

Scheme & Syllabus of Master of Technology

(M. Tech – Civil Engineering)

Specialization: GEOTECHNICAL ENGINEERING

Batch 2018 onwards



By

Board of Study Civil Engineering

Department of Academics

I.K. Gujral Punjab Technical University

M. Tech (Civil Engineering)

Specialization: GEOTECHNICAL ENGINEERING

Program Outcomes (POs):

1. Students will learn soil and rock behavior. Students will be able to perform various laboratories and in-situ tests on soil/rock to find out design parameters.
2. Students can design shallow/deep foundations, earth retaining structures, embankment and earthen dams, tunnel support systems for given site conditions.
3. Student can compute factor of safety to assess stability of slopes and apply preventive measures for stability.
4. Student can develop numerical models to estimate response of various geotechnical structures under different loadings

First Semester

| Course Type | Course Name | Load Allocations | | | Marks Distribution | | | Credits |
|---------------------|--|------------------|----------|-----------|--------------------|------------|-------------|-----------|
| | | L | T | P | Internal | External | Total Marks | |
| Core Theory | MTGT101-18 Advanced Soil Mechanics | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| Core Theory | MTGT102-18 Advanced Foundation Engineering | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| Program Elective I | Elective – I | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTGT901 - 18 Soil Structure Interaction | | | | | | | |
| | MTGT902 - 18 Ground Improvement Techniques | | | | | | | |
| | MTGT903 - 18 Pavement Analysis and Design | | | | | | | |
| Program Elective II | Elective – II | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTGT904 - 18 FEM in Geomechanics | | | | | | | |
| | MTGT905 - 18 Environmental Geotechnology | | | | | | | |
| | MTGT906 - 18 Critical Soil Mechanics | | | | | | | |
| Core Lab I | MTGT111 - 18 Soil Mechanics lab - I | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| Core Lab II | MTGT112 - 18 Soil Mechanics lab - II | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MLC | Research Methodology and IPR | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| Audit 1 | Audit Course | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | MTGT113 - 18 Technical Seminar - I | 0 | 0 | 2 | 60 | 40 | 100 | 1 |
| Total | | 16 | 0 | 10 | 380 | 420 | 800 | 19 |

Second Semester

| Course Type | Course Name | Load Allocations | | | Marks Distribution | | | Credits |
|----------------------|---|------------------|----------|-----------|--------------------|------------|-------------|-----------|
| | | L | T | P | Internal | External | Total Marks | |
| Core 3 | MTGT201 - 18 Dynamics of soils and foundations | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| Core 4 | MTGT202 - 18 Subsurface investigations and instrumentation | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| Program Elective III | Elective – III | | | | | | | |
| | MTGT907 - 18 Offshore Geotechnical Engineering/marine Geotechniques | | | | | | | |
| | MTGT910 - 18 Computational Geomechanics | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTST911 - 18 Engineering rock mechanics | | | | | | | |
| Program Elective IV | Elective – IV | | | | | | | |
| | MTST912 - 18 Earth Retaining Structures | | | | | | | |
| | MTST913 - 18 Design of underground excavations | 3 | 0 | 0 | 40 | 60 | | 3 |
| | MTST914 - 18 Physical and Constitutive Modeling on Geomechanics | | | | | | | |
| Core Lab III | MTGT113 - 18 Sub soil exploration Lab | 0 | 0 | 4 | 60 | 60 | 100 | 2 |
| | MTGT114 - 18 Soil dynamics Lab | 0 | 0 | 4 | 60 | 60 | 100 | 2 |
| CORE | MTGT231 - 18 Mini Project | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| Audit 2 | Audit Course-2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| | MTGT 115 – 18 Technical Seminar - II | 0 | 0 | 2 | 60 | 40 | 100 | 1 |
| Total | | 14 | 0 | 14 | 400 | 440 | 700 | 19 |

Third Semester

| Course Type | Course Name | Load Allocations | | | Marks Distribution | | | Credits |
|------------------------------|--|------------------|----------|-----------|--------------------|------------|-------------|-----------|
| | | L | T | P | Internal | External | Total Marks | |
| Program Elective-V | Elective - V | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTGT915 - 18 Stability analysis of slopes | | | | | | | |
| | MTGT916 - 18 Foundations on weak rocks | | | | | | | |
| Open Elective | MTGT917 - 18 Geotechnical earthquake engineering | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTGT919 - 18 Business Analytics | | | | | | | |
| | MTGT920 - 18 Industrial Safety | | | | | | | |
| | MTGT921 - 18 Operations Research | | | | | | | |
| | MTGT922 - 18 Cost Management of Engineering Projects | | | | | | | |
| | MTGT923 - 18 Composite Materials | | | | | | | |
| MTGT924 - 18 Waste to Energy | | | | | | | | |
| Dissertation | MTGT232 - 18 Dissertation Phase – I | 0 | 0 | 20 | 60 | 40 | 100 | 10 |
| Total | | 6 | 0 | 20 | 140 | 160 | 300 | 16 |

Forth Semester

| Course Type | Course Name | Load Allocations | | | Marks Distribution | | | Credits |
|--------------|--------------------------------------|------------------|---|----|--------------------|----------|-------------|---------|
| | | L | T | P | Internal | External | Total Marks | |
| Dissertation | MTGT233 - 18 Dissertation Phase – II | 0 | 0 | 32 | - | - | S/US | 16 |

