

CHOICE BASED CREDIT SYSTEM
M.TECH- GEOTECHNICAL ENGINEERING
(FULL TIME)
I – IV SEMESTERS

SEMESTER-I							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1	PM	MMA101	Advanced Mathematical Methods	4	0	0	4
2	PC	MGT101	Soil Properties and Behavior	3	0	0	3
3	PC	MGT102	Strength and Deformation Behavior of Soils	3	0	0	3
4	PC	MGT103	Subsurface Investigation and Instrumentation	3	0	0	3
5	PC	MGT104	Soil Dynamics	4	0	0	4
6	PE	MGTE01	Elective I	3	0	0	3
			Total	20	0	0	20

SEMESTER-II							
S.No	Category	Code	Subject Name	L	T	P	C
Theory							
1.	PC	MGT201	Shallow Foundations	3	0	0	3
2.	PC	MGT202	Deep Foundations	3	0	0	3
3.	PC	MGT203	Ground Improvement Techniques	3	0	0	3
4.	PC	MGT204	Finite Element Method	3	0	0	3
5.	PE	MGTE02	Elective II	3	0	0	3
6.	PE	MGTE03	Elective III	3	0	0	3
Practical							
7	EEC	MGT2L1	Advanced Soil Mechanics Laboratory - I	0	0	4	2
			Total	18	0	4	20

SEMESTER-III							
S.No	Category	Code	Subject Name	L	T	P	C
1	PE	MGTE04	Elective IV	3	0	0	3
2	PE	MGTE05	Elective V	3	0	0	3
Practical							
3.	EEC	MGT3L1	Advanced Soil Mechanics Laboratory - II	0	0	4	2
4.	EEC	MGT3L2	Computer Applications in Geotechnical Engineering	0	0	2	1
5.	EEC	MGT3L3	Practical Training (4 weeks – During vacation after II semester)	-	-	-	2
6.	EEC	MGT3P1	Project Work(Phase-I)	0	0	12	6
Total				6	0	18	17

SEMESTER- IV

S.No	Category	Code	Subject Name	L	T	P	C
1	EEC	MGT4P1	Project Work Phase II	0	0	24	12
Total				0	0	24	12

Overall Credits for the Programme – 69

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

	Sub Area	Credit as per Semester				No. of Credit	% of credit
		I	II	III	IV		
1	Professional Mathematics(PM)	4	-	-	-	4	5.79
2	Professional Core (PC)	13	12	-	-	25	36.23
3	Professional Electives (PE)	3	6	6	-	15	21.74
5	Employability Enabled Courses (Practicals)	-	2	5	-	7	10.14
6	Project Work, Seminar, Internship, Term Paper, etc. (PR)			6	12	18	26.08
	Total Credits	20	20	17	12	69	100

LIST OF ELECTIVES

Professional Electives (PE-I)

S.No	Code	Subject Name	L	T	P	C
1	MGT051	Theoretical Soil Mechanics	3	0	0	3
2	MGT052	Earthquake Resistant Design of Foundations	3	0	0	3
3	MGT053	Earth and Earth Retaining Structures	3	0	0	3

Professional Electives (PE-II)

Sl.No.	Code	Subject Name	L	T	P	C
4	MGT054	Geoenvironmental Engineering	3	0	0	3
5	MGT055	Advance Soil Mechanics	3	0	0	3
6	MGT056	Geosynthetic and Reinforced Soil Structures	3	0	0	3

Professional Electives (PE-III)

Sl.No.	Code	Subject Name	L	T	P	C
7	MGT057	Geotechnical Earthquake Engineering	3	0	0	3
8	MGT058	Geotechnics for Design of Underground Structures	3	0	0	3
9	MGT059	Geology for Geotechnical Applications	3	0	0	3

Professional Electives (PE-IV)

Sl.No.	Code	Subject Name	L	T	P	C
10	MGT060	Mechanics of Unsaturated Soils	3	0	0	3
11	MGT061	Pavement Engineering	3	0	0	3
12	MGT062	Soil Structure Interaction	3	0	0	3

Professional Electives (PE-V)

Sl.No.	Code	Subject Name	L	T	P	C
13	MGT063	Rock Mechanics and Applications	3	0	0	3
14	MGT064	Earth and Rock Fill Dams	3	0	0	3
15	MGT065	Foundation on Expansive Soils	3	0	0	3

Employability Enabled Courses (EEC)

Sl.No.	Category	Subject Name	L	T	P	C
1	EEC	Advanced Soil Mechanics Laboratory - I	0	0	4	2
2	EEC	Advanced Soil Mechanics Laboratory - II	0	0	4	2
3	EEC	Computer Applications in Geotechnical Engineering	0	0	2	1
4	EEC	Practical Training (2 weeks – During vacation after II semester)	-	-	-	1
5	EEC	Project Work(Phase-I)	0	0	12	6
6	EEC	Project Work Phase II	0	0	24	12

MMA101		ADVANCED MATHEMATICAL METHODS			L	T	P	C
		Total Contact Hours:60			3	2	0	4
		Prerequisite: Numerical Methods						
		Course Designed by :Department of Civil Engineering						
OBJECTIVES To familiarize the students in the field of differential equations to solve bound value problems associated with engineering applications.								
COURSE OUTCOMES (COs)								
CO1		To make them master the techniques of Partial Differential Equations						
CO2		To know about Fourier Transform Techniques						
CO3		To understand about Concept of variation and its properties						
CO4		To know about the Conformal Mapping and Applications						
CO5		To know about Tensor Analysis						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H						
	CO2	H	L	M				
	CO3	H						
	CO4	H		M				
	CO5	H						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
		√				
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS

12

Laplace transform: Definitions, properties -Transform of 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 – Problems with constraints – 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 – Innerproduct – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient, divergence and curl.

TOTAL : 60 PERIODS

TEXTBOOKS:

1. Sankara Rao K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 2010
2. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2014
3. Spiegel M.R., "Theory and Problems of Complex Variables and its Application" (Schaum's Outline Series), McGraw Hill Book Co., Singapore, 1981.
4. Ramanaiah, G.T., "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.
5. James G., "Advanced Modern Engineering Mathematics", Pearson Education, Third Edition, 2004.
6. O'Neil P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.

REFERENCES:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Fortieth Edition, 2007
2. Andrew L.C. and Shivamoggi B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. Elsgolts L., "Differential Equations and the Calculus of Variations", MIR Publishers, Moscow, 1973.
4. Mathews J.H. and Howell R.W., "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, New Delhi, 1997.
5. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, Fortieth Edition, 2007

MGT101		SOIL PROPERTIES AND BEHAVIOUR				L	T	P	C
		Total Contact Hours:45				3	0	0	3
Prerequisite: Soil Mechanics									
Course Designed by :Department of Civil Engineering									
OBJECTIVES To impart knowledge on the various factors governing the Engineering behavior of soils and the suitability of soils for various Geotechnical Engineering applications.									
COURSE OUTCOMES (COs)									
CO1	To study soil deposit and minerals.								
CO2	To know about the physical and chemical behavior of soils.								
CO3	To analysis the compaction behavior of soils.								
CO4	To study the compressibility, shear strength and permeability behavior of soils								
CO5	To know about the prediction in soil behavior								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	M						
	CO2	M	H						
	CO3	M	H	H					

	CO4	H	H	M		M
	CO5	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL DEPOSITS AND CLAY MINERALS 8

Introduction – 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 – 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 structure.

