**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

(‘A+’ Grade, NAAC Accredited)

**SCHEME OF EXAMINATIONS FOR**

**Master of Technology (Civil Engineering) Specialization: Geo-technical Engineering**

**(w.e.f. SESSION: 2018-19)**

**SEMESTER-Ⅰ**

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| **S. No.** | **Course Code** | **SUBJECT** | L | T | P | **Total** | **Minor****Test** | **Major Test** | **Cr.** | **Duration of Exam (Hrs.)** |
| 1 | MCG-101 A | Advanced Soil Mechanics | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | MCG-103 A | Advanced Foundation Engineering | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | \* | Program Elective –I | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | \*\* | Program Elective-II | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | MCG-117 A |  lab I – Soil mechanics-1 | - | - | 2 | 2 | 40 | 60 | 2 | 3 |
| 6 | MCG-119 A |  lab II-Soilmechanics-2 | - | - | 2 | 2 | 40 | 60 | 2 | 3 |
| 7 | MTRM-111 A | Research Methodology and IPR | 2 | - | - | 2 | 40 | 60 | 2 | 3 |
| 8 | \*\*\* | Audit Course-I | 2 | - | - | 0 | 100 | - | 0 | 0 |
|  | **TOTAL** | **16** | **0** | **4** | **18** | **280** | **420** | **18** |  |
|  |  | **700** |

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| **\*Program Elective - I** | **\*\*Program Elective- II** |
| MCG-105 AMCG-107 AMCG-109 A | Soil Structure InteractionGround Improvement TechniquesPavement Analysis and Design | MCG-111 AMCG-113 AMCG-115 A | FEM in GeomechanicsEnvironmental GeotechnologyCritical Soil Mechanics |

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| **\*\*\*Audit Course-I** |
| MTAD-101 A | English for Research Paper Writing |
| MTAD-103 A | Disaster Management |
| MTAD-105 A | Sanskrit for Technical Knowledge |
| MTAD-107 A | Value Education |

**Note:** 1.The course of program elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

**Note:**2.\*\*\* Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

**SEMESTER-II**

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| **S. No.** | **Course code** | **Subject** | **L** | **T** | **P** | **Total** | **Minor****Test** | **Major Test** | **Cr.** | **Duration of Exam (Hrs.)** |
| 1 | MCG- 102 A | Dynamics of soils and foundations | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | MCG-104A | Subsurface investigations andinstrumentation | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | \* | Program Elective-III | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | \*\* | Program Elective-IV | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | MCG-118 A |  Lab III –Sub soil exploration |  | - | 2 | 2 | 40 | 60 | 2 | 3 |
| 6 | MCG- 120 A |  Lab IV- Soil dynamics | - | - | 2 | 2 | 40 | 60 | 2 | 3 |
| 7 | MCG- 122 A |  Mini Project | - | - | 4 | 2 | 40 | 60 | 2 | 3 |
| 8 | \*\*\* | Audit Course-II | 2 |  |  | 0 | 100 |  | 0 | 3 |
|  | **TOTAL** | **14** |  | **8** | **18** | **280** | **420** | **18** |  |
|  | **700** |

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| **\*Program Elective - III** | **\*\*Program Elective –IV** |
| MCG-106 AMCG-108 AMCG-110 A | Offshore Geotechnical Engineering/marine GeotechniquesComputational GeomechanicsEngineering rock mechanics | MCG-112AMCG-114AMCG-116A | Earth Retaining StructuresDesign of underground excavationsPhysical and ConstitutiveModelling on Geomechanics |

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| **\*\*\*Audit Course - II** |
| MTAD-102 A | Constitution of India |
| MTAD-104 A | Pedagogy Studies |
| MTAD-106 A | Stress Management by Yoga |
| MTAD-108 A | Personality Development through Life Enlightenment Skills. |

**Note:** 1.The course of program elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

***Note:*** \*\*\*Along with the credit course, a student may normally be permitted to take audit course, however for auditing a course; prior consent of the course coordinator of the course is required. These courses shall not be mentioned for any award/calculation of SGPA/CGPA in the DMC. A certificate of successful completion of the audit course will be issued by the Director/Head of institution.