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| List of Audit Course 1 & 2 |
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| 1. English for Research Paper Writing |
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| 2. Disaster Management |
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| 3. Sanskrit for Technical Knowledge |
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| 4. Value Addition |
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| 5. Constitution of India |
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|---------------------|
| 6. Pedagogy Studies |
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| 7. Stress Management by Yoga |
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| 8. Personality Development through Life Enlightenment Skills. |
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M. Tech (Civil Engineering) Specialization: GEOTECHNICAL ENGINEERING

Core-I

MTGT101 – 18 - ADVANCED SOIL MECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students obtain the complete knowledge on strength of soil mass
- The students are able to develop mathematical models for solving different problems in soil mechanics

Syllabus Contents:

Unit I: Compressibility of soils: consolidation theory (one, two, and three dimensional consolidation theories), consolidation in layered soil and consolidation for time dependent loading, determination of coefficient of consolidation (Casagrande method and Taylors method)

Unit II: Strength behavior of soils; Mohr Circle of Stress; UU, CU, CD tests, drained and undrained behavior of sand and clay, significance of pore pressure parameters; determination of shear strength of soil; Interpretation of triaxial test results.

Unit III: Stress path; Drained and undrained stress path; Stress path with respect to different initial state of the soil; Stress path for different practical situations.

Unit IV: Critical state soil mechanics; Critical state parameters; Critical state for normally consolidated and over consolidated soil; Significance of Roscoe and Hvorslev state boundary surface; drained and undrained plane. Critical void ratio; effect of dilation in sands; different Dilation models.

Unit V: Elastic and plastic deformations: elastic wall; introduction to yielding and hardening; yield curve and yield surface, associated and non-associated flow rule.

References:

- Atkinson, J.H. and Bransby, P.L, The Mechanics of Soils: An introduction to Critical soil mechanics, McGraw Hill, 1978.
- Atkinson J.H, An introduction to the Mechanics of soils and Foundation, McGraw- Hill Co., 1993.
- Das, B.M., Advanced Soil Mechanics, Taylor and Francis, 2nd Edition, 1997.
- Wood, D.M., Soil Behavior and Critical State Soil Mechanics, Cambridge University Press, 1990.
- Craig, R.F., Soil Mechanics, Van Nostrand Reinhold Co. Ltd., 1987.
- Terzaghi, K., and Peck, R.B., Soil Mechanics in Engineering Practice, John Wiley & Sons, 1967.
- Lambe, T.W. and Whitman, R.V., Soil Mechanics, John Wiley & Sons, 1979.

Core –II
MTGT102 – 18 -ADVANCED FOUNDATION ENGINEERING

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to decide the type of foundations to be recommended for
- construction of different engineering structures
- The students will be able to design different types of foundations
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Syllabus Contents:

Unit I: Planning of soil exploration for different projects, methods of subsurface exploration, methods of borings along with various penetration tests

Unit II: Shallow foundations, requirements for satisfactory performance of foundations, methods of estimating bearing capacity, settlements of footings and rafts, proportioning of foundations using field test data, IS codes.

Unit III: Pile foundations, methods of estimating load transfer of piles, settlements of pile foundations, pile group capacity and settlement, negative skin friction of piles, laterally loaded piles, pile load tests, analytical estimation of load- settlement behavior of piles, proportioning of pile foundations, lateral and uplift capacity of piles.

Unit IV: Well foundation, IS and IRC Codal provisions, elastic theory and ultimate resistance methods

Unit V: Foundations on problematic soils: Foundations for collapsible and expansive soil

Unit VI: Cofferdams, various types, analysis and design Foundations under uplifting loads

References:

- Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.
- Das B.M., Shallow Foundations: Bearing capacity and settlement, CRC Press, 1999.
- Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
- Poulos, H. G. and Davis, F. H., “Pile Foundation Analysis and Design”, Wiley and Sons. 1980

Core –III
MTGT201 – 18 - DYNAMICS OF SOILS AND FOUNDATIONS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students understand theory of vibration and resonance phenomenon, dynamic amplification.
- Students understand propagation of body waves and surface waves through soil.
- Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
- Students can predict dynamic bearing capacity and assess liquefaction potential of any site. Students apply theory of vibrations to design machine foundation based on dynamic soil properties and bearing capacity.

Syllabus Contents:

Unit I: Fundamentals of vibrations: single, two and multiple degree of freedom systems, vibration isolation, vibration absorbers, vibration measuring instruments

Unit II: Wave propagation: elastic continuum medium, semi-infinite elastic continuum medium, soil behavior under dynamic loading.

Unit III: Liquefaction of soils: liquefaction mechanism, factors affecting liquefaction, studies by dynamic tri-axial testing, oscillatory shear box, shake table and blast tests, assessment of liquefaction potential.

Unit IV: Dynamic elastic constants of soil: determination of dynamic elastic constants, various methods including block resonance tests, cyclic plate load tests, wave propagation tests, oscillatory shear box test.

Unit V: Machine foundations: Design criteria for machine foundations; Elastic homogeneous half space and lumped parameter solutions, analysis and design of foundations for reciprocating and impact type machines, turbines, effect of machine foundation on adjoining structures.

Unit VI: Bearing capacity of foundations: Introduction to bearing capacity of dynamically loaded foundations, such as those of water towers, chimneys and high rise buildings, response of pile foundations.