UNIT III SWELLING, SHRINKAGE AND COMPACTION BEHAVIOUR OF SOILS 10

Problems associated with swelling and shrinkage behaviour of soils – Causes, consequences and mechanisms – factors influencing swell – shrink characteristics – swell potential – osmotic swell pressure – soil fabric and measurement – sensitivity, thixotropy of soils – soil suction – soil compaction – factors affecting soil compaction.

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

Compressibility, shear strength and permeability behaviour of fine and coarse grained soils – mechanisms and factors influencing engineering properties – liquefaction potential – causes and consequences.

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

REFERENCES:

1. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2006.
2. Mitchell, J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.
3. Yong, R.N. and Warkentin, B.P., Introduction to Soil Behaviour, Macmillan, Limited, London, 1979.
4. Coduto, D.P., Geotechnical Engineering – Principles and practices, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
5. Perloff, W.H. and Baron, W, Soil Mechanics, The Ronal Press Company, 1976.
6. Van Olphen, H., Clay colloid Chemistry, John Wiley, 1996
7. Grim, R.E., Applied Clay Mineralogy, McGraw Hill, New York, 1966.
8. Lambe, T.W. & 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. Robert D. Holtz and William D. Kovacs, “An Introducion to Geotechnical Engineering”, Prentice Hall (UK) International, London, 1981.

MGT102	STRENGTH AND DEFORMATION BEHAVIOUR OF SOILS				L	T	P	C
Total Contact Hours:45					3	0	0	3
Prerequisite: Soil Mechanics								
Course Designed by :Department of Civil Engineering								
OBJECTIVES To impart knowledge to characterize stress-strain behavior of soils, the failure criteria and to evaluate the shear strength and compressibility parameters of soils.								
COURSE OUTCOMES (COs)								
CO1	To study the shear strength of cohesionless soils							
CO2	To study the shear strength of cohesive soils							
CO3	To study the failure of soils.							
CO4	To study the modulus of soils							
CO5	To learn about critical state soil mechanics							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H	H	M				
	CO2	H	M	H				
	CO3	H	M					
	CO4	H			M			
	CO5	H	M					

2. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014.
3. .. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.
4. Braja, M, Das. "Advanced soil mechanics", McGraw Hill, 1997.
5. Atkinson J.H. and Bransby P.L. "Introduction to critical state soil mechanics" McGraw Hill, 1978.
6. Lambe, T.W. and Whitman R.V. "Soil Mechanics in S.I. Units John Wiley, 1979.
7. Wood, D.M., "Soil behaviour and Critical State Soil Mechanics", Cambridge University Press, New York, 1990.
8. Graham Barnes, "Soil Mechanics Principles and Practices", Macmillan Press Ltd., London, 2002.
9. Braja, M. Das, "Principles of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, Fifth Edition, 2002.
10. Malcolm D. Bolton, "A guide to soil mechanics", Universities Press (India) Private Ltd., Hyderabad, India, 2003.
11. Braja, M. Das, "Fundamentals of Geotechnical Engineering", Brooks/Cole, Thomson Learning Academic Resource, Center, 2000.

MGT103	SUBSURFACE INVESTIGATION AND INSTRUMENTATION				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Foundation Engineering							
	Course Designed by :Department of Civil Engineering							
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.								
COURSE OUTCOMES (COs)								
CO1	To study the different methods of exploration							
CO2	To study the exploration techniques							
CO3	To know about the soil sampling							
CO4	To study the field testing in soil exploration							
CO5	To know about the Instrumentation in soil engineering							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H	M				M	
	CO2	H	W	M				
	CO3	H	M					
	CO4	H					M	
	CO5	H	M				M	

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS 8

Scope and objectives, planning an exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic method, Multichannel Analysis of Surface Waves (MASW) method and electrical methods, cross bore hole, single bore 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, 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, 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

REFERENCES:

1. 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.
2. Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw Hill, 1984.
3. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a Nostrand Reinhold 1994.
4. 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.

5. Nair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter-worths, 1987.
6. Dunnicliff, J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance, John Wiley, 1993.
7. Hanna, T.H., Field Instrumentation in Geotechnical Engineering, Trans Tech., 1985.
8. Day, R.N., Geotechnical and Foundation Engineering, Design and Construction, McGraw-Hill, 1999.
9. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, The McGraw-Hill companies, Inc., New York, 1995.
10. Clayton C. R. I., Matthews M. C. and Simons N. E., Site Investigation, Second Edition Halsted Press, 1982

MGT104	SOIL DYNAMICS					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Foundation Engineering								
	Course Designed by :Department of Civil Engineering								
OBJECTIVES To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods									
COURSE OUTCOMES (COs)									
CO1	To study about the theory of vibration.								
CO2	To know about the dynamic soil properties and behavior								
CO3	To learn about the types of Machines and Foundations								
CO4	To study the dynamic analysis of impact type machines								
CO5	To know the influence of vibration and remediation								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	H						
	CO2	H	H						
	CO3	H	H	H	M				
	CO4	H	H						
	CO5	M	H	H					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	Board of Studies meeting – 23 rd September 2016							

UNIT I THEORY OF VIBRATION

9

Introduction – 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 – structure – Interaction, Codal Provisions.

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

REFERENCES:

1. Moore, P.J., "Analysis & Design of Foundations for Vibrations", Oxford & IBH, 2006.
2. Kramer S.L., "Geotechnical Earthquake Engineering", Prentice hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
3. Kameswara Rao, N.S.V., "Dynamics soil tests and applications", Wheeler Publishing , New Delhi, 2000. 4. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.
5. Swami Saran, "Soil Dynamics and Machine Foundation", Galgotia publications Pvt. Ltd., New Delhi 1999.
6. Kameswara Rao, "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998.

MGT201	SHALLOW FOUNDATIONS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Foundation Engineering							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES To impart knowledge to select, analyse, geotechnical and structural design of shallow foundation depending on ground conditions.								
COURSE OUTCOMES (COs)								
CO1	To learn the different type foundation design.							
CO2	To study the bearing capacity of soil.							
CO3	To know about the component of settlement							
CO4	To study the analysis of foundation							
CO5	To study the foundation for special conditions							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H	M	M				
	CO2	H						
	CO3	H		H				
	CO4	H	M	H				
	CO5	H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	Board of Studies meeting – 23 rd September 2016						

UNIT I FOUNDATION DESIGN DECISIONS

6

Introduction to International codes-Geotechnical triangle – Geotechnical design triangle – Types of foundation – Types of Shallow foundation, their applicability – Selection of type of foundation – **conceptual design principles** – General and additional considerations – Depth of foundations – Hostile Environment – **holistic approach** – **circumstances**.

UNIT II BEARING CAPACITY

9

Theories of bearing capacity – Ultimate Bearing capacity - Homogeneous - Layered soils – Rocks -

Evaluation of bearing capacity from in-situ tests – Safe bearing capacity – **Bearing capacity of foundations in slope** – Bearing capacity **under eccentric loading** – partial safety factor approach – Codal provisions.

UNIT III SETTLEMENT AND ALLOWABLE BEARING PRESSURE 9

Component of settlement – Influence of foundation stiffness approach to settlement computations - immediate, primary and secondary consolidation settlement - **stress path method of settlement** evaluation - layered soil - **construction period correction**. Evaluation from in-situ tests – Allowable settlement – **Allowable bearing pressure** - codal provisions.

