

ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M.E. SOIL MECHANICS AND FOUNDATION ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABUS
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4153	Advanced Mathematical Methods	FC	4	0	0	4	4
2.	SF4101	Properties and Behaviour of Soils	PCC	3	0	0	3	3
3.	SF4102	Strength and Deformation Behaviour of Soils	PCC	3	0	0	3	3
4.	SF4103	Subsurface Investigation and Instrumentation	PCC	3	0	0	3	3
5.	SF4104	Theory of Geomechanics	PCC	4	0	0	4	4
6.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Audit course I*	AC	2	0	0	2	0
PRACTICALS								
8.	SF4111	Advanced Soil Mechanics Laboratory – I	PCC	0	0	4	4	2
TOTAL				21	0	4	25	21

* Audit Course is Optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	SF4201	Deep Foundations	PCC	3	0	0	3	3
2.	SF4202	Earth and Earth Retaining Structures	PCC	3	0	0	3	3
3.	SF4203	Ground Improvement Techniques	PCC	3	0	0	3	3
4.	SF4204	Shallow Foundations	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit course II*	AC	2	0	0	2	0
PRACTICALS								
8.	SF4211	Advanced Soil Mechanics Laboratory – II	PCC	0	0	4	4	2
TOTAL				20	0	4	24	20

*Audit Course is Optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective III	PEC	3	0	0	3	3
2.		Professional Elective IV	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	SF4311	Design Studio	PCC	0	0	4	4	2
6.	SF4312	Practical Training (2 weeks)	EEC	0	0	0	0	1
7.	SF4313	Project Work I	EEC	0	0	12	12	6
TOTAL				12	0	16	28	21

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	SF4411	Project Work II	EEC	0	0	24	24	12
TOTAL				0	0	24	24	12

TOTAL CREDITS: 74

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4153	Advanced Mathematical Methods	3	1	0	4	1

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	SF4101	Properties and Behaviour of Soils	3	0	0	3	1
2.	SF4102	Strength and Deformation Behaviour of Soils	3	0	0	3	1
3.	SF4103	Subsurface Investigation and Instrumentation	3	0	0	3	1
4.	SF4104	Theory of Geomechanics	4	0	0	4	1
5.	SF4111	Advanced Soil Mechanics Laboratory - I	0	0	4	2	1
6.	SF4201	Deep Foundations	3	0	0	3	2
7.	SF4202	Earth and Earth Retaining Structures	3	0	0	3	2
8.	SF4203	Ground Improvement Techniques	3	0	0	3	2
9.	SF4204	Shallow Foundations	3	0	0	3	2
10.	SF4211	Advanced Soil Mechanics Laboratory - II	0	0	4	2	3
11.	SF4311	Design Studio	0	0	4	2	3
TOTAL CREDITS						31	

LIST OF PROFESSIONAL ELECTIVE COURSES [PEC]**SEMESTER II, ELECTIVE I**

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	SF4001	Environmental Geotechnology	3	0	0	3	3
2.	SF4002	Geology for Geotechnical Applications	3	0	0	3	3

SEMESTER II, ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	SF4003	Finite Element Method in Geotechnical Engineering	3	0	0	3	3
2.	SF4004	Soil Structure Interaction	3	0	0	3	3
3.	SF4005	Mechanics of Unsaturated Soils	3	0	0	3	3

SEMESTER III, ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	SF4006	Dynamics of Soils and Foundations	3	0	0	3	3
2.	SF4007	Geotechnical Earthquake Engineering	3	0	0	3	3
3.	SF4008	Earthquake Resistant Design of Foundations	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	SF4009	Rock Mechanics and Applications	3	0	0	3	3
2.	SF4010	Earth and Rock Fill Dams	3	0	0	3	3
3.	SF4011	Geotechnics for Underground Structures	3	0	0	3	3

SEMESTER III, ELECTIVE V

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
1.	SF4012	Geosynthetics and Reinforced Soil Structures	3	0	0	3	3
2.	SF4013	Marine Geotechniques	3	0	0	3	3
3.	SF4014	Pavement Engineering	3	0	0	3	3

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						2	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	SF4312	Practical Training (4 Weeks)	0	0	0	2	3
2.	SF4313	Project Work I	0	0	12	6	3
3.	SF4411	Project Work II	0	0	24	12	4
TOTAL CREDITS						20	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX4091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX4092	Disaster Management	2	0	0	0	
3.	AX4093	Constitution of India	2	0	0	0	
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0	

SUMMARY

Name of the Programme: M.E SOIL MECHANICS AND FOUNDATION ENGINEERING						
SUBJECT AREA		CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	15	14	02	00	31
3.	PEC	00	06	09	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	00	07	12	19
7.	Non Credit/Audit Course	✓	✓	00	00	
TOTAL CREDIT		21	20	21	12	74

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
12

Laplace transform : Definitions – Properties – Transform error function – Bessel's function - Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform : Complex inversion formula – Solutions to partial differential equations : Heat equation – Wave equation.