References:

- Das, B.M., “Fundamentals of Soil Dynamics”, Elsevier,1983.
- Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson,2008.
- Prakash, S., Soil Dynamics, McGraw Hill, 1981.
- Kameswara Rao, N.S.V., Vibration analysis and foundation dynamics, WheelerPublication Ltd., 1998.
- Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice HallInc., 1970.
- Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons, 1998

Core-IV

MTGT202 – 18 - SUBSURFACE INVESTIGATION AND INSTRUMENTATION

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can plan subsurface investigation based on the requirement of civil engineering project and site condition. Can finalize depth and number of boreholes
- Students can execute different subsurface exploration tests, collect disturbed/undisturbed samples for laboratory tests and can suggest design parameters.
- Student exposed to different methods for estimation of dynamic soil properties required for design purpose.
- Students can develop instrumentation scheme for monitoring of critical sites

Syllabus Contents:

1. Soil formation -Processes – Characteristics of major soil deposits of India. Necessity and Importance of soil exploration Method of sub surface exploration Test pits , Trenches, Caissons, Tunnels and drifts, Wash boring , Percussion drilling , Rotary drilling, Factors affecting the selection of a suitable method of boring. Extent of boring, Factors controlling spacing and depth of bore holes, Spacing and depth for various Civil engineering structures.
2. Indirect method of exploration, Seismic method, Electrical resistivity, Resistivity sounding and profiling, Qualitative and quantitative interpretation of test results, Comparison of resistivity and seismic surveys, Shortcomings.
3. Stabilization of bore holes, Different method of stabilization of the bore holes, their relative merits and demerits.
4. Ground water Observation: Different method of ground water observation: Time lag in observation, Sampling of ground water.
5. Sampling: Source of disturbance and their influence, Type of sampler, Principle of design of sampler, Representative and undisturbed sampling in various types of soils, Surface sampling, Amount of sampling, Boring and sampling record, Preservation and shipment of sample preparation of bore log.
6. In situ Permeability. Pumping in test in a cased hole with open end, Falling head packer test constant head packer test, Pump in out tests in a single test wall and open pit or unlined hole. Piezometer methods .
7. Water content at site: Speedy moisture tester, Their relative merits and demerits.
8. Fields Tests: Standard penetration test, Dynamic cone penetration tests with and without bentonite mud slurry. Static cone penetration test, Surface sampling. Cyclic plate load test, Large shear box test, Vane shear test, Pile load, , Block resonance test, wave propagation test. Small size penetrometers, Pressuremeter test and Diltometer test. Various corrections in the test results

and interpretation of test results for design of foundations. Correlation among various test results. Precautions to be exercised during the execution of these tests. Preparation of bore hole log.

9. Investigation below sea/river bed – methods and equipments – interpretation of offshore exploration, Instrumentation in soil engineering - strain gauges - resistance and inductance type - load cells, earth pressure cells - settlement and heave gauges - Piezometers and slope indicators - inclinometer, Field visit, data and report preparation.

References:

- Bowles, J.E., Foundation Analysis and Design, McGraw-Hill International Edition, 1997.
- Schnaid, F., “ In Situ Testing in Geomechanics”, Taylor and Francis.
- Hvorsler M. "Subsurface exploration and sampling of soil for Civil Engg. purposes.
- Simon and Cayton " Site investigation",

PE-I
MTGT901 – 18 - SOIL STRUCTURE INTERACTIONS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can apply different soil response models for specific problem based on the requirement.
- Students can analyze footings/rafts resting on soil as beams/plates on elastic foundation and work out design bending moments/shear and displacements.
- Student can compute pile response for various loading condition for design purpose.

Syllabus Contents:

Unit I: Soil-Foundation Interaction: Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior.

Unit II: Beam on Elastic Foundation- Soil Models: Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

Unit III: Plate on Elastic Medium: Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions.

Unit IV: Elastic Analysis of Pile: Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

Unit V: Laterally Loaded Pile: Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts. An introduction to soil-foundation interaction under dynamic loads.

References:

- Selvadurai, A.P.S, Elastic Analysis of Soil-Foundation Interaction, Elsevier, 1979.
- Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.
- Scott, R.F., Foundation Analysis, Prentice Hall, 1981.
- Structure Soil Interaction - State of Art Report, Institution of Structural Engineers, 1978.
- ACI 336. (1988), Suggested Analysis and Design Procedures for combined footings and Mats, American Concrete Institute.

PE-I
MTGT902 – 18 - GROUND IMPROVEMENT TECHNIQUES

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- At the completion of the course the students will be able to understand the different types of ground modification can be done depending upon the site condition.
- Reinforcement Methods for type and purpose of structure to be constructed.
- Understand and Illustrate concept of Chemical grouting techniques alongwith freezing techniques for stable foundations.

Syllabus Contents:

Unit I: Introduction: situations where ground improvement becomes necessary

Unit II: Mechanical modification: dynamic compaction, impact loading, compaction by blasting, vibro-compaction; pre-compression, stone columns; Hydraulic modification: dewatering systems, preloading and vertical drains, electro-kinetic dewatering

Unit III: Chemical modification; modification by admixtures, stabilization using industrial wastes, grouting

Unit IV: Thermal modification: ground freezing and thawing.

Unit V: Soil reinforcement: Reinforced earth, basic mechanism, type of reinforcements, selection

of stabilization/improvement of ground using Geotextiles, Geogrid, Geomembranes, geocells, geonets, and soil nails.