UNIT IV INTERACTIVE ANALYSIS AND DESIGN OF FOUNDATIONS 12

Analysis of foundation - isolated - strip - combined footings - **Flat raft** – Stiffened raft foundations. Conventional - elastic approach - **Soil Structure Interaction Principles** – Winkler foundation – Elastic half space approach – Structural design of Shallow foundation – Codal provisions.

UNIT V FOUNDATION FOR SPECIAL CONDITIONS 9

Shell foundations - **Foundation design in relation to ground movements** - Foundation on compressible fills – Foundation for tower – Foundation for earthquake effects – **Offshore foundation** – Machine foundation - Codal Provisions.

TOTAL: 45 PERIODS

REFERENCES:

1. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014
2. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., "Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II" ICE Publishing, UK., 2012.
3. Karuna Moy Ghosh, "Foundation Design in Practice" PHI learning private Ltd, Delhi, 2009.
4. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., "Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II" ICE Publishing, UK., 2012.
5. Nainan P. Kurian, "Design of Foundation Systems, Principles and Practices, Narosa Publishing House, Third Edition, 2006.
6. Varghese, P.C. "Design of Reinforced Concrete Foundations", Prentice-Hall of India, New Delhi, 2009
7. Ian Smith, "Elements of Soil Mechanics", John Wiley & Sons, UK, 9th edition, 2014
8. Braja M. Das, "Geotechnical Engineering Handbook" J. Ross Publishing, Cengage Learning India Pvt Ltd, 2010
9. Edward Tsudik, Analysis of Structures on Elastic Foundations, J. Ross Publishing, Cengage Learning India Private limited, Delhi, 2013.
10. Som. N. N., Das. S. C., "Theory and Practice of Foundation Design" PHI learning private Ltd, Delhi, 2013.
11. Bowles, J. E., "Foundation Analysis and Design, 5th Edition, McGraw Hill, New York, 1995.
12. Swami Saran, "Soil Dynamics and Machine Foundation, Galgotia Publications Pvt. Ltd., New

MGT202	DEEP FOUNDATIONS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Foundation engineering							
	Course Designed by :Department of Civil Engineering							
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.								
COURSE OUTCOMES (COs)								
CO1	To study the pile foundation and classification.							
CO2	To study the axial load of piles and pile groups							
CO3	To learn about the lateral and uplift load capacity of piles							
CO4	To know the structural design of pile and pile groups							
CO5	To study about caissons and its principles.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	M	M	M				
	CO2	H		H				
	CO3	H	M	H		M		
	CO4	M						
	CO5	M						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	Board of Studies meeting – 23 rd September 2016						

UNIT I PILE CLASSIFICATIONS & LOAD TRANSFER PRINCIPLE**10**

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments and methods – effect of pile installation on soil condition – pile raft system – basic interactive analysis - criteria for pile socketing - responsibility of engineer and

contractor.

UNIT II AXIAL LOAD CAPACITY PILES AND PILE GROUPS 10

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 - codal provisions and IRC guide lines.

UNIT III LATERAL AND UPLIFT LOAD CAPACITY OF PILES 10

Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out load tests – codal provision – IRC guide lines – case studies.

UNIT IV STRUCTURAL DESIGN OF PILE AND PILE GROUPS 9

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 – codal provision – IRC guide line.

UNIT V CAISSONS 6

Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences - codal provision.

TOTAL: 45 PERIODS

REFERENCES:

1. Varghese P.C.,” Design of Reinforced Concrete Foundations”, PHI Learning Private Limited, New Delhi, 2009.
2. Varghese P.C.,” Foundation Engineering”, PHI Learning Private Limited, New Delhi, 2005.
3. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.
4. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
5. Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.
4. Michael Tomlinson and John Woodward, Pile design and construction practice, Taylor & Francis Group, London & New York, 2008.
6. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
6. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1996.
7. Donald, P., Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1996.
8. Varghese P.C.,” Foundation Engineering”, PHI Learning Private Limited, New Delhi, 2005.

MGT203	GROUND IMPROVEMENT TECHNIQUES				L	T	P	C
Total Contact Hours:45					3	0	0	3
Prerequisite: Building Construction								
Course Designed by :Department of Civil Engineering								
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.								
COURSE OUTCOMES (COs)								
CO1	To learn the Scope and necessity of ground improvement.							
CO2	To study the compaction and sand drains							
CO3	To know about the stone column, lime piles and soil nailing							
CO4	To study the geosynthetics and its applications							
CO5	To have a clear understanding about the grouting method.							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H	M					
	CO2	M	M		M	M		
	CO3	H		H				
	CO4	H	M					
	CO5	H						
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	Board of Studies meeting – 23 rd September 2016						

UNIT I DEWATERING

9

Introduction – 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 COMPACTION AND SAND DRAINS

9

Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand

piles – Concept, design, factors influencing compaction. **Blasting and dynamic consolidation** – Preloading with sand drains, fabric drains, wick drains etc. – **Theories of sand drain** – design and relative merits of various methods – Case studies.

UNIT III STONE COLUMN, LIME PILES AND SOIL NAILING 9

Stone column with and without encased, lime piles – Functions – **Methods of installation** – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – **methods of installation** – Design and Applications - **Soil liquefaction mitigation methods** - case studies.

UNIT IV GEOSYNTHETICS AND ITS APPLICATIONS 9

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 GROUTING 9

Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – **Chemical stabilization** – Stabilization with cement, lime - **Stabilization of expansive clays – case studies.**

TOTAL: 45 PERIODS

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
2. Cox, B.R., and Griffiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010.
3. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
4. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
5. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.
6. Moseley, M.P., Ground Treatment, Blackie Academic and Professionals, 1998.
7. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
8. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
9. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
10. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.
11. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.

MGT204	FINITE ELEMENT METHODS	L	T	P	C
	Total Contact Hours:60	3	0	0	3
	Prerequisite: Structural Analysis-II				

Course Designed by :Department of Civil Engineering						
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.						
COURSE OUTCOMES (COs)						
CO1	To analysis the basic concepts in structures.					
CO2	To determine displacement models					
CO3	To design the isoperimetric formulation					
CO4	To learn the geotechnical consideration					
CO5	To know the application in geotechnical engineering					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H	H		
	CO2	H	H	H		M
	CO3	H	H	H		
	CO4	M	H	M		
	CO5	H	H	M		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC CONCEPTS

9

Introduction – 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

Displacement based elements - element equations, convergence requirements, shape functions – element stresses and strains – element stiffness matrix - global equations – boundary conditions – solution of global equations – finite elements for axi-symmetric problem – one dimensional problem of

stresses and strains – finite element analysis for two – dimensional problems.

UNIT III ISOPARAMETRIC FORMULATION

8

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

9

Introduction – total stress analysis – pore pressure calculation – FEM to model structural components, strain definitions, constitutive equation, finite element formulation, membrane elements – Finite elements to model interfaces – basic theory – finite element formulation – boundary conditions – finite element theory for nonlinear behavior of soils.