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS
12

Fourier transform : Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT III CALCULUS OF VARIATIONS
12

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
12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS
12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient - Divergence and curl.

TOTAL : 60 PERIODS**OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

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

REFERENCES :

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolc, L.D., "Calculus of Variations", Dover Publications Inc., New York, 2007.
3. Mathews, J. H., and Howell, R.W., "Complex Analysis for Mathematics and Engineering", 6th Edition, Jones and Bartlett Publishers, 2011.
4. Kay, D. C., "Tensor Calculus", Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
5. Naveen Kumar, "An Elementary Course on Variational Problems in Calculus ", Narosa Publishing House, 2005.
6. Saff, E.B and Snider, A.D, "Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics", 3rd Edition, Pearson Education, New Delhi, 2014.
7. Sankara Rao, K., "Introduction to Partial Differential Equations", 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
8. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.
9. Ramaniah. G. "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.

SF4101

PROPERTIES AND BEHAVIOUR OF SOILS

L T P C
3 0 0 3

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 8

Formation of soils – different soil deposits and their engineering properties – Genesis of clay minerals – classification and identification – Anion and Cation exchange capacity of clays – specific surface area – index properties – bonding in clays.

UNIT II PHYSICAL AND PHYSIO CHEMICAL BEHAVIOUR OF SOILS 9

Physical and physio chemical behaviour of soils – diffused double layer theory – computation of double layer distance – effect of ion concentration, ionic valency, pH, dielectric constant, temperature on double layer – stern layer – attractive and repulsive forces in clays – types of soil water – mechanism of soil – water interactions - soil fabric and structure.

UNIT III SWELL - SHRINK AND COMPACTION BEHAVIOUR OF SOILS 10

Swelling and shrinkage behaviour of soils – mechanisms, Causes and consequences – factors influencing swell – shrink characteristics – swell potential —swell pressure —and measurements – sensitivity, thixotrophy of soils – soil suction – soil compaction – factors affecting soil compaction - case studies.

UNIT IV COMPRESSIBILITY, SHEAR STRENGTH AND PERMEABILITY BEHAVIOUR OF SOILS 10

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 8

Conduction in soils – hydraulic, electrical, chemical and thermal flows in soils – applications - coupled flows – Electro-kinetic process – thermo osmosis - electro osmosis – prediction of engineering behaviour of soils using index properties – empirical equations and their applicability.

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:

1. Mitchell, J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.
2. Yong, R.N. and Warkentin, B.P., Introduction to Soil Behaviour, Macmillan, Limited, London, 1979.
3. Coduto, D.P., Geotechnical Engineering – Principles and practices, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. Perloff, W.H. and Baron, W, Soil Mechanics, The Ronal Press Company, 1976.
5. Van Olphen, H., Clay colloid Chemistry, John Wiley, 1996
6. Grim, R.E., Applied Clay Mineralogy, McGraw Hill, New York, 1966.
7. Lambe, T.W. and Whitman, R.V. Soil Mechanics, John Wiley & Sons, New York, 1979.
8. Das, B.M., Principles of Geotechnical Engg, PWS Publishing Comp, Boston, 1998
9. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2002.
10. Robert D. Holtz and William D. Kovacs, "An Introducion to Geotechnical Engineering", Prentice Hall (UK) International, London, 1981.
11. Gopal Ranjan and A.S.R Rao, 'Basic and Applied Soil Mechanics', New Age International (P) Limited, New Delhi, 2000.
12. Knappett J.A. and R.F. Craig, 'Craig's Soil Mechanics', Span Press, 711 Third Avenue, New York, NY 10017, 2012

SF4102

STRENGTH AND DEFORMATION BEHAVIOUR OF SOILS

L T P C
3 0 0 3

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**

9

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**

9

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**9**

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**9**

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**9**

The critical state line- Roscoe's surface- Hvorslev's surface- Behavior of sand- Effects of dilation- Limitations of Taylor model- Elastic and plastic deformation-Camclay critical state model- Modified Camclay model- Parameters for design

TOTAL: 45 PERIODS**OUTCOMES:**

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

- CO1** 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.
- CO2** Select the shear strength parameters of cohesive soil based on mode of shear, drainage conditions, degree of saturation and degree of consolidation
- CO3** Apply different failure criteria and its applicability based on drainage conditions and type of soil.
- CO4** Apply constitutive models for soils and their applicability for different type of drainage conditions.
- CO5** Explain critical state behaviour, modelling of soils and to select the respective design parameters.