Unit VI: Application of soil reinforcement: shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, analysis and design of shallow foundations on reinforced earth, road designs with geosynthetics.

References:

- Hausmann, M.R., Engineering Principles of Ground Modification, McGraw-Hill International Editions, 1990.
- Yonekura, R., Terashi, M. and Shibasaki, M. (Eds.), Grouting and Deep Mixing, A.A.Balkema, 1966.
- Moseley, M.P., Ground Improvement, Blackie Academic & Professional, 1993.
- Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
- Koerner, R. M., Designing with Geosynthetics, Prentice Hall Inc. 1998.
- Shukla, S.K., Yin, Jian-Hua, "Fundamentals of Geosynthetic Engineering", Taylor & Francis.

PE-I
MTGT903 – 18 - PAVEMENT ANALYSIS AND DESIGN

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to design flexible as well rigid pavements.
- Students can select materials and methods for drainage and various criteria for pavements types.
- Students will understand effect of design parameters, type of loading on pavements.

Syllabus Contents:

Unit I: Philosophy of design of flexible and rigid pavements,

Unit II: analysis of pavements using different analytical methods,

Unit III: selection of pavement design input parameters – traffic loading and volume,

Unit IV: material characterization, drainage, failure criteria, reliability,

Unit V: design of flexible and rigid pavements using different methods,

Unit VI: comparison of different pavement design approaches, design of overlays and drainage system.

References:

- Yang and H. Huang, Pavement Analysis and Design, Pearson Prentice Hall, 2004.
- Yoder and Witzech, Pavement Design, McGraw-Hill, 1982.
- Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980.
- Teng, Functional Designing of Pavements, McGraw- Hill, 1980.

PE-2
MTGT904 – 18 - FEM IN GEOMECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand basic stress-strain relationship for soil and develop Stress deformation analysis.
- Students can develop finite element formulation for different geotechnical problems including shallow foundation, seepage and consolidation problems.

Syllabus Contents:

Unit I: Stress-deformation analysis: One dimensional, Two dimensional and Three-dimensional formulations.

Unit II: Discretization of a Continuum, Elements, Strains, Stresses, Constitutive, Relations, Hooke's Law, Formulation of Stiffness Matrix, Boundary Conditions, Solution Algorithms.

Unit III: Principles of discretization, element stiffness and mass formulation based on direct, variational and weighted residual techniques and displacements approach, Shape functions and numerical integrations, convergence.

Unit IV: Displacement formulation for rectangular, triangular and iso parametric elements for two dimensional and ax symmetric stress analysis.

Unit V: Settlement Analysis, 2-D elastic solutions for homogeneous, isotropic medium, Steady Seepage Analysis: Finite element solutions of Laplace's equation, Consolidation Analysis: Terzaghi consolidation problem, Choice of Soil Properties for Finite Element Analysis.

References:

- O.C. Zienkiewicz and R.L. Taylor, Finite element methods Vol I & Vol II, McGrawHill,1989,1992.
- K.J. Bathe, Finite element procedures, PHI Ltd., 1996.
- David M Potts and LidijaZdravkovic, "Finite Element Analysis in Geotechnical Engineering Theory and Application", Thomas Telford. 1999

PE-2
MTGT905 – 18 - ENVIRONMENTAL GEOTECHNOLOGY

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand Soil-environment interaction, Soil mineralogy and Mechanisms of soil-water interaction
- Students can learn ground water flow and predict contaminant transport phenomenon.
- Can apply remediation techniques for contaminated site.

Syllabus Contents:

Unit I: Soil as a multiphase system; Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Unit II: Soil mineralogy; significance of mineralogy in determining soil behavior; Mineralogical characterization.

Unit III: Mechanisms of soil-water interaction: Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Unit IV: Concepts of waste containment; Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, ground water flow and contaminant transport, desirable properties of soil; contaminant transport and retention; contaminated site remediation.

Unit V: Soil characterization techniques; volumetric water content; gas permeation in soil; electrical and thermal properties; pore-size distribution; contaminant analysis. Contaminated site characterization, estimation of landfill quantities, landfill site location, design of various landfill components such as liners, covers, leachate collection and removal, gas generation and management, ground water monitoring, end uses of landfill sites, slurry walls and barrier systems, design and construction, stability, compatibility and performance, remediation technologies, stabilization of contaminated soils and risk assessment approaches.

References:

- Mitchell, J.K and Soga, K., Fundamentals of Soil Behavior, John Wiley and Sons Inc., 2005.
- Fang, H-Y., Introduction to Environmental Geotechnology, CRC Press,1997.
- Daniel, D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall, 1993.
- Rowe, R.K., Quigley, R.M. and Booker, J.R., Clay Barrier Systems for Waste Disposal Facilities, E & FN Spon, 1995.
- Rowe, R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
- Reddi, L.N. and Inyang, H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc, 2000.
- Sharma, H.D. and Lewis, S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc., 1994.