UNIT V APPLICATION IN GEOTECHNICAL ENGINEERING

10

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

TOTAL: 45 PERIODS

REFERENCES:

1. Programming the Finite Element Method with application to Geomechanics by Smith, I.M., John Wiley and Sons, New Delhi, 2000.
2. Introduction to the finite element method by Desai and Abel, Van Nostrand Reinhold Company, New York, 1972.
3. Finite element analysis Theory and Programming by Krishnamoorthy.C.S., Tata McGraw-Hill, New Delhi, 1990.
4. Finite element in geotechnical engineering by Naylor, Pande, Simpson and Tabb., Pineridge Press Ltd, Swansea, U. K, 1981.
5. The Finite Element Method by Zienkiewicz, O.C., 3rd Edition, Tata McGraw-Hill publishing Co., New Delhi, 1983.
6. Finite element analysis in geotechnical engineering – theory by Potts, D.M. and Zdravkovic, L., Published by Thomas Telford, London, 1999.
7. An introduction to the finite element method by Reddy, J.N., McGraw Hill, New York, 1984.
8. The Finite Element Methods in Engineering by Rao, S.S., Pergamon, New York, 1998.
9. Soil-machine introduction – A finite element perspective by Shen, J. and Kushwahs, R.L., Moral Dikker, Inc., 1998.
10. Concepts and applications of finite element analysis by Cook, R.D., Malkus, D.S., and Plesha, M.E., John Wiley, New York., 1989.

MGT2L1	ADVANCED SOIL MECHANICS LABORATORY - I			L	T	P	C
	Total Contact Hours:45			0	0	4	2
	Prerequisite: Soil Mechanics Lab						
	Course Designed by :Department of Civil Engineering						
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.							
COURSE OUTCOMES (COs)							
CO1	To carries out index test on soil						
CO2	To analysis the chemical tests on soil.						
CO3	To solve practical problems related compaction and cbr tests on soil						
CO4	To study the consolidation and permeability tests						
CO5	To determine the of percent swell						
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low							
1	COs/Pos	a	b	c	d	e	
2	CO1	H					
	CO2	M					
	CO3	M	M	H		M	
	CO4	H		H			
	CO5	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				
4	Approval	Board of Studies meeting – 23 rd September 2016					

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 - Field density Test

UNIT II CHEMICAL TESTS

12

Chemical analysis – pH – Conductivity – quantification ions through flame Photometer of Determination of organic, sulphate and chlorite content.

UNIT III COMPACTION AND CBR TESTS**12**

Compaction tests - Determination of moisture – density relationship – Influence of compaction energy – CBR Test.

UNIT IV COSOLIDATION AND PERMEABILITY TESTS**12**

One dimensional

consolidation test, C_v , C_c and m_v determination. Permeability of soil – constant and falling head methods.

UNIT V SWELLTESTS**12**

Determination of percent swell – swell pressure, constant volume method; expanded - loaded method.

TOTAL: 60 PERIODS**REFERENCES:**

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi,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.
6. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin, 1997
7. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
8. “Soil Engineering Laboratory Instruction Manual”, Published by the Engineering College Cooperative Society, Chennai, 1996.
9. Lambe T.W., Soil Testing for Engineers”, John Wiley and Sons, New York, 1990.
10. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

MGT3L1	ADVANCED SOIL MECHANICS LABORATORY -II	L	T	P	C
	Total Contact Hours:60	0	0	4	2
	Prerequisite: Soil Engineering Laboratory-I				
	Course Designed by :Department of Civil Engineering				
<p>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.</p>					
COURSE OUTCOMES (COs)					
CO1	To estimate the stresses under any system of foundation loads				
CO2	To solve Soil water characteristic problems				

CO3	To carry out the test on geosynthetics					
CO4	To carry out the test on rocks					
CO5	To analysis the Model test on foundation elements					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H			
	CO2	H	H	H		M
	CO3	H	H			
	CO4	H	H			
	CO5	H	H	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SHEAR STRENGTH TESTS 12

Direct shear – Triaxial compression (UU and CU) test – Unconfined compression test – Vane shear 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

Point load index – Brazilian test – Direct shear test – Uniaxial compressive strength test

UNIT V MODEL AND FIELD TESTS 16

Model test on foundation elements - strain gauges - load cells. Field tests - Plate load test – static cone penetration test – standard penetration test – pressure meter test - Block vibration test – Cyclic

triaxial test (demonstration only).

TOTAL: 60PERIODS

REFERENCES:

1. Alam Singh and Chowdary, G.R., Soil Engineering in Theory and Practice (Vol.2) Geotechnical Testing and Instrumentation, CBS Publishers and Distributors, NewDelhi,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. Kameswara Rao, N.S.V., Dynamics Soil Tests and Applications, Wheeler Publishing, New Delhi, 2000.
6. Das, B.M., Soil Mechanics Laboratory Manual, Engineering Press, Austin,1997
7. Al-Khataji, A.W. and Anderstand, O.B., Geotechnical Engineering & Soil Testing, Sounders College Publishing, Fort Worth, 1992.
8. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
9. “Soil Engineering Laboratory Instruction Manual”, Published by the Engineering College Co-operative Society, Chennai, 1996.
10. Lambe T.W., Soil Testing for Engineers”, John Wiley and Sons, New York, 1990.
11. I.S. Code of Practice (2720): Relevant Parts, as amended from time to time.

MGT3L2	COMPUTER APPLICATIONS IN GEOTECHNICAL ENGINEERING				L	T	P	C
	Total Contact Hours:30				0	0	2	1
	Prerequisite: Computer Aided Building Drawing							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.								
COURSE OUTCOMES (COs)								
CO1	Have a fundamental knowledge of the design of irrigation structures.							
CO2	To study about drawing such as Foundations, Retaining walls, and Ground improvement							
CO3	To learn about design and Drawing for deep foundation							
CO4	Have a fundamental knowledge of the design embankment or surcharge adjacent to an existing structure which can describe real life phenomena							
CO5	To analysis the structure using Software							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		

2	CO1	H	H			M
	CO2	H	H	H		
	CO3	H	H	H		M
	CO4	H	H			
	CO5	M	H			M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	Board of Studies meeting – 23 rd September 2016				

SYLLABUS:

Students have to work individually with software packages for simulating and analyzing the soil – structure interaction such as Foundations, Retaining walls, and Ground improvement related problems. Software use to analyze and design real challenging problems such as a deep excavation adjacent to an existing structure and slope stability analysis. Also, to predict the response of any other field problems like an embankment or 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.

TOTAL: 30 PERIODS

MGT051	THEORETICAL SOIL MECHANICS	L	T	P	C
	Total Contact Hours:45	4	0	0	4
	Prerequisite: soil mechanics				
	Course Designed by :Department of Civil Engineering				
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					
COURSE OUTCOMES (COs)					
CO1	To study the Material behavior				

CO2	To study the stress and displacement					
CO3	To study the theory of plasticity					
CO4	To study the Stability of Soil Structure					
CO5	To study the Steady state condition of porous media					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H	M		
	CO2	M	H			
	CO3	M	H	M		M
	CO4	H	M			
	CO5	H	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I THEORY OF ELASTICITY

12

Material behavior – Basic Concepts – Elastic, Viscous and Plastic idealization, 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 IN ELASTIC – HALF SPACE MEDIUM

14

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 – Kelvin, 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 THEOREMS OF PLASTIC COLLAPSE AND THEIR APPLICATIONS

10

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.

UNIT IV STABILITY OF SOIL STRUCTURE BY SLIP LINE METHOD AND LIMIT EQUILIBRIUM ANALYSIS 14

Introduction – stress – strain relationship in a perfectly plastic material – discontinuous slipping – stress and displacement field calculations – associated field calculation – Slip line solutions for undrained and drained conditions – limit equilibrium solutions for stability of foundation, retaining walls and slopes.