REFERENCES:

1. Robert D. Holtz., William D. Kovacs., Thomas C. Sheahan., "An Introduction to Geotechnical Engineering" Dorling Kindersley India pvt. Ltd., Second edition, 2013.
2. Braja, M, Das., "Advanced soil mechanics", CRC Press, fifth edition, 2019.
3. Atkinson J.H. and Bransby P.L. "Introduction to critical state soil mechanics" McGraw Hill, 1978.
4. Lambe, T.W. and Whitman R.V. "Soil Mechanics in S.I. Units John Wiley, India, Pvt Ltd. 2008.
5. Wood, D.M., "Soil behaviour and Critical State Soil Mechanics", Cambridge University Press, New York, 1990.
6. Graham Barnes, "Soil Mechanics Principles and Practices", Macmillan Press Ltd., London, 2002.
7. Braja, M. Das, "Principles of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, Fifth Edition, 2002.
8. Malcolm D. Bolton, "A guide to soil mechanics", Universities Press (India) Private Ltd., Hyderabad, India, 2003.
9. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014.
10. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.
11. Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons, Inc., third edition, 2011.
12. Punmia.B.C., Ashok K.Jain, Arun K.Jain., "Soil Mechanics and Foundations", Lakshmi Publications, seventeenth edition, 2017.

OBJECTIVES:

- Students are expected to understand the importance of site investigation, planning of sub soil investigation, interpretation of investigated data to design suitable foundation system.

UNIT I PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS 8

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 7

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 8

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 12

Field tests, penetration tests, Field vane shear, Insitu 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 10

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
 - Plan the subsurface investigation program for a given project also capable of extending consultancy service for real time Soil Mechanics and Foundation Engineering problems
 - Apply the knowledge of different methods of exploration to select appropriate method of boring for investigating real field condition.
 - 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.
 - Carryout appropriate field test to arrive at required soil parameters for the design of geotechnical structures considering all the influential parameters
 - 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

REFERENCES:

1. Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.
2. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.
3. Alam Singh and Chowdhary, G.R., Soil Engineering in Theory and Practice, Volume-2, Geotechnical testing and instrumentation, CBS Publishers and Distributors, New Delhi, 2006.
4. Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butterworths, 1987.
5. Duncicliff, J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.
6. Hanna, T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.
7. Day, R.N., Geotechnical and Foundation Engineering, Design and Construction, McGraw-Hill, 1999.
8. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, The McGraw-Hill companies, Inc., New York, 1995.
9. Clayton C. R. I., Matthews M. C. and Simons N. E., Site Investigation, Second Edition Halsted Press, 1982.

SF4104

THEORY OF GEOMECHANICS

L T P C
4 0 0 4

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 THEOREY OF ELASTICITY

12

Basic Concepts – Mechanics of continua: Stress and strain - concept of stress and strain – Three dimensional and Two dimensional state of stress – Plane stress, plane strain and axisymmetric problems – equilibrium and compatibility conditions, constitutive relations, stress functions – Two dimensional problems in Cartesian and polar co-ordinates.

UNIT II STRESS AND DISPLACEMENT

12

Elastic half-space medium – Stress by external loads – Isotropic, anisotropic and non-homogeneous elastic continuum – Boussinesq, Frochlich, Westergaard solutions for force on the surface of semi-infinite medium – Cerruti and Mindlin's method for force in interior of semi-infinite medium, solutions by influence charts – Elastic displacement – Layered soil – Burmister method.

UNIT III THEORY OF PLASTICITY

14

Perfect plastic material- theory of plasticity – Hardening law, flow rule. Theorem of plastic collapse – bound theorems – Mechanism for plane plastic collapse – slip fans, stress fans – discontinuities – Simple solutions for undrained and drained loading – Stability of foundations, retaining walls, slopes and cuts. Slip line solutions for undrained and drained conditions.

UNIT IV FLOW THROUGH POROUS MEDIA

10

Flow through porous media – Darcy's law – General equation of flow, seepage through isotropic anisotropic and non-homogeneous conditions – Steady state condition, confined and unconfined flow – solution by flow net – seepage pressure – piping.