**SEMESTER-Ⅲ**

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| **S. No.** | **Course Code** | **Subject** | **L** | **T** | **P** | **Total** | **Minor****Test** | **Major Test** | **Cr.** | **Duration of Exam (Hrs.)** |
| 1 | \* | Program Elective-V | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | \*\* | Open Elective | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | MCG-207 A | Dissertation Phase-I | - | - | 20 | 20 | 100 | - | 10 | 3 |
|  |  | **TOTAL** | **6** |  | **20** | **26** | **180** | **120** | **16** |  |
|  |  | **300** |  |  |

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| **\*Program Elective –V** |
| MCG-201 A | Stability analysis of slopes |
| MCG-203 A | Foundation and Weak Rocks |
| MCG-205 A | Geotechnical earthquake engineering |

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| **\*\*Open Elective** |
| 1. | MTOE-201A | Business Analytics |
| 2. | MTOE-203A | Industrial Safety |
| 3. | MTOE-205A | Operations Research |
| 4. | MTOE-207A | Cost Management of Engineering Projects |
| 5. | MTOE-209A | Composite Materials |
| 6. | MTOE-211A | Waste to Energy |

**SEMESTER-IV**

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| **S. No.** | **Course Code** |  | **L** | **T** | **P** | **Total** | **Minor****Test** | **Major Test** | **Cr.** | **Duration of Exam (Hrs.)** |
| 1 | MCG-202 A | Dissertation Phase-II | - | - | 32 | 32 | 100 | 200 | 16 | 3 |
|  | **TOTAL** | **300** | **16** |  |

 **Total Credits – 68**

**Note:** 1.The course of program elective/ open elective will be offered at 4 numbers of students (whichever is smaller) strength of the class.

**MCG-101A 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 fornormally 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.

**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 No strand 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.

**MCG-103A 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

**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.

**Well foundation**, IS and IRC codal provisions, elastic theory and ultimate resistance methods

**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

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**Unit IV**

 **Foundations on problematic soils:** Foundations for collapsible and expansive soil

 **Coffer dams**, 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.andDavis,F.H.,“PileFoundationAnalysisandDesign”,WileyandSons.

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**Program Elective –I**

**MCG-105A Soil Structure Interaction**

Teaching Scheme

Lectures: 3 hrs/week

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

1. Understand soil structure interaction concept and complexities involved.
2. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
3. Prepare comprehensive design oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.
4. Analyze different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.
5. Evaluate action of group of piles considering stress-strain characteristics of real soils.

**Unit I**

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method.

**Unit II**

Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different Types of Structure under various Conditions of Loading and Subsoil Characteristics.

**Unit III**

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc.

**Unit IV**

Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Characteristics.

Determination of Pile Capacities and Negative Skin Friction, Action ofGroup of PilesConsidering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

**Reference Books:**

* Analytical and Computer Methods in Foundation, Bowels J.E.,McGraw Hill Book Co., New York, 1974.
* Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGraw Hill Book Co., New York.
* Soil Structure Interaction - The real behaviour of structures, Institution of Structural Engineers.
* Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol-17, Elsevier Scientific Publishing Company.
* Elastic Analysis of Soil-Foundation Interaction, Selvadurai A.P.S., Elsevier Scientific Publishing Company.
* Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd.
* Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing

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| **MCG-107 A** |  **Ground improvement technique** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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

**Thermal modification:** ground freezing and thawing.

**Unit VI**

**Soil reinforcement:** Reinforced earth, basic mechanism, type of reinforcements, selection of stabilization/improvement of ground using Geotextiles, Goegrid, geomembranes, geocells, geonets, and soil nails.

**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 Shibazaki, 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.

**Program Elective -I**

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| **MCG-109 A** | **PAVEMENT ANALYSIS AND DESIGN** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**Syllabus Contents:**

**Unit I**

Philosophy of design of flexible and rigid pavements, **Analysis** of pavements using different analytical methods,

**Unit II**

Selection of pavement design input parameters – traffic loading and volume

**Unit III**

Material characterization, drainage, failure criteria, reliability

**Unit IV**

Design of flexible and rigid pavements using different methods,

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.

**Program Elective -II**

**MCG- 111A FEM IN GEOTECHNICAL ENGINEERING TEACHING**

Teaching Scheme

Lectures: 3 hrs/week

**COURSE OUTCOME**

Students can understand basic stress-strain relationship for soil and develop Stress deformation analysis.

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| **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. 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 III**Displacement formulation for rectangular, triangular and isoparametric elements for two dimensional and axisymmetric stress analysis. **Unit IV**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, McGraw Hill,1989,1992.
* K.J. Bathe, Finite element procedures, PHI Ltd., 1996.
* David M Potts and LidijaZdravkovic, “Finite Element Analysis in Geotechnical Engineering Theory and Apllication”, Thomas Telford. 1999
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| **MCG-113 A** | **ENVIRONMENTAL GEOTECHNOLOGY** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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.