UNIT V 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.

TOTAL : 60 PERIODS

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 Smolte, 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.

MGT052	EARTHQUAKE RESISTANT DESIGN OF FOUNDATIONS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Foundation engineering				
	Course Designed by :Department of Civil Engineering				
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.						
COURSE OUTCOMES (COs)						
CO1	To study the basic design parameters of soil					
CO2	To study the behavior of shallow foundation					
CO3	To study the Earthquake loading on deep foundation					
CO4	To study the seismic design of retaining wall					
CO5	To study the structural design of foundation					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	M	H		M
	CO2	M	H	M		
	CO3	H	H	H		M
	CO4	M	M	H		
	CO5	H	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC DESIGN PARAMETERS

9

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

9

Design requirements – bearing capacity theory under earthquake loading – bearing capacity analysis for liquefied soil – bearing capacity analysis for cohesive and cohesionless soils - seismic settlement of foundation.

UNIT III DEEP FOUNDATION

10

Earthquake loading – inertial and kinematic loading - performance of piles during earthquake loading

– theories of pile failure in liquefiable soils – failure based on bending mechanism/buckling instability – methods of analysis – force based or limit equilibrium method – p-y method – pile settlement - guidelines for designing of piles under kinematic loading due to liquefaction – seismic design of well/cassion foundations.

UNIT IV SEISMIC DESIGN OF RETAINING WALL 9

Introduction – 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

General requirements of machine foundations – Design criteria – principles of & simple procedures of design of foundations for machineries – loads acting on foundations during earthquake – fundamental failure mechanisms of foundations – essential criteria for design of foundations in liquefiable soils – structural design of foundations subjected to earthquake loading.

TOTAL: 45 PERIODS

REFERENCES:

1. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett and Stuart Haigh, Imperial College Press, London WC2H 9HE, 2010.
2. Geotechnical Earthquake Engineering by Day R. W., handbook, McGraw – Hill, New York, 2002..
3. Design of Pile Foundations in Liquefiable Soils by Gopal Madabhushi, Jonathan Knappett and Stuart Haigh, Imperial College Press, London WC2H 9HE, 2010.
4. Basic geotechnical earthquake engineering by Kamalesh Kumar, New Age International Publishers, New Delhi, 2008.
5. Design of foundation in seismic areas: Principles and some applications by Bhattacharya S. (eds), Published by NICEE [National Centre for Earthquake Engineering (India)]. ISBN: 81-904190 1-3, 2007
6. Pile foundation analysis and design by Poulos H.G. and Davis E.H., John Wiley and Sons, 1980.
7. Soil dynamics by Prakash, S., McGraw Hill, New York, 1981.
8. Geotechnical Earthquake Engineering by Steven L. Kramer, Prentice Hall, New Delhi, 1996.
9. Foundation design and construction by Tomilinson M.J., Longman Scientific & Technical, England, 1986.
10. Soil Mechanics in Engineering Practice by Terzaghi and Peck, R. B, John Wiley & Sons, New York, 1967.

MGT053	EARTH AND EARTH RETAINING STRUCTURES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Engineering Earth Science				

Course Designed by :Department of Civil Engineering						
OBJECTIVES At the end of this course, students are expected to analyze and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.						
COURSE OUTCOMES (COs)						
CO1	To study the earth pressure theories					
CO2	To determine stability of retaining structures					
CO3	To study the behavior of sheet pile walls					
CO4	To study the supported excavations					
CO5	To study the behavior of stability of slopes					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	M	M			
	CO2	M		H		M
	CO3	H	M	H		
	CO4	H				M
	CO5	M	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I EARTH PRESSURE THEORIES

10

Introduction – 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 COMPACTION, DRAINAGE AND 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

Introduction, 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

REFERENCES:

1. . Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.
2. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.
3. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001
4. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.
5. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Book- source, 2000.
6. Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS series in Civil Engineering, 1998.
7. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
8. Day, R.W., Geotechnical and Foundation Engineering: Design and Construction, McGraw Hill, 1999.
9. Mandal, J.N., Reinforced Soil and Geotextiles, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.
10. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
11. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley – Interscience Publication, 1984.
12. Petros P. Xanthakos., Slurry walls as structural systems, McGraw-Hill, Inc., New York, 1994.
13. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow, 1986.

MGT054	GEOENVIRONMENTAL ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Geotechnical engineering				
	Course Designed by :Department of Civil Engineering				

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..						
COURSE OUTCOMES (COs)						
CO1	To study the Environmental laws and regulations					
CO2	To study the Transport of contaminant in subsurface					
CO3	To study the waste containment and remediation of contaminated					
CO4	To study the behavior of landfills					
CO5	To study the stabilisation of waste					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H				
	CO2	M				
	CO3	M		M		M
	CO4	M				
	CO5	H				M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL – WASTE INTERACTION

8

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

Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatilization, biodegradation – characterization of contaminated sites – soil and rock data – hydrological and chemical data – analysis and evaluation – risk assessment – case studies.

UNIT III WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES

Insitu containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – soil vapour extraction, soil waste stabilization, solidification of soils, electrokinetic remediation, soil heating, vitrification, bio remediation, phyto remediation – ground water remediation – pump and treat , Insitu flushing, permeable reacting barrier, Insitu air sparging - case studies.

UNIT IV LANDFILLS AND SURFACE IMPOUNDMENTS 9

Source and characteristics of waste - site selection for landfills – components of landfills – liner system – soil, geomembrane, geosynthetic clay, geocomposite liner system – leachate collection – final cover design – monitoring landfill.

UNIT V STABILISATION OF WASTE 10

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

REFERENCES:

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGrawHill, Inc. Singapore, 1994.

MGT055	ADVANCE SOIL MECHANICS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Soil mechanics				

Course Designed by :Department of Civil Engineering						
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..						
COURSE OUTCOMES (COs)						
CO1	To study the characteristics strength of soil					
CO2	To study the fluid flow for 1-d, 2-d and 3d seepage					
CO3	To study the stresses in soil from surface loads					
CO4	To study the stress-strain relationship of soils					
CO5	To study the geotechnical physical modeling					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	M	M		M
	CO2	H	H	H		
	CO3	H	H	H		M
	CO4	H	M	H		
	CO5	M	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL COMPOSITION AND SOIL STRUCTURE

9

Soil formation; - Types of soils and their characteristics- Particle sizes and shapes- their impact on engineering properties; Soil structure; Clay mineralogy; Soil-air-water interaction; Consistency; Soil compaction; Concept of effective stress.

UNIT II PERMEABILITY AND SEEPAGE

9

Permeability; Seepage force and effective stress during seepage. Laplace equations of fluid flow for 1-D, 2-D and 3D seepage, Flow nets, Anisotropic and non-homogeneous medium, Confined and Unconfined seepage.

UNIT III COMPRESSIBILITY AND CONSOLIDATION

9

Stresses in soil from surface loads; Terzaghi's 1-D consolidation theory; Application in different boundary conditions; Ramp loading. Determination of Coefficient of consolidation c_v ; Normally and Overconsolidated soils; Compression curves; Secondary consolidation. Radial consolidation; Settlement of compressible soil layers and Methods for accelerating consolidation settlements.

