  METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal-Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III  POLYMER BASED NANOCOMPOSITES
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV  NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V  NANOCOMPOSITE TECHNOLOGY

REFERENCES:
5. The search for novel, superhard materials- Stan Vepřek (Review Article) JVST A, 1999

TOTAL : 45 PERIODS

UNIT I  IPR
UNIT II  AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES


UNIT III  BIOSAFETY


UNIT IV  GENETICALLY MODIFIED ORGANISMS

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V  ENTREPRENEURSHIP DEVELOPMENT


REFERENCES


TOTAL : 45 PERIODS