M.Tech. (Civil Engg) -Soil Mechanics & Foundation Engineering

Applied Mechanic Department
S V National Institute of Technology, Surat

M.Tech. (Civil Engg) - SOIL MECHANICS & FOUNDATION ENGINEERING

Course Structure and Scheme of Evaluation (Semester –wise) as per AICTE guidelines.

I[ST] SEMESTER

COURSE NO.	NAME OF SUBJECT	HOURS / WEEK			MARKS				CREDIT		
					Theory		T / P				
		L	T	P	Int.	Ext.	Int.	Ext	Th	T/P	Total
AM 601*	Theory of Elasticity & Plasticity	3	1	0	50	50	20	30	3	1	4
AM 631	Rock Mechanics	3	1	0	50	50	20	30	3	1	4
AM 633	Foundation Engineering	3	-	2	50	50	20	30	3	1	4
AM 635	Advance soil mechanics	3	1	0	50	50	20	30	3	1	4

** Common with M.Tech. Structural Engineering*

*** student can opt any one elective subject from the subject mentioned below.*

II[ND] SEMESTER

COURSE NO.	NAME OF SUBJECT	HOURS / WEEK			MARKS				CREDIT		
					Theory		T / P				
		L	T	P	Int.	Ext.	Int.	Ext	Th	T/P	Total
AM 702*	Finite Element Method	3	1	0	50	50	20	30	3	1	4
AM 704*	Design of Earthquake Resistant Structures	3	1	0	50	50	20	30	3	1	4
AM 732	Soil Improvement Techniques	3	1	0	50	50	20	30	3	1	4
AM 734	Soil Dynamic & Machine Foundation	3	-	2	50	50	20	30	3	1	4

** Common with M.Tech. Structural Engineering*

*** student can opt any one elective subject from the subjects mentioned below.*

ELECTIVE SUBJECT**

COURSE NO.	NAME OF SUBJECT	HOURS / WEEK			MARKS				CREDIT		
					Theory		T / P				
		L	T	P	Int.	Ext.	Int.	Ext	Th	T/P	Total
AM 637	Measurement Techniques in Geotechnical Engineering	3	1	0	50	50	20	30	3	1	4
AM 639	Computer Application in Geotechnical Engineering	3	1	0	50	50	20	30	3	1	4
AM 736	Environmental Geotechnology	3	1	0	50	50	20	30	3	1	4
AM 738	Foundation in Difficult Sub soil	3	1	0	50	50	20	30	3	1	4

III[rd] SEMESTER

COURSE NO.	NAME OF SUBJECT	HOURS / WEEK			MARKS				CREDIT		
		L	T	P	Theory		T / P		Th	T/P	Total
					Int	Ext	Int	Ext			
AM 831	Seminar / Project Report	0	0	4	-	-	50	50	-	-	2
AM 840	Dissertation (Prelims)	0	0	16	-	-	100	150	-	-	8
	TOTAL	**0**	**0**	**20**	**-**	**-**	**150**	**200**	**-**	**-**	**10**

IV[th] SEMESTER

COURSE NO.	NAME OF SUBJECT	HOURS / WEEK			MARKS				CREDIT		
		L	T	P	Theory		T / P		Th	T/P	Total
					Int	Ext	Int	Ext			
AM 840	Dissertation	-	0	24	-	-	160	240	-	-	12
	TOTAL	**-**	**0**	**24**	-	-	160	**240**	**-**	**-**	**12**

TOTAL CREDIT OF THE COURSE = 62

M.Tech. (SMFE) 1st Semester
AM 601 : Theory of Elasticity & Plasticity

L	T	P	C
3	1	-	4

- Introduction, Forces, stresses and strains (Three dimensional) plane stress and plane strain problem, Cauchy's strain displacement relations, generalized Hook`s law - Navier`s equilibrium conditions-compatibility- Boundary conditions – Belttrami – Michell compatibility equations.

(Hours – 12)

- Air's stress function-Saint Venant's principle- boundary value problems in two-dimensional and three dimensional elasticity –Two dimensional stress – strain problems in Cartesian co-ordinates. Solution of simply supported and Cantilever beams by polynomials.