UNIT IV STRESS-STRAIN RELATIONSHIP AND SHEAR STRENGTH OF SOILS 9
 Stress state, Mohr's circle analysis and Pole, Principal stress space, Stress paths in p-q space; Mohr-coulomb failure criteria and its limitations, correlation with p-q space; Stress-strain behaviour: Isotropic compression and pressure dependency, confined compression, large stress compression, Definition of failure, Interlocking concept and its interpretations, Drainage conditions; Triaxial behaviour, stress state and analysis of UC, UU, CU, CD, and other special tests, Stress paths in triaxial and octahedral plane; Elastic modulus from triaxial tests.

UNIT V GEOTECHNICAL PHYSICAL MODELING 9
 Physical modeling methods; Application of centrifuge modeling and its relevance to geotechnical engineering; Centrifuge modeling of geotechnical structures.

REFERENCES:

1. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II), Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGrawHill, Inc. Singapore, 1994.

MGT056	GEOSYNTHETIC AND REINFORCED SOIL STRUCTURES	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Soil Mechanics				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES To understand the mechanism of the reinforcement, its influence in the shear strength and design concept for various applications in geotechnical engineering					
COURSE OUTCOMES (COs)					
CO1	To study about the materials used in reinforced soil structures				

CO2	To learn about the design for soil reinforcement and separation					
CO3	To study about the soil reinforcement and separations					
CO4	To learn the concepts of filtration mechanisms and filtration design					
CO5	To learn the functions of reinforcement against slope failure & Stability analysis					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H			M
	CO2	H	H	H		M
	CO3	H	H			
	CO4	M	M			
	CO5	M	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

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 compatibility. To learn the concepts and mechanisms of reinforced earth, soil and Geosynthetics interaction

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 – Embankments – Basal reinforcement – piled embankment – unpaved roads – paved roads – railway tracks – Shallow

foundations – seismic aspects.

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 SLOPES 9

Type and orientation of Geosynthetics – Function of reinforcement against slope failure – Stability analysis – Design aspects – Seismic aspects – General construction aspects.

REFERENCES:

1. Sanjay Kumar Shukla., “Handbook of Geosynthetic Engineering” ICE publishing, London., Second edition., 2012
2. John Burland, Tim Chapman, Hilary Skinner, Michael Brown., “Geotechnical Design Construction and verification – ICE Manual of Geotechnical Engineering volume-II” ICE Publishing, UK., 2012.
- 3.. Cheng.Y.M., Lau.C.K., “Slope Stability Analysis and Stabilization” Routledge Taylor & Francis Group, London., 2008.
4. Kerry Rowe.R., “Geotechnical and GeoEnvironmental Engineering handbook” Kluwer Academic Publishers, 2001
5. Muller, W.W. HDPE Geomembranes in Geotechnics, Springer, New York 2007
6. Sivakumar Babu, G.L., An Introduction to Soil Reinforcement and Geosynthetics, University Press (India), Pvt. Ltd., Hyderabad, 2006.
7. John, N.W.M., Geotextiles, John Blackie and Sons Ltd., London, 1987.
8. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
9. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
10. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Earthworks, London, 1982.

MGT057	GEOTECHNICAL EARTHQUAKE ENGINEERING	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Dynamics and Seismic Design				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES To understand the dynamics of earth and its response, effect on earth structure and measure so mitigate the effects..					
COURSE OUTCOMES (COs)					
CO1	To learn the mechanism and causes of Earthquakes				
CO2	To learn the principles of vibration measuring instruments effect of Transient and Pulsating loads				
CO3	To learn the concepts of ground motion characteristics				

CO4	To study the concepts of design ground motion and to develop design ground motion					
CO5	To learn about the evaluation of slope stability					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H			M
	CO2	H	H	H		
	CO3	H	H	H		M
	CO4	M	H	H		
	CO5	M	H	H		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I ELEMENTS OF EARTHQUAKE SEISMOLOGY

6

Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources - Elastic Rebound theory - Seismic wave in Earthquake shaking - Definition of earthquake terms - Locating an earthquake - Quantification of earthquakes.

UNIT II THEORY OF VIBRATION

9

Introduction – 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 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

Wave propagation Analysis - Site Amplification, Ground Response Analysis - Method of analysis -

One Dimensional Analysis - Equivalent linear Analysis – shear beam Analysis - site effects - Design Ground Motion - Developing Design Ground Motion. Application of software package - codal recommendations.

UNIT V SEISMIC STABILITY ANALYSIS

10

Assessment of liquefaction potential based on SPT-N value – permanent settlement – displacement prediction – Mitigation of liquefaction induced damage – Microzonation for intensity – liquefaction – Bearing capacity analysis – Effects of Pile foundation – Response of slopes – Evaluation of slope stability – Pseudostatic – Newmark’s study of Block analysis – Dynamic analysis – Earthpressure due to ground shaking – Dynamic analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Ikuo Towhata, “Geotechnical Earthquake Engineering” Springer series in Geomechanics and Geoengineering, Scientific Publishing services Pvt. Ltd., 2008.
2. Wai-Fah Chen and Charles Scawthorn, Earthquake Engineering Hand book, Caspress,2003
3. Robert W. Day, Geotechnical Earthquake Engineering Hand book, Second Edition, McGraw Hill, 2012.
3. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
4. Kramer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
6. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
7. Swami Saran, "Soil Dynamics and Machine Foundation, Galgottia Publications Pvt. Ltd., New Delhi-110002, 1999.

MGT058	GEOTECHNICS FOR DESIGN OF UNDERGROUND STRUCTURES	L	T	P	C
	Total Contact Hours:45	0	0	2	1
	Prerequisite: Foundation Engineering				
	Course Designed by :Department of Civil Engineering				
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.					
COURSE OUTCOMES (COs)					
CO1	To understanding the ground & building response to ground movements				
CO2	To study the stress and deformation analysis of excavation				
CO3	To learn the design of underground supporting systems				
CO4	To learn the design of tunnel				
CO5	To learn about the protection of building using the behavior of excavation 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

Introduction – 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

REFERENCES:

1. Deep Excavation Theory and Practice by Chang – Yu Ou, Taylor & Francis Group, London, UK, 2006.
2. An Introduction to Geotechnical Engineering by Holtz, R.D. and Kovaces, W.D., Prentice – Hall, Inc., Englewood Cliffs, NJ, 1981.
3. Soil Mechanics in Engineering Practice by Terzaghi, K. and Peck, R. B, John Wiley & Sons, New York, 1967.
4. Foundation Engineering by Peck, R. B., Hanson, W.E., and Thornburn, T.H., John Wiley & Sons, New York, 1977.
5. Engineering Principles of Ground Modification by Hausman, M. R., McGraw – Hill Publishing Company, New York, 1990.