PE-2
MTGT906 – 18 CRITICAL SOIL MECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- At the completion of the course the students will be able to decide the type of mathematical models to be used for analyzing the behavior of soil mass at critical state

Syllabus Contents:

Unit I: Soil Behavior: State of stress and strain in soils, Stress and strain paths and invariants, behavior of soils under different laboratory experiments

Unit II: The Critical state line and the Roscoe surface: Families of undrained tests, Families of drained tests, the critical state line, drained and undrained surfaces, The Roscoe surface

Unit III: Behavior of Over consolidated samples: The Hvorslev surface: Behaviour of over consolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes

Unit IV: Behaviour of Sands: The critical state line for sands, Normalized plots, the effect of dilation, Consequences of Taylor's model

Unit V: Behaviour of Soils before Failure: Elastic and plastic deformations, Plasticity theory, Development of elastic-plastic model based on critical state soil mechanics, The Cam-clay model, The modified Cam-clay model.

References:

- J. H. Atkinson and P. L. Bransby, "The mechanics of soils: An introduction to critical statesoil mechanics", McGraw Hill, 1978
- D. M. Wood, "Soil behaviour and critical state soil mechanics", Cambridge UniversityPress, 1990
- B. M. Das, "Fundamental of geotechnical engineering", Cengage Learning, 2013

Research Methodology and IPR

Teaching Scheme

Lectures: 1hrs/week

Course Outcomes:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, Interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.
- Asimov , "Introduction to Design", Prentice Hall, 1962.

- Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
- T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

PE-III

MTGT907 – 18 - OFFSHORE GEOTECHNICAL ENGINEERING MARINE GEOTECHNIQUES

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

Students can execute investigation program for marine soil deposits and select necessary design Parameters. Design suitable marine foundation as per project requirement. Can develop numerical model for response of marine foundation for offshore conditions.

Syllabus Contents:

Unit I: Marine soil deposits: Offshore environment, Offshore structures and foundations, Specific problems related to marine soil deposits, Physical and engineering properties of marine soils

Unit II: Behavior of soils subjected to repeated loading: Effect of wave loading on offshore foundations, Behavior of sands and clays under cyclic loading, Laboratory experiments including repeated loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods which can be used for practical cases

Unit III: Site Investigation in the case of marine soil deposits: Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits

Unit IV: Foundations in marine soil deposits: Different offshore and near shore foundations, Gravity platforms, Jack-up rigs, pile foundations. Caissons, spud cans

Unit V: Numerical modeling of marine foundations subjected to wave loading: Numerical modeling of cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

References:

- H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
- D. V. Reddy and M. Arockiasamy, “Offshore Structures”, *Volume: 1*, R.E. Kreiger Puband Co., 1991
- D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, USNavy, 2012

PE-III
MTGT910 – 18 - COMPUTATIONAL GEOMECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand different numerical and statistical tools for analyzing various
- geotechnical engineering problems.
- Students can apply probabilistic approach for selection of design parameters and compute their impact on risk assessment.

Syllabus Contents:

Unit I: Solution of Non-linear Equations: Bisection, False Position, Newton-Raphson, Successive approximation method, Iterative methods

Unit II: Solution of Linear Equations: Jacobi's method, Gauss Seidal method, Successive over relaxation method.

Unit III: Finite Difference Method: Two point Boundary value problems – Dirichlet conditions, Neumann conditions; ordinary and partial differential equations.

Unit IV: Finite Element Method: Fundamentals, Constitutive finite element models for soils.

Unit V: Correlation and Regression Analysis: Correlation - Scatter diagram, Karl Pearson coefficient of correlation, Limits of correlation coefficient; Regression – Lines of regression, Regression curves, Regression coefficient, Differences between correlation and regression analysis.

Unit VI: One-dimensional Consolidation - Theory of consolidation, Analytical procedures, Finite difference solution procedure for multilayered systems, Finite element formulation

Unit VII: Flow Through Porous Media - Geotechnical aspects, Numerical methods, Applications and Design analysis, Flow in jointed media.

Unit VIII: Risk assessment in Geotechnical Engg. - Probabilistic site characterisation and design of foundations

References:

- S. Chandrakant., Desai and John T. Christian, “Numerical Methods in Geotechnical Engineering”, Mc. Graw Hill Book Company, 1977.
- M.K. Jain, S.R.K. Iyengar and R.K. Jain, “Numerical Methods for Scientific and Engineering computations”, Third edition, New Age International (P) Ltd. Publishers, New Delhi.
- D.J. Naylor and G.N. Pande, “Finite Elements in Geotechnical Engineering”, Pineridge Press Ltd., UK.
- Sam Helwany, “Applied soil mechanics”, John Wiley & sons, Inc,

PE-III
MTGT911 – 18 - ENGINEERING ROCK MECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to perform various laboratory tests on rock and classify rock mass.
- Be able to predict strength of rock mass with respect to various Civil Engineering applications

Syllabus Contents:

Unit I: Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Elastic constants of rock; In-situ stresses in rock

Unit II: Rock Testing: Laboratory and Field tests

Unit III: Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock.

Unit IV: Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior.

Unit V: Strength/ Failure Criterion: Mohr-Coulomb, Griffith theory, Hoek and Brown, strength and other strength criteria. Stresses in rock near underground openings;

Unit VI: Application of rock mechanics in Civil Engineering: Rock tunneling, rock slope stability, bolting, blasting, grouting and rock foundation design. Modern modeling techniques & analyses in rocks.

References:

- Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
- Goodman, R.E. Introduction to Rock Mechanics, John Wiley & Sons.
- Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
- Jaeger, J.C. and Cook, N.G.W, Fundamentals of Rock Mechanics, Chapman and Hall, 1976.
- Wyllie, D.C., Foundations on Rock, E & FN Spon. 2nd Edition, 1992.