(Hours – 10)

- Polar Co-ordinates – Prandtl's theory of torsion-Membrane analogy, Edge Dislocation - Biharmonic equations-Stresses in circular disc - uniqueness of solution- Betti and Maxwell's reciprocity Theorems-concentrated load action on vortex of wedge (Mitchell's Problem)-concentrated load action on the free surface of a plate (Filament's problem) - stress concentration due to circular hole in stressed plate (Kirsch's problem).

(Hours-10)

- Introduction to plasticity – plastic behaviour of solids – stress / strain diagram for structural solids – yield criteria and flow rules – strain hardening – plastic analysis of structures – unloading from elastic – plastic states.

(Hours – 10)

RECOMMEND BOOKS

1. Filonenko M., " Theory of Elasticity" Borodich Dover Publication, New York, USA, 2000.
2. Timoshenko S P and Goodier J N, "Theory of Elasticity", MC Graw Hill Book Co., Inc., New York , USA, 2004.
3. Venkatraman B & Patel S A., "Structural Mechanics with Introduction to Elasticity and Plasticity", MC Graw Hill Publication, New York, USA, 2006.
4. Volterra E. & Gaines J H, "Advanced Strength of Materials", Prentice Hall Publication, New York, USA, 2000.
5. Wang C T "Applied Elasticity" Mc Graw Hill Publication, NY, USA , 2000.

M.Tech. (SMFE) 2nd Semester
AM 631 : Rock Mechanics

L	T	P	C
3	1	-	4

- Revision of physical and structural geology, faults and shear zones - treatment -engineering classification -need -classification of intact rock and insitu rock masses -insitu state of stress - mapping of joints.

(Hours-7)

- Mechanical properties -intact rock -insitu rock masses.

(Hours-7)

- Brittle failure of rock -fracture in compression -rupture criteria for brittle rock

(Hours-7)

- Insitu test: need -plate load test -pressure tunnel test -flat jack test - cable jacking test -dynamic insitu shear test -permeability test

(Hours-7)

- Principles of rock stress measurements stresses relief techniques -bore hole deformation meters - stress meter -photoelastic stress meter -multipoint strain cell -flat jack.

(Hours-7)

- Behaviour of rock structures -plasticity and- failure of rock -introduction of analysis of general slip -rock bolting and grouting.

(Hours-7)

REFERENCES:

1. Stagg K G & Zienkiewicz 0 C, “Rock Mechanics in Engineering Practical”, John Wiley & Sons, London, 1969.
2. Goodman R E, “Introduction to Rock Mechanics”, John Wiley & Sons, New York, 1989.
3. Muller L, “Rock Mechanics”, Springer -Verlag, New York, 1972
4. Ramamurthy T., “Engineering in Rocks for Slopes, Foundation and tunnels”, Prentice Hall of India Pvt Ltd, New Delhi, 2007.
5. Hudson J A and Harrison J P., “Engineering Rock Mechanics – An Introduction to the Principles” Elsevier, Oxford, 1997.

M.Tech. (SMFE) 1st Semester
AM 633 Foundation Engineering

L	T	P	C
3	-	2	4

- **Soil Properties and Exploration**

  (Hours-08)

  Soil properties and its applications, Laboratory testing , Soil exploration techniques – comparisons, Sounding tests, Geophysical methods, Sampling, Interpretation of Laboratory & field Testing.

- **Introduction Shallow Foundation**

  (Hours – 08)

  Soil Investigation Reports study, Bearing capacity of soil, Settlement of Foundations

- **Machine Foundation**

  (Hours – 08)

  Machine foundation – Types of machine foundation, General criteria, Theory of vibration, Single degree freedom system, Soil dynamic parameters, Block type machine foundation (Checking of resonance and permissible amplitude), vibration isolation techniques

- **Pile Foundation**

  (Hours-08)

  Pile foundation – Types of piles, Factors affecting choice of types of piles, Load carrying capacity of piles, Pile group, Group efficiency, Lateral resistance of piles, settlement of piles , Negative skin friction

- **Special Foundations**

  (Hours-10)

  Classification of Foundation, Special foundations, Raft foundation, types of rafts, Beams on elastic foundation, Footing subjected to moments, Footing subjected to tension, Geotextiles, various methods of foundation design, Technological consideration in Geotechnical Engineering.