MGT059	GEOLOGY FOR GEOTECHNICAL APPLICATIONS					L	T	P	C
	Total Contact Hours:60					3	0	0	3
	Prerequisite: Geotechnical Engineering								
	Course Designed by : Department of Civil Engineering								
OBJECTIVES Train the students to use various software packages for simulating and analyzing the real field problems in Geotechnical Engineering.									
COURSE OUTCOMES (COs)									
CO1	To learn the engineering properties of rocks and minerals								
CO2	To study about the seismic geophysical methods in subsurface geological investigations for foundation engineering								
CO3	To learn about the logging techniques								
CO4	To learn about the preparation of profiles from contour map								
CO5	To study about the ground stability								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	H						
	CO2	H	H	M					

	CO3	H	H	H		
	CO4	M	M			
	CO5	M	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I ENGINEERING PROPERTIES OF ROCKS AND MINERALS 12

Geology for foundation engineering – Types of rocks, rock description-texture, structure, composition and its relation to quality and strength of rocks, engineering classification of rocks – **weathering grade and its significance in engineering site-Engineering properties of rocks - Physical and chemical properties of minerals and its relation to strength and durability of rock. Geotechnical properties of rocks of Tamilnadu.**

UNIT II SURFACE AND SUBSURFACE GEOLOGICAL INVESTIGATIONS 9

Field investigations - electrical and seismic geophysical methods in subsurface geological investigations for foundation engineering, applications of GPR in subsurface strata studies, **Description of structural discontinues, Strike and dip of rocks, folds, faults and joints.**

UNIT III DRILL HOLE AND CORE LOGGING 8

Logging techniques – Resistivity log, Neutron log, sonic log, gamma log. Rock core logging – rocks description, **weathering grade, RMR, RQD and sampling methods for rock strength**, and composition studies.

UNIT IV MAPPING TECHNIQUES 8

Preparation of profiles from contour map; lithological and structural mapping of shallow and deep excavated sites. **Hand on exercises.**

UNIT V GEOLOGICAL INVESTIGATIONS FOR FOUNDATION ENGINEERING 8

Ground stability studies - Scour and erosion studies-stability of slopes and geological solution for **slope stability in landslides areas.**

TOTAL: 45 PERIODS

REFERENCES:

1. Varghese P.C. Engineering Geology for civil engineers, PHI learning Pvt.Ltd. New Delhi-1, 2012
2. Venkata Reddy. D., Engineering geology, Vikas Publishing Home, Noida, 2010
3. Bell FG. by Engineering Geology, Second Edition, Butterworth-Heinemann, Oxford, 2007
4. Sathya Narayanaswami, Engineering Geology, Dhanpat Raj and Co.1710, Nai Sarak, Delhi-110 006, 2000.
5. Chenna Kesavulu. N., Text book of engineering geology, II edition, MacMillan Publishers India Ltd. Delhi, 2009.
6. Krynine and Judd Principles of Engineering Geology and Geotechnology McGraw Hill, New York 1962.
7. Waltham, A.C. Foundations of Engineering Geology, Blackie Academic Professional Pub.1 Ed.UK.1994

MGT060	MECHANICS OF UNSATURATED SOILS				L	T	P	C
	Total Contact Hours:45				0	0	2	1
	Prerequisite: Soil Mechanics							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES To impart knowledge in assessing both physical and engineering behaviour of unsaturatedsoils, measurement and modeling of suction – water content and suction – hydraulic conductivity of unsaturated soils.								
COURSE OUTCOMES (COs)								
CO1	To study the state of unsaturated soil							
CO2	To study the physical properties of Air and water							
CO3	To study the stress state variables and shear strength							
CO4	To learn the concept of permeability and hydraulic conductivity							
CO5	To learn about the measurement of total suction							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	M	H					
	CO2	M				M		
	CO3	M	M	H				
	CO4	H						
	CO5	M						

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I STATE OF UNSATURATED SOIL 6

Definition – Interdisciplinary nature of unsaturated soil – soil classification – Nature and practice – stress profiles, stress state variables - material variables – constitutive law – suction potential of soil water

UNIT II PHYSICS OF SOIL WATER SYSTEM 9

Physical properties of Air and water – partial pressure and relative Humidity Density of moist air – surface Tension – cavitations of water. Solubility of Air in water – Air – water solid interface – vapor pressure lowering – soil water characteristic-curve. Capillary tube model – contacting sphere model. Young Laplace equation – Height of capillary rise – Rate of capillary rise – capillary pore size distribution – theoretical basis – determination – laboratory method.

UNIT III STRESS STATE VARIABLES AND SHEAR STRENGTH 12

Effective-stress – stress between two spherical particles – Hysteresis in SWCC – stress parameter, stress tensor – stress control by Axis Translation - analytical representation of stress – volume change characteristics. Extended Mohr – Coulomb criterion – shear strength parameters – Interpretation of Direct shear test results and Tri axial test results – unified representation of failure envelope – Influence of suction in earth pressure distribution.

UNIT IV STEADY AND TRANSIENT FLOWS 9

Driving mechanism – Permeability and Hydraulic conductivity – capillary barriers – steady infiltration and evaporation – Vapor flow – Air diffusion in water. Principles for pore liquid flow – Rate of infiltration, Transient suction and moisture profiles. Principles for Pore Gas flow – Barometric pumping Analysis.

UNIT V MATERIAL VARIABLE MEASUREMENT AND MODELLING 9

Measurement of total suction – psychrometers – Filter paper measurement of matric suction – High Air Entry disks – Direct measurements – Tensiometers – Air-translation technique – Indirect

measurements – Thermal conductivity sensors – measurement of osmotic suction – squeezing technique – soil water characteristic curves and Hydraulic conductivity models.

TOTAL: 45 PERIODS

REFERENCES:

1. Fredlund, D.G., Rahardjo, H. and Fredlund, M.D., Unsaturated Soil Mechanics in Engineering Practice, John Wiley & Sons, INC, New Jersey, 2012.
2. Ning Lu and William, J. Likes, Unsaturated Soil Mechanics, John Wiley & sons, INC. New Jersey, 2004
3. Ng Charles, W.W., Menzies Bruce, Advanced unsaturated Soil Mechanism and Engineering, Taylor & Francis Group, 2007.
4. Ning Lu, Laureano R. Hoyes and Lakshmi Reddi, Advances in unsaturated soil, seepage and Environmental Geotechnics, ASCE., Geotechnical special publication No.148.
5. Jean- Louis Briaud., Geotechnical Engineering: Unsaturated and Saturated soils, John Wiley & Sons, INC, New Jersey, 2013.

MGT061	PAVEMENT ENGINEERING				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Transportation Engineering							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES Student gains knowledge on designing rigid and flexible pavements for different serviceability conditions of roads..								
COURSE OUTCOMES (COs)								
CO1	To study the historical development of pavements, types & classification.							
CO2	To learn the factors affecting flexible pavements							
CO3	To design flexible and rigid pavements using IRC methods							
CO4	To suggests modern material, pavement evaluation and rehabilitation							
CO5	To evaluate and carry out stabilization of soils for road constructions							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	H	H					
	CO2	H	M			M		
	CO3	H	H	H				
	CO4	H	M					
	CO5	M	M			M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I BASIC CONCEPTS 9

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 9

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 9

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 9

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 9

Need for a stabilized soil – Design criteria – Mechanisms - factors influencing choice of stabilizers - Testing and field control – Applications of Geosynthetics in road construction - Case studies.

TOTAL: 45 PERIODS

REFERENCES:

1. O' Flaherty, C.A., Highways – The location, Design, Construction & Maintenance of Pavements, Fourth Edition, Elsevier, 2006
2. Khanna S.K and Justo C.E.G, Highway Engineering, Eighth Edition, New Chand and Brothers, Roorkee, 2001.

3. Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.
4. Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.
5. Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001.
6. Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.
7. Guideline for the Design of Rigid Pavements for Highways, IRC:58-1998, The Indian Roads Congress, New Delhi.
- 8.. Wright, P.H., Highway Engineers, John Wiley & Sons, Inc., New York, 1996.
9. Bell. P.S., Developments in Highway Engineering, Applied Sciences publishers, 1978.