**Soil mineralogy**; significance of mineralogy in determining soil behavior; Mineralogical characterization.

**Unit II**

 **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 III**

 **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 IV**

**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.KandSoga, K.,FundamentalsofSoilBehavior, JohnWileyandSonsInc.,2005.
* Fang, H-Y., Introduction to Environmental Geotechnology, CRCPress,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:

**Program Elective -II**

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| **MCG-115 A** | **CRITICAL SOIL MECHANICS** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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

**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 II**

 **Behavior of Overconsolidated samples**:

 The Hvorslev surface: Behaviour of overconsolidated samples, drained and undrained tests, The Hvorslev surface, complete State Boundary Surface, Volume changes and pore water pressure changes

**Unit III**

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

**Unit IV**

 **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 state soil mechanics”, McGraw Hill, 1978
* D. M. Wood, “Soil behaviour and critical state soil mechanics”, Cambridge University Press, 1990
* B. M. Das, *“*Fundamental of geotechnical engineering”, Cengage Learning, 2013

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| **MCG-117 A** |  **Lab-I SOIL Mechanics-1** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **2** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** |  |

**Syllabus Content:**

**List of Experiments:**

1. Determination of Moisture Content and Specific gravity of soil
2. Grain Size Distribution Analysis and Hydrometer Analysis
3. Atterberg 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

Consolidation test

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| **MCG-119A** | **Lab- II Soil Mechanics-II** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **2** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**List of Experiments:**

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

**MTRM-111 A Research Methodology and IPR**

**Teaching Scheme**

Lectures: 2 hrs/ week

**Course Outcomes**

* 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 emphasis 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 I**

 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 II**

Effective literature studies approaches, analysis Plagiarism, Research ethics,

 Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committeePatent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**Unit III**

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 IV**

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

 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

**Audit-I**

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| **MTAD-101 A** | **English For Research Paper Writing**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Student will able to understand the basic rules of research paper writing.* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Understand that how to improve your writing skills and level of readability*  |
| **CO2** | *Learn about what to write in each section*  |
| **CO3** | *Understand the skills needed when writing a Title*  |
| **CO4** | *Ensure the good quality of paper at very first-time submission* |  |

**UnitI**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**Unit II**

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

**Unit III**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check. 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,

**Unit IV**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

**References:**

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. Highman’sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**Audit -I**

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| **MTAD-103 A** | **Disaster Management**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Develop an understanding of disaster risk reduction and management* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.*  |
| **CO2** | *Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.*  |
| **CO3** | *Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*  |
| **CO4** | *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* |  |

**Unit I**

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

**Unit II**

**Repercussions of Disasters and Hazards**: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

**Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

**Unit III**

**Disasters 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

**Preparedness:** Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

**Unit IV**

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

**References:**

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.
2. Sahni, PardeepEt.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 -I**

|  |  |  |
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| **MTAD-105 A** | **Sanskrit for Technical Knowledge**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Students will be able to Understanding basic Sanskrit language and Ancient Sanskrit literature about science & technology can be understood and Being a logical language will help to develop logic in students*  |
| **Course Outcomes (CO)** |  |
| **CO1** | *To get a working knowledge in illustrious Sanskrit, the scientific language in the world*  |
| **CO2** | *Learning of Sanskrit to improve brain functioning*  |
| **CO3** | *Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power*  |
| **CO4** | *The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*  |

**Unit I**

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

**Unit II**

Order, Introduction of roots, Technical information about Sanskrit Literature

**Unit III**

Technical concepts of Engineering: Electrical, Mechanical

**Unit IV**

Technical concepts of Engineering: Architecture, Mathematics

***References***

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.

**Audit I**

|  |  |  |
| --- | --- | --- |
| **MTAD-107 A** | **Value Education** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Understand value of education and self- development, Imbibe good values in students and Let the should know about the importance of character*  |
| **Course Outcomes (CO)** |  |
| **CO1** | *Knowledge of self-development*  |
| **CO2** | *Learn the importance of Human values*  |
| **CO3** | *Developing the overall personality*  |
| **CO4** | *Know about the importance of character* |

**Unit I**

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

**Unit II**

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 III**

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 IV**

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

***References***

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

**M Tech Semester - II**

**MCG-102A DYNAMICS OF SOILS AND FOUNDATIONS**

**Teaching Scheme**

Lectures: 3 hrs/ week

**COURSE OUTCOME**

* Students understand theory of vibration and resonance phenomen on, dynamic amplification.
* Students understand propagation of body waves and surface waves throughsoil.
* 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 anysite.
* 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

**Wave propagation:** elastic continuum medium, semi-infinite elastic continuum medium ,soil behaviour under dynamic loading.