PE- IV
MTST912 – 187 EARTH RETAINING STRUCTURES

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to do analysis and design of different types of retaining Structures.

Syllabus Contents:

Unit I: Earth Pressure: Rankine and Coulomb theories, active, passive and pressure at rest; concentrated surcharge above the back fill, earth pressure due to uniform surcharge, earth pressure of stratified backfills, saturated and partially saturated backfill.

Unit II: Retaining walls: Proportioning of retaining walls, stability of retaining walls, mechanically stabilized retaining walls/reinforced earth retaining walls

Unit III: Sheet Pile wall: free earth system, fixed earth system

Unit IV: Bulkheads: bulkheads with free and fixed earth supports, equivalent beam method, Anchorage of bulkheads and resistance of anchor walls, spacing between bulkheads and anchor walls, resistance of anchor plates

Unit V: Tunnel and Conduit: Stress distribution around tunnels, Types of conduits, Load on projecting conduits; Arching and Open Cuts: Arching in soils,

Unit VI: Braced excavations: Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays.

References:

- Das, Braja M., “Principles of Foundation Engineering”, PWS Publishing. 1998
- Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

PE-V
MTGT 913 – 18 - DESIGN OF UNDERGROUND EXCAVATIONS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand the use of elastic and plastic analysis in the design of underground support system.
- Students will have idea about the field tests generally conducted during and after construction of under structures.

Syllabus Contents:

Unit I: Introduction, planning of and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

Unit II: Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory

Unit III: Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM), construction dewatering.

Unit IV: Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi's elasto-plastic analysis of tunnels, design of various support systems including concrete and shotcrete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

Unit V: In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies.

• **References:**

- Hoek, E and Brown, E. T., "Underground Excavations in Rocks", Institute of Mining Engineering.
- Obert, L. and Duvall, W.I., "Rock Mechanics and Design of Structures in Rocks", John Wiley.
- Singh, B. and Goel, R.K., "Rock Mass Classification- A Practical Engineering Approach", Elsevier.

- Singh, B. and Goel, R.K., “Tunnelling in Weak Rocks”, Elsevier

PE-IV

MTGT914 – 18 - PHYSICAL AND CONSTITUTIVE MODELLING ON GEOMECHANICS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students can understand theory of plasticity and various yield criteria and flow rule.
- Students can apply critical state concept of consolidation and triaxial soil behavior.

Syllabus Contents:

Unit I: Role of constitutive modeling; Importance of laboratory testing with relation to constitutive modeling; Elasticity: linear, quasi linear, anisotropic;

Unit II: Plasticity basics: yield criteria, flow rule, plastic potential, hardening/softening; Rate Independent Plasticity: Mohr-coulomb, nonlinear failure criteria, Drucker Prager, and cap models;

Unit III: Critical state soil mechanics: critical state concept, cam clay models, simulation of single element test using cam clay,

Unit IV: Consolidation, drained and undrained triaxial test; Stress dilatancy theory;

Unit V: Work hardening plasticity theory: formulation and implementation; Applications of elasto-plastic models; Special Topics: hypo elasticity-plasticity, disturbed state concept.

References:

- Hicher and Shao, “Constitutive Modeling of Soils and Rocks”, John Wiley. 2008
- C.S. Desai and H. J. Siriwardane, “Constitutive Laws for Engineering Materials with Emphasis on Geologic Materials”, Prentice-Hall, Inc., New Jersey. 1984
- David M Potts and Lidija Zdravkovic, “Finite Element Analysis in Geotechnical Engineering Theory and Application”, Thomas Telford. 1999
- C.S. Desai, “Mechanics of Materials and Interfaces: The Disturbed State Concept”, CRC Press LLC. 2000
- A.P.S. Selvadurai, M.J. Boulon, “Mechanics of Geomaterial Interfaces, Elsevier.

PE – V
MTGT915 – 18 - STABILITY ANALYSIS OF SLOPES

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Student will be able to check the stability of earthen dams, and the safety measures to be undertaken to prevent the instability of slopes, earthen dams and embankments

Syllabus Contents:

Unit I: Slopes: Types and causes of slope failures, mechanics of slope failure, failure modes.

Unit II: Stability analysis: infinite and finite slopes with or without water pressures; concept of factor of safety, pore pressure coefficients, Mass analysis, Wedge methods, friction circle method ;Method of slices, Bishop's method, Janbu's method, Morgenstern and Price, Spencer's method.

Unit III: Stability analysis in the presence of seepage: Two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams under steady seepage and draw-down conditions, seepage control in earth dams, influence of seepage on slope stability stability analysis of dam body during steady seepage.

Unit IV: Strengthening measures: stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring, instrumentation and monitoring of slopes, slope movements, warning devices, maintenance of slopes.

References:

- Chowdhary R and ChowdharyI , "Geotechnical Slope Analysis", CRC Press.
- Harr M.E., " Ground Water and Seepage", McGraw Hill. 1962

PE – V

MTGT916 – 18 - FOUNDATIONS ON WEAK ROCKS

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- The students will be able to classify different types of rock mass and design different types of foundations placed over rock mass.

Syllabus Contents:

Unit I: Engineering properties of weak rocks, different rock mass classification systems, relative merits and demerits

Unit II: Failure criteria for weak rocks, bi-linear Mohr-Coulomb failure criterion, Hoek and Brown criterion and modified Hoek and Brown failure criterion etc.