MGT062	SOIL STRUCTURE INTERACTION					L	T	P	C
	Total Contact Hours:45					3	0	0	3
	Prerequisite: Soil Mechanics & Foundations Engineering								
	Course Designed by :Department of Civil Engineering								
<p>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..</p>									
COURSE OUTCOMES (COs)									
CO1	To study soil response models of interaction analysis								
CO2	To solve the infinite and finite beams on elastic foundations								
CO3	To estimate the plate on elastic medium using ACI method								
CO4	To analysis the pile and pile groups using design charts								
CO5	To find the deflection on lateral loaded pile								
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low									
1	COs/Pos	a	b	c	d	e			
2	CO1	H	H	M		M			
	CO2	M	H	H					
	CO3	M	M	H					
	CO4	M	H	H					
	CO5	H	M	H		M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			

				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I SOIL RESPONSE MODELS OF INTERACTION ANALYSIS 9

Introduction to soil – Foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis, soil response models, Elastic continuum, Winkler, Two parameter elastic models, Elastic – plastic behavior, Time dependent behavior.

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

Infinite plate, elastic continuum, Winkler, Two parameters, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, simple solution, ACI method, Analysis of highway and airfield pavements – solutions - General method.

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

REFERENCE:

1. Michael J Tomlinson, John C Woodward., Pile Design and Construction Practice, Sixth Edition, CRC Press, 2014
2. Edward Tsudik, “Analysis of Structures on Elastic Foundations”, J. Ross Publishing, Cengage learning India Private limited, Delhi, 2013.
3. Salgado, R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, 2011.
4. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, 200643. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, 1998.

5. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, 1980.
6. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier 1979.
7. Kurien, N.P., "Design of Foundation Systems: Principles and Practices Narosa Publishing House, New Delhi, 1999.

MGT063	ROCK MECHANICS AND APPLICATIONS				L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Engineering Earth Science							
	Course Designed by :Department of Civil Engineering							
OBJECTIVES Students are expected to classify, understand stress-strain characteristics, failure criteria, and influence of insitu stress in the stability of various structures and various technique to improve the insitu strength of rocks..								
COURSE OUTCOMES (COs)								
CO1	To study the classification of rocks.							
CO2	To learn about the strength criteria of rocks and its behavior							
CO3	To analysis the design aspects in rock							
CO4	To understand the slope stability and bearing capacity of rocks							
CO5	To study the reinforcement of fractured and joined rocks							
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low								
1	COs/Pos	a	b	c	d	e		
2	CO1	M	H					
	CO2	M	H				M	
	CO3	H	H	H				
	CO4	H	H					
	CO5	H	H	H			M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)		
				√				
4	Approval	Board of Studies meeting – 23 rd September 2016						

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 deviatric 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.

III INSITU STRESSES IN ROCKS 10

In situ 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 9

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

REFERENCES:

1. Ramamurthy T. , “Engineering in Rocks for Slopes Foundations and Tunnels”, PHI Learning Pvt. Ltd., 2007.
2. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.
3. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.
4. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamon publications, 1997.
4. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
6. Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K. 1981.
7. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley, 1967.
8. Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.
9. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer-Verlag, Berlin, 1990.

MGT064	EARTH AND ROCK FILL DAMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Engineering Earth Science				
	Course Designed by :Department of Civil Engineering				
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.					

COURSE OUTCOMES (COs)						
CO1	To learn the types of earth and rock fill dams					
CO2	To study the slope stability and seepage analysis					
CO3	To understand the mechanisms in hydraulic fracturing					
CO4	To study the failure and damages					
CO5	To analysis the special design problems					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H			
	CO2	H	H			M
	CO3	H	H	H	M	M
	CO4	H	M			
	CO5	H	M	H		M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I DESIGN CONSIDERATION

9

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

8

Stability of infinite and finite slopes, Method of Slices, Bishop's method, Flow nets, Stability conditions during construction, Full reservoir and drawdown - cut off walls – Trenches – Importance of drainage and filters.

UNIT III HYDRAULIC FRACTURING

9

Introduction, Conditions and mechanisms for hydraulic fracturing, Failure criterion for hydraulic fracturing – cubic specimen with a crack – core with a transverse crack – core with a vertical crack, strike-dip of easiest crack spreading; factors affecting hydraulic fracturing, self-healing of a core crack.

UNIT IV FAILURE AND DAMAGES**9**

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**10**

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**REFERENCES:**

1. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kulwer Academic Publishers, 2001.
2. Jun-Jie Wang, Hydraulic Fracturing in Earth-rock Fill Dams, John Wiley & Sons, 2014.
3. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.
4. Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., Earth and Earth rock dam, John Wiley, 1963.
5. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
6. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.
7. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow, 1986.
8. Chandhar, R.J., Engineering Developments and Applications, Thomas Telford, 1991
9. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.

9.MGT065	FOUNDATION ON EXPANSIVE SOILS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Foundation Engineering				
	Course Designed by :Department of Civil Engineering				
OBJECTIVES To get exposure about various aspects of structures especially constructed on expansive soil. To understand various methods of stabilization used in expansive soils					
COURSE OUTCOMES (COs)					
CO1	To study the general principles in foundation.				
CO2	To do the Laboratory tests for Swelling characteristics				

CO3	To understand the techniques for controlling swelling in soil					
CO4	To study the foundations on expansive soils					
CO5	To learn the modification of swelling characteristics					
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	H	H			
	CO2	M	H	H		
	CO3	M	H	H		M
	CO4	H	H			M
	CO5	M	M			M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	Board of Studies meeting – 23 rd September 2016				

UNIT I GENERAL PRINCIPLES 9

Origin of expansive soils – Physical properties of expansive soils – Mineralogical composition – Identification of expansive soils – Field conditions that favour swelling – Consequences of swelling.

UNIT II SWELLING CHARACTERISTICS 9

Swelling characteristics – Laboratory tests – Prediction of swelling characteristics – Evaluation of heave.

UNIT III TECHNIQUES FOR CONTROLLING SWELLING 9

Horizontal moisture barriers – Vertical moisture barriers – Surface and subsurface drainage – Prewetting – Soil replacement – Sand cushion techniques – CNS layer technique.

UNIT IV FOUNDATIONS ON EXPANSIVE SOILS 9

Belled piers – Bearing capacity and skin friction – Advantages and disadvantages – Design of belled piers – Under reamed piles – Design and construction.

UNIT V MODIFICATION OF SWELLING CHARACTERISTICS 9

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization – Construction.

TOTAL: 45 PERIODS

REFERENCES

1. FU HUA CHEN, “Foundations on Expansive Soils”, Elsevier Scientific Publishing Company, New York. 1988

2. GopalRanjan&A.S.RRao, “Basic and Applied Soil Mechanics”, New Age International Publishers – New Delhi. 2002
3. Hand Book on Underreamed and Bored Compaction Pile Foundation, CBRI, Roorkee
4. IS : 2720 (Part XLI) – 1977 – Measurement of Swelling Pressure of Soils.
5. R.K.Katti, “Search for Solutions in Expansive Soils”.
6. Alam Singh, “Modern Geotechnical Engineering”, Geo-Environ Academia, Jodhapur.
7. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBH, New Delhi.