RECOMMENDED BOOKS

1. Bowles J E “Foundation Analysis & Design” McGraw Hill Inc. New York, 1988.
2. Nayak N V “Foundation Design Manual” Dhanpatrai & Sons, New Delhi 1985.
3. Das B M “Principles of Foundation Engineering” PWS Publishing Co., Boston, 1990.
4. Barnes G E “Soil Mechanics” Principles and Practice “ MacMillan, 2000.
5. Terzaghi , Peck .and Mesri “ Soil Mechanics in Engineering Practice “ 1996

M.Tech. (SMFE) 1st Semester
AM635 : Advanced Soil Mechanics

L	T	P	C
3	1	-	4

- Stresses and displacements in soil: soil as elastic body -concept of effective stress - equations of equilibrium in soil mass -principal stresses and strains -problems of plane stresses and strains - stress distribution by Boussenesq, Westerdgards theory –Newmark's chart -influence of anisotropy on stress distribution -applications to geotech problems

(Hours – 12)

- Shear resistance: stress -strain relationship in soils -failure criteria –Mohr Coulomb's failure - shear parameters under different drainage conditions construction - pore pressure in saturated and unsaturated soils -analytical predictions of pore pwater pressures -stress dilatency theory - results of plain strain shear tests -forces on shear parameters

(Hours – 10)

- Mechanics of consolidation: phenomenon of consolidation -Terzaghi's theory of unidimensional consolidation - methods to determine precompression history -applications to estimate settlements -introduction of creep and stress relaxation by rheological models.

(Hours – 10)

- Mechanics of flow through soils: flow through soils -unidimensional - radial and Spherical flow cases -seepage forces quick sand and piping - flow nets of confined and unconfined flow by relaxation techniques - phreatic surfaces by conformal mapping -flow net for anisotropic non-homogeneous soils

(Hours – 10)

RECOMMEND BOOKS

1. Scott R F, "Principles of Soil Mechanics", Addition Wesley Publishing Co. Inc., 1988.
2. Harr M E, "Foundation of Theoretical Soil Mechanics", McGraw Hill Book Co., New York, 1962.
3. Kaniraj S R, "Design Aids in Soil Mechanics & Foundation Engineering", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1988
4. Terzaghi , Peck .and Mesri " Soil Mechanics in Engineering Practice " 1996
5. Bowles J E "Foundation Analysis & Design" McGraw Hill Inc. New York, 1988.

M.Tech. (SMFE) 1st Semester	L	T	P	C
AM 637:Measurement Technique in Geotechnical Engg	3	1	-	4

- Introduction -load measurements -pore water pressure measurements - earth pressure measurements -measurements of ground movements

(Hours – 8)

- Instrumentation of different structures such as earth dams -foundations, retaining walls, rock slopes, their recording and processing

(Hours – 8)

- Consolidation test and its applications to settlement computations

(Hours – 8)

- Shear test: triaxial shear test -pore pressure & volume change during shear -vane shear test -measurements of A & B parameters

(Hours – 9)

- Techniques of field measurements of penetration resistance (Static /Dynamic) plate load test -resistivity of soil -compression and tensile tests on rock cores

(Hours – 9)

RECOMMEND BOOKS

1. Hanna T H, “Foundation Instrumentation”, Trans Tech Publication, Ohio, 1985
2. Leonard, “Foundation Engineering”, McGraw Hill Book Co. Inc., New York
3. Dunnicliff J & Gree G E, “Geotechnical Instrumentation for Monitoring Field Performance”, John Wiley, 1988
4. Indian Geotechnical Conference: “Construction Practices and Instrumentation”, Proceeding -1982
5. Bishop A W & Henkel D J., “Measurement of soil Properties in the Triaxial Test”, Edward Arnold, London, 1957.