Unit III: Effect of structural planes on rock foundations, possible modes of failure of foundations on rocks/ rock masses, determination of in-situ shear strength of rocks and rock masses

Unit IV: Requirements for satisfactory performance of foundations, bearing capacity of foundations on rocks and rock masses, allowable bearing pressure of rock foundations using a nonlinear failure criterion, monotonic and cyclic plate load tests

Unit V: Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity and inelasticity

Unit VI: Shallow foundations, shallow foundations on sloping ground, raft foundations, stilt foundations, foundations for suspension bridges, transmission line towers, framed buildings etc, treatment of foundations - open joints, solution cavities, weak seams

Unit VII: Piles in weak rocks, bearing capacity and settlement of piles, piles in stratified rock masses, field load tests on piles in weak rocks, behaviour of bored / driven piles in soft /weathered rocks

References:

- Wyllie Duncan C.,” Foundations on Rock: Engineering Practice”, E&FN Spon, Taylor and Francis.
- Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction to the Principles, 1997. Elsevier, Oxford
- Singh, B. and Goel, R.K.,”Rock Mass Classification- A Practical Engineering Approach”, Elsevier .
- Ramamurthy, T., “Engineering in Rocks”, PHI Learning Pvt. Ltd.
- Hoek, E., “Practical Rock Engineering”, Rock science.

PE – V
MTGT 917 – 18 - GEOTECHNICAL EARTHQUAKE ENGINEERING

Teaching Scheme

Lectures: 3 hrs/ week

COURSE OUTCOME

- Students will know the causes and quantification of earthquake.
- Student will be exposed to the effect of earthquake and the design criterions to be followed for the design different geotechnical structures

Syllabus Contents:

Unit I: Earthquake seismology – Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models.

Unit II: Earthquake ground motion – Seismograph, Characteristics of ground motion, Effect of Local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.

Unit III: Ground response analysis – One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches, Computer code “SHAKE”.

Unit IV: Liquefaction and lateral spreading - Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

Unit V: Seismic design of foundations, Seismic slope stability analysis: Internal stability and weakening instability and Seismic design of retaining walls.

References:

- Steven Kramer, “Geotechnical Earthquake Engineering”, Pearson, 2008.
- Seco e Pinto, P., Seismic behaviour of ground and Geotechnical structure, A. A.
- Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001.
- Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities Service Centre, Port Hueneme, 1997.

Lab-I
MTGT111 – 18 - Soil Mechanics Lab -I

Lab: 4 hrs/week

List of Practicals:

1. Determination of Moisture Content and Specific gravity of soil
2. Grain Size Distribution Analysis and Hydrometer Analysis
3. Atterberg's Limits (Liquid Limit, Plastic limit, Shrinkage limit)
4. Visual Classification Tests
5. Vibration test for relative density of sand
6. Standard and modified proctor compaction test
7. Falling head permeability test and Constant head permeability test
8. Consolidation test

Lab-II
MTGT112 – 18 - Soil Mechanics Lab -II

Lab: 4 hrs/week

List of Practicals:

1. Unconfined compression test
2. Direct shear test
3. Tri-axial compression test – UU, CU, CD tests
4. Laboratory vane shear test
5. Field Vane shear test
6. Field direct shear test

Lab-III
MTGT113 – 18 - Sub soil exploration Lab

Lab: 4 hrs/week

List of Practicals:

1. Exploratory borings by different methods including auger boring, wash boring, percussion drilling and rotary drilling.
4. Standard penetration test
5. Dynamic cone penetration test
6. Static cone penetration test
7. Plate load test
8. Pressure meter test
9. Geophysical exploration tests

Lab-IV
MTGT114 - 18 - Soil dynamics Lab

Lab: 4 hrs/week

List of Practical:

1. Spectral analysis of surface waves (SASW) Test / Multi-channel analysis of surface waves (MASW) test
2. Seismic cross-hole test
3. Seismic down-hole / up-hole test
4. Seismic dilatometer test
5. Resonant column test
6. Piezoelectric bender element test
7. Cyclic triaxial test
8. Cyclic direct shear test

Core –

MTGT232 – 18 - Dissertation I (Credits- 0:0:20 = 10)

Teaching Scheme

Lectures: 4 hrs/week Mid Sem Evaluation weight age - 30%

End Sem Evaluation weight age - 70%

Course Outcomes: At the end of the course, the student will be able to:

- Identify structural engineering problems reviewing available literature.
- Identify appropriate techniques to analyze complex structural systems.
- Apply engineering and management principles through efficient handling of project
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Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester
- Presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individual's contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

Core –
MTGT233 – 18 - Dissertation II (Credits- 0:0:32 = 16)

Teaching Scheme

Contact Hours: 3hrs/week

Course Outcomes: At the end of the course, the student will be able to:

1. Solve complex structural problems by applying appropriate techniques and tools.
2. Exhibit good communication skill to the engineering community and society.
3. Demonstrate professional ethics and work culture.

Syllabus Contents:

Dissertation – II will be extension of the to work on the topic identified in Dissertation – I. Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre - submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.

OPEN ELECTIVES
MTGT919 – 18 - Business Analytics

Teaching scheme

Lecture: - 3 h/week

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit1:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit 2:

Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit 4:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5:

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6:

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

COURSE OUTCOMES

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling
- To support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
- Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education.