**Unit II**

 **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 III**

 **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.

**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 adjoiningstructures.

**Unit IV**

 **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,
* Richart, F.E. Hall J.R and Woods R.D., Vibrations of Soils and Foundations, Prentice Hall Inc.,1970.
* Prakash, S. and Puri, V.K., Foundation for machines: Analysis and Design, John Wiley & Sons,1998

**MCG 104 A SUBSURFACE INVESTIGATIONS 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

**UNIT I**

**PLANNING OF EXPLORATION AND GEOPHYSICAL METHODS** Scope and objectives, planning an exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic and electrical methods, cross bore hole, single bore hole – up hole -down hole methods.

**UNIT II**

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

**UNIT III**

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

**FIELD TESTING IN SOIL EXPLORATION**

Field tests, penetration tests, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, dilatometer test - plate load test–monotonic and cyclic; field permeability tests – block vibration test. Procedure, limitations, correction and data interpretation of all methods.

**UNIT IV**

**INSTRUMENTA** Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, pore pressure measurements - slope indicators, sensing units, case studies.

**Program Elective -III**

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| **MCG-106 A** | **MARINE GEOTECHNIQUES** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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 off shore 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. cassions, spudcans

**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 Pub and Co.,1991
* D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy,2012

**Program Elective III**

**MCG -108A 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

**Unit I**

**Solution of Non-linear Equations**: Bisection, False Position, Newton-Raphson,

Successive approximation method, Iterative methods

 **Solution of Linear Equations**: Jacobi’s method, Gauss Seidal method, Successive over relaxation method.

**Unit II**

 **Finite Difference Method**: Two point Boundary value problems – Disichlet conditions,

Neumann conditions; ordinary and partial differential equations.

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

**Unit III**

 **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 IV**

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

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

**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.

**Program Elective -III**

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| **MCG-110 A** | **ENGINEERING ROCK MECHANICS** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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; Insitu stresses in rock

**Rock Testing:** Laboratory and Field tests

**Unit II**

**Discontinuities in Rock Masses:** Discontinuity orientation, Effect of discontinuities on strength of rock ;

**Unit III**

 **Strength Behaviour:** Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior ;

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

**Unit IV**

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

**References:**

* Hudson J.A. and J.P. Harrison. Engineering Rock Mechanics: an Introduction tothe

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,199

**Program Elective -IV**

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| **MCG-112 A** | **EARTH RETAINING STRUCTURES** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**COURSE OUTCOME**

* The students will be able to do analysis and design of different types of retaining strcuctures

**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

**Sheet Pile wall:** free earth system, fixed earth system

**Unit III**

**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 IV**

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

 **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

**Program Elective -IV**

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| **MCG-114 A** | **DESIGN OF UNDERGROUND EXCAVATIONS** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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.

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 II**

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,NewAustrianTunnelingMethod(NATM),NorwegianTunnelingMethod(NTM),

construction dewatering.

**Unit III**

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi’selasto-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 IV**

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 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”, Elsevie

**MCG-116 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 to consolidation and triaxial soil behavior.

 **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; Work hardening plasticity theory: formulation and implementation; Application of elasto-plastic models; Special Topics : hypoelasticity-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.

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| **MCG-118 A** | **Sub-soil exploration lab** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **2** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**Syllabus Content**

**List of Practical**

1 Exploratory borings by different methods including auger boring, wash boring, percussion drilling rotary drilling.

1. Standard penetration test
2. Dynamic cone penetration test
3. Static cone penetration test
4. Plate load test
5. Pressure meter test

 7 Geophysical exploration tests

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| **MCG-120A** | **Soil Dynamic Lab** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **2** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**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 triaxialtest
8. Cyclic direct shear test

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| **MCG-122 A** | **Mini Project** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **0** | **0** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**Syllabus Content:**

Mini Project 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 highlighting individuals’ contribution.

Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

**Audit II**

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| **MTAD-102 A** | **Constitution of India**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and 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.*  |
| **Course Outcomes (CO)** |  |
| **CO1** | *Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*  |
| **CO2** | *Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*  |
| **CO3** | *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.*  |
| **CO4** | *Discuss the passage of the Hindu Code Bill of 1956.*  |  |

**Unit I**

**History of Making of the Indian Constitution**: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features

**Unit 2**

**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.

**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 3**

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

**Unit 4**

**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.

**References**

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.

**Audit-II**

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| **MTAD-104