UNIT V RISK ANALYSIS IN GEOMECHANICS

12

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

REFERENCES:

1. Aysen, A., Problem solving in Soil Mechanics, Taylor & Francis, London, First Indian Print, 2011.
2. Chowdhury, I., Dasgupta S.P., Dynamics of Structure and Foundations, Taylor & Francis Group, London, 2009.
3. Bolton, M.D; A Guide to Soil Mechanics, University press (India) Pvt.Ltd., 2009
4. Atkinson, J.H; The Mechanics of Soils and Foundations, Taylor and Francis, London, 2007.
5. Aysen, A., Soil Mechanics, Basic concepts and Engineering Applications, A.A.Balkema Publishers, 2002.
6. Ulrich Smoltc, YK, Geotechnical Engineering Handbook (Vol.1), Ernst & Sohn, 2002.
7. Muni Budhu, Soil Mechanics and Foundations, John Wiley and Sons, Inc., Network, 2000.
8. Cedergren, H.R., Seepage, Drainage and Flownets, John Wiley, 1997.
9. Davis, R.O and Selvadurai, A.P.S., Elasticity and Geomechanics, Cambridge University Press, 1996.
10. Wai-Fah Chen, and Liu, X.L., Limit Analysis in Soil Mechanics, Elsevier Science Ltd., 1991.
11. Atkinson, J.H., Foundations and Slopes, McGraw Hill, 1981.
12. Kok-Kwang Phoon Jianye Ching., Risk and Reliability in Geotechnical Engineering, CRC Press, Taylor and Francis Group, 2015.
13. Gordon A. Fenton and D. V. Griffiths, Risk Assessment in Geotechnical Engineering, John Wiley and Sons, Inc., 2008.
14. Gregory B. Baecher and John T. Christian, Reliability and Statistics in Geotechnical Engineering, John Wiley and Sons, Inc., 2003.
15. Braja M. Das, 'Advanced Soil Mechanics', 4th edition, CRC Press Taylor & Francis Group, 2014.

UNIT I RESEARCH DESIGN**6**

Overview of 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 presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS**6**

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS**6**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL :30 PERIODS**REFERENCES**

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

PROGRESS THROUGH KNOWLEDGE

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****12**

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

12

UNIT III COMPACTION AND CBR TESTS

12

UNIT IV CONSOLIDATION AND PERMEABILITY TESTS

12

UNIT V SWELL TESTS

12

TOTAL: 60 PERIODS

- 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.

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, New Delhi, 2006.
2. Head, K.H., Manual of Soil Laboratory Testing Vol.I and II, Pentech Press, London 1990.
3. Head, K.H., Manual of Soil Laboratory Testing Vol.III, Second Edition, John Wiley & Sons, 1998.
4. Bowles, J.E., Engineering properties of soils and their measurements, McGraw Hill, 1992.
5. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin, 1997
6. Al-Khatiji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
7. "Soil Engineering Laboratory Instruction Manual", Published by the Engineering College Cooperative Society, Chennai, 1996.
8. Lambe T.W., Soil Testing for Engineers", John Wiley and Sons, New York, 1990.
9. SP : 36 (Part I) – 1987, 'Compendium of Indian Standards on Soil Engineering', Bureau of Indian Standards, New Delhi.
10. SP : 36 (Part 2) – 1987, 'Compendium of Indian Standards on Soil Engineering', Bureau of Indian Standards, New Delhi.
11. I.S. Code of Practice (2720): Relevant Parts. as amended from time to time.

AUDIT COURSES

AX4091

ENGLISH FOR RESEARCH PAPER WRITING

L T P C
2 0 0 0

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

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

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

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

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**6**

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**6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA**6**

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**6**

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**6**

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

1. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

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 Revolution in 1917 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

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental 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

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

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.

TOTAL: 30 PERIODS

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.
- Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

UNIT I

சங்க இலக்கியம்

6

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
- எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
- இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
- போரை நிறுத்திய ஒளவையார்

UNIT II

அறநெறித் தமிழ்

6

1. அறநெறி வகுத்த திருவள்ளுவர்
- அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
- ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III

இரட்டைக் காப்பியங்கள்

6

1. கண்ணகியின் புரட்சி
- சிலப்பதிகார வழக்குரை காதை
சமூகசேவை இலக்கியம் மணிமேகலை
- சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV

அருள்நெறித் தமிழ்

6

1. சிறுபாணாற்றுப்படை
- பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குத் போர்வை கொடுத்தது, அதியமான் ஒளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
- அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
- இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
- சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
நற்றிணை (11) - நண்டு
கலித்தொகை (11) - யானை, புறா
ஐந்திணை 50 (27) - மான்
ஆகியவை பற்றிய செய்திகள்

1. உரைநடைத் தமிழ்,
 - தமிழின் முதல் புதினம்,
 - தமிழின் முதல் சிறுகதை,
 - கட்டுரை இலக்கியம்,
 - பயண இலக்கியம்,
 - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - <https://ta.wikipedia.org>
3. தர்மபுர ஆதின வெளியீடு
4. வாழ்வியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

PROGRESS THROUGH KNOWLEDGE