M.Tech. (SMFE) 1st Semester **AM639 : Computer Applications in Geotechnical Engg**	L	T	P	C
	3	1	-	4

- Flow chart & spread sheets applications in a soil laboratory tests Grain size analysis - Shear, consolidation soil classification - Solution of problems using slope stability softwares - Retaining structures – Earth Pressure

(Hours – 8)

- Bearing capacity of soils -analytical, empirical, code and experimental approaches -effect of shape, depth of water table and eccentricity of loading -bearing capacity of saturated clay, clean sand, silt & non- saturated silty clays –comparative study by different methods, solution of bearing capacity problems using computer programming

(Hours – 10)

- Settlement computations -permissible total settlement -permissible differential settlement - computation of initial -primary consolidation for, foundations on clay and sand, solution of computation of settlement using computer programming

(Hours – 8)

- Design of spread footings -types of footings -pressure distribution below footings -computer aided design of RCC footings - design of raft foundation -beams on elastic foundations – Solution of Problems using Softwares Spread footing – Pile Foundation - Analysis of anchored wall , Behavior of pile under lateral load , Application of GIS

(Hours – 10)

- Constitutional modeling of Soil.

(Hours – 6)

RECOMMEND BOOKS

1. Bowles J E, "Foundation Analysis & Design", McGraw Hill Inc., New York, 1988
2. Das B M, "Principles of Foundation Engineering", PWS Publishing Co., Boston, 1 990
3. Purushottam Raj, "Geotechnical Engineering", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1995
4. Khan Iqbal H "A Text Book of Geotechnical Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
5. Kurian N P, “Design of Foundation Systems”, Narora Publishing House, 1992.

M.Tech. (Structural Engg) 2nd Semester	L	T	P	C
AM 702 : Finite Element Method	3	1	-	4

- Concept & Solution procedure for finite element displacement approach.

  (Hours -6)
- Principles of discretization.

  (Hours -6)
- Lagragian & Hermitian interpolation functions.

  (Hours -6)
- Shape function & numerical integration technique.

  (Hours -6)
- Element properties for one dimensional (bar & beam) element & two dimensional (rectangular, triangular & isoparametric elements using natural & area coordinate system.

  (Hours -6)
- Introduction to plate elements – shell elements – dynamics and vibration – buckling – Galerkin method

  (Hours -6)
- Pre and post processors, Solution Techniques & Software Packages.

  (Hours -6)

BOOKS RECOMMENDED

1. Cook R. D. et. al. “Concept & application of finite element analysis” by John Wiley & Sons Inc.,2003. Singapore, 4th Edition,
2. Logan D L, “ A first course in the Finite Element Method”, 3rd Edition, Thomson Asia Pvt Ltdm Bangalore, 2004.
3. Reddy J N, “An Introduction to the Finite Element Method”, 3rd edition, Tata McGraw Hill Pub.com Ltd, New Delhi, 2005.
4. Chandrupatla, T. R. & Belegundu, A. D., “Introduction to Finite Elements in Engineering”, 3rd edition, , Prentice – Hall of India Pvt. Ltd., New Delhi, 2002.
5. Rao, S. S.,“The Finite Element Method in Engineering” 4th Edition, Butterworth – Heinemann, Oxford, U. K., 2005.

M.Tech. (SMFE) 2nd Semester
AM 732 : Soil Improvement Techniques

L	T	P	C
3	1	-	4

- Types of Soil Structure – Clay Minerals – Characteristics and Construction of mineral groups – soil water

(Hours – 6)

- Definitions – Principles – Objectives – Field compaction methods – suitability of field compaction methods – field compaction controls – methods

(Hours – 6)

- Weak Deposits- Identification-Problems associated with weak deposits- Mitchel chart of applicability of treatment methods

(Hours – 6)

- Insitu compaction of cohesion less soil – Injection and grouting – stabilization of soils – Preloading and sand drains , Prefabricated vertical drain

(Hours – 6)

- Vibroflotation - Stone column – Encased stone column , Stone column design – strengthening of subsoil by stone column installation

(Hours – 6)

- Earth reinforcement , Geosynthesics , Mechanically stabilized earth wall

(Hours – 6)