OPEN ELECTIVES
MTGT920 – 18 - Industrial Safety

Teaching scheme

Lecture: - 3 h/week

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, (i) Screw down grease cup, (ii) Pressure grease gun, (iii). Splash lubrication, (iv). Gravity lubrication, (v). Wick feed lubrication (vi). Side feed lubrication, (vii). Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, (i). Any one machine tool, (ii). Pump (iii). Air compressor, (iv). Internal combustion engine, (v) Boiler, (vi). Electrical motors. Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES
MTGT921 – 18 - Operations Research

Teaching Scheme

Lectures: 3 hrs/week

Course Outcomes: At the end of the course, the student should be able to

1. Students should be able to apply the dynamic programming to solve problems of discrete and continuous variables.
2. Students should be able to apply the concept of non-linear programming
3. Students should be able to carry out sensitivity analysis
4. Student should be able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Open Elective
MTGT922 – 18 - Cost Management of Engineering Projects

Teaching scheme

Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; list Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective
MTGT923 – 18 - Composite Materials

Teaching scheme

Lecture: - 3 h/week

Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite Performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and preparation regarding – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection molding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygro thermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol. 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective
MTGT924 – 18 - Waste to Energy

Teaching scheme

Lecture: - 3 h/week

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digesters

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology

and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion -biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion -Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

- 1.** Understand that how to improve your writing skills and level of readability
- 2.** Learn about what to write in each section
- 3.** Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness (4 Hours)

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction (4 Hours)

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, (4 Hours)

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, and skills are needed when writing the Conclusions (4 Hours)

Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission (4 Hours)

Suggested Studies:

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

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Introduction

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

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

Disaster Prone Areas in India

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" "NewRoyal book Company.
2. Sahni, Pardeep Et. Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , "Disaster Administration And Management Text And Case Studies" , Deep & Deep

Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Content

Unit 1

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

Unit 2

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

Unit 3

- Technical concepts of Engineering-Electrical, Mechanical,
- Architecture, Mathematics

Suggested reading

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit 1(4 Hours)

- Values and self-development –Social values and individual attitudes.
- Work ethics, Indian vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgments

Unit 2(6 Hours)

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration.
- Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism.Love for nature ,Discipline

Unit 3(6 Hours)

- Personality and Behavior Development - Soul and Scientific attitude.
- Positive Thinking. Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature

Unit 4 (6 Hours)

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.
- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested *reading*

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Unit 1 (4 Hours)

- **History of Making of the Indian Constitution:**
History, Drafting Committee, (Composition & Working)

Unit 2 (4 Hours)

- **Philosophy of the Indian Constitution:**
Preamble
Salient Features

Unit 3 (4 Hours)

- **Contours of Constitutional Rights & Duties:**
 - Fundamental Rights
 - Right to Equality
 - Right to Freedom
 - Right against Exploitation
 - Right to Freedom of Religion
 - Cultural and Educational Rights
 - Right to Constitutional Remedies
 - Directive Principles of State Policy
 - Fundamental Duties.

Unit 4 (4 Hours)

- **Organs of Governance:**
 - Parliament
 - Composition
 - Qualifications and Disqualifications
 - Powers and Functions
 - Executive
 - President
 - Governor
 - Council of Ministers
 - Judiciary, Appointment and Transfer of Judges, Qualifications
 - Powers and Functions

Unit 5 (4 Hours)

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

Unit 6 (4 Hours)

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

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

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken , other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Unit 1 (4 Hours)

- **Introduction and Methodology:**
- Aims and rationale, Policy background, Conceptual framework and terminology
- Theories of learning, Curriculum, Teacher education.
- Conceptual framework, Research questions.
- Overview of methodology and Searching.

Unit 2 (4 Hours)

- Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
- Curriculum, Teacher education.

Unit 3 (4 Hours)

- Evidence on the effectiveness of pedagogical practices
- Methodology for the in depth stage: quality assessment of included studies.
- How can teacher education (curriculum and practicum) and the school Curriculum and guidance materials best support effective pedagogy?
- Theory of change.
- Strength and nature of the body of evidence for effective pedagogical practices.
- Pedagogic theory and pedagogical approaches.
- Teachers' attitudes and beliefs and Pedagogic strategies.

Unit 4 (4 Hours)

- Professional development: alignment with classroom practices and followup support
- Peer support
- Support from the head teacher and the community.
- Curriculum and assessment
- Barriers to learning: limited resources and large class sizes

Unit 5 (4 Hours)

- **Research gaps and future directions**

- Research design
- Contexts
- Pedagogy
- Teacher education
- Curriculum and assessment
- Dissemination and research impact.

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in Developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit 1 (8 Hours)

- Definitions of Eight parts of yog. (Ashtanga)

Unit 2 (8 Hours)

- Yam and Niyam.
- Do`s and Don`t`s in life.
- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Unit 3 (8 Hours)

- Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

Suggested reading

1. ‘Yogic Asanas for Group Training-Part-I’ :Janardan Swami Yogabhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency.

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENTSKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit 1 (8 Hours)

- Neetisatakam-Holistic development of personality
- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (don't's)
- Verses- 71,73,75,78 (do's)

Unit 2 (8 Hours)

- Approach to day to day work and duties.
- Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,
- 23, 35,
- Chapter 18-Verses 45, 46, 48.

Unit 3 (8 Hours)

- Statements of basic knowledge.
- Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad BhagwadGeeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

Suggested reading

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.