- Ground Water Control – Methods – Diaphragm techniques – well point system

(Hours – 6)

RECOMMND BOOKS

1. Koerner R M, “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill Publishing Co. Ltd., 1984
2. Hausmann M.R. ‘Engineering Principles of Ground Modification’ McGraw Hill Publishing Company, New York - 1990.
3. Zeevart L, “Foundation Engineering for Difficult Subsoil Conditions” Van Nostrand Reinheld Co., Newyork, 1973.
4. Bell F G, “Foundation Engineering in Difficult Ground”, Butterworth, 1978.
5. Harr M E, “Ground Water & Seepage” Mc Graw Hill Publication, 1973.

M.Tech. (SMFE) 2nd Semester
AM 734 : Soil Dynamics & Machine Foundation

L	T	P	C
3	-	2	4

- Introduction -nature of dynamics loads -free vibrations of spring mass systems -forced vibrations -viscous damping -principles 0 vibration measuring equipments

(Hours – 8)

- Dynamic stress -deformation and strength of soils -dynamic bearing capacity and earth pressure -Effect of transient and pulsating loads - resonant column apparatus -field tests -typical values of soil constants

(Hours – 8)

- Liquefaction of soils -factors influencing -liquefaction potential -analysis from standard penetration data

(Hours – 6)

- Machine foundations -design criteria -degrees of freedom -foundations for reciprocating machines -block foundations -elastic half space theory- lumped parameter analog model- foundations for high speed machinery- dynamic soil structure interaction

(Hours – 12)

- Vibration isolation -passive and active isolation -use of springs and damping materials -construction aspects of machine foundations

(Hours – 8)

REFERENCES

1. Das B M, “Fundamental of Soil Dynamics”, Elsevier Scientific Publishing Co., New York, 1983
2. Barkan D D, “Dynamics of Bases of Foundations”, McGraw Hill Book Co. Inc., New York
3. Srinivashula P & Vaidyanathan C V, Handbook of “Machine Foundation”, McGraw Hill, 1986
4. Prakash S & Puri V K, “Foundations for Machines”, McGraw Hill, 1987
5. Srinivasalu., “Handbook of Machine Foundations”, Mc Graw Hill, 2004.

M.Tech. (Structural Engg) 2nd Semester
AM 704 : Design of Earthquake Resistant Structures

L	T	P	C
3	1	-	4

- Earthquake magnitude and intensity -ground motion -site effects - sensors -design response spectrum

(Hours – 8)

- Earthquake analysis -idealization of structures -response spectrum analysis -equivalent force concepts -torsionally coupled system -effects of soil-structure interaction

(Hours – 8)

- Earthquake resistant design philosophy -ductility -base isolation -codal provisions -detailing provisions -review of damage during past earthquake

(Hours – 8)

- Dynamic properties of soil -liquefaction & ground improvement techniques -examples of earthquake resistant design of RCC-and steel structures - retrofitting and strengthening of buildings and other structures

(Hours – 10)

- Earthquake tips, plate tectonics.

(Hours – 8)

BOOKS RECOMMENDED

1. Agrawal Pankaj & Shrinkhande Manish, "Earthquake Resistant Design of Structures" 1st Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2004.
2. Farzand Naeim & Van Nostrand Reinmhold, "The Seismic Design", Handbook, New York, 1989
3. Comite Euro, "Seismic Design of Concrete Structures", International du Beton (CEO), edited by Pinto P E Technical Press, 1987
4. Ambrose James & Vergun Dimitry, "Design of Lateral Forces", John Wiley & Sons, New York, 1987
5. (a) IS: 1893-2000, Indian Standard Criteria of Practice for Earthquake Resistant Design of Structures
   (b) IS: 4326-1976, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings
   (c) IS: 13920-1993-, Indian Standard Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces -Code of Practice
   (d) SP22 -1982 -Explanatory handbook on codes for Earthquake Engineering

M. Tech. (SMFE) 2nd Semester
AM 736 : Environmental Geotechnology

L	T	P	C
3	1	-	4

- Environmental cycles and their interaction -soil water environment interaction relation to geotechnical problems -pollution effect on soil behaviour and foundations -effect of bacteria -pore fluid on soil water behaviour -load factor versus environmental factor -environmental technology and public concerns

(Hours-10)

- Subsurface disposal of refuse -geotechnical considerations -technology and environmental impacts -load bearing capacity of compacted water fills -settlement of structures on uncompacted rubbish -criteria for geotechnical construction on sanitary landfills -ground improvement techniques in land fill areas -leachate contamination -control of gas generator -geomembranes in solid waste disposal

(Hours-12)

- Geotechnical and geohydrological aspects of hazardous waste management -hazardous waste control and storage system -evaluation of effects of hazardous waste disposal sites upon ground water aquifers - environmental geotechnical considerations

(Hours-10)

- Environmental effects caused by pile driving and their control -dynamic response of soil under environmental stress -contribution of environmental stress such as hazardous waste -acid rain, tree cutting etc. to mechanism of landslides -subsidence and sink holes in soils including dispersive clays -case studies

(Hours-10)

RECOMMENDED BOOKS

1. Oweis I Sand Khera R P, “Geotechnology of Waste Management”, Butterworth & Co., 1990
2. Oft W R, “Environmental Indices: Theory and Practice”, Ann Arbor, 1978

M.Tech. (SMFE) 2nd Semester
AM 738 : Foundation in Difficult Subsoil

L	T	P	C
3	1	-	4

- Weak Deposits- Identification-Problems associated with weak deposits- Mitchel chart of applicability of treatment methods

(Hours-6)

- Introduction role of ground improvement in foundation engineering - drainage techniques -well point vacuum and electronic methods

(Hours-6)

- Insitu densification of soils -dynamic compaction -blasting dynamic consolidation -preloading with sand drains

(Hours-6)

- Stone columns methods of installation vibro-flotation technique -grouting and stabilization -earth reinforcement geosynthesics

(Hours-6)

- Geotechnical aspects of hazardous waste management - hazardous waste management - environmental geotechnical consideration

(Hours-6)

- Foundation on expansive soil -collapsible soil

(Hours-6)

RECOMMEND BOOKS

1. Bell F G, “Foundation Engineering in Difficult Ground”, Butter Worth, 1978
2. Hausmann M.R. ‘Engineering Principles of Ground Modification’ McGraw Hill Publishing Company, New York - 1990.
3. Mandal J. N. – ‘Geo-synthetics World’ Wiley Eastern Limited, 1994.
4. Jones J E P, “Earth Reinforcement and Soil Structure”, Butter Worth, 1985
5. Koerner R M, “Construction and Geotechnical Methods in Foundation Engineering”, McGraw Hill Publishing Co. Ltd., 1984

M.Tech. (SMFE) 3rd Semester **AM 831 : Seminar**	L	T	P	C
	-	-	-	2

The candidate is given state of art areas to be explored a specific problem especially with field / practical applications. Sponsored research areas can also be investigated. Industry related problems, Codal specification examinations, new areas of material research, are some of the key features of the seminar.

The candidate will study, complete state of art literature review and present the same before the jury. The assessment will be done based on the above mentioned aspects.

M.Tech. (SMFE) 4th Semester **AM 840 : Dissertation**	L	T	P	C
	-	-	-	12

The dissertation topic is covered in two parts. Dissertation Preliminary is covered during third semester. The work is assigned to the students immediately after the second semester examination. Thus, the candidate starts working on the given problem during the summer vacation prior to commencement of third semester.

The preliminary work involved is related to a state-of-art literature review, identification of the area and finalization of the specific problem, with clearly defined title. The presentation of the preliminaries is addressed as the 1st stage seminar of the proposed dissertation work. The candidate is expected to present the plan of action and review of the published work related to the area.

After obtaining the approval along with necessary modification from the jury, the candidate proceeds for the second stage of the dissertation work.

The second stage of dissertation work, which can be termed as the core part can be carried out at any of the advanced institutions, laboratories, centre-of-excellence places, with whom prior permission is obtained through MOU. The MOU can be with the industry, laboratories, and universities, all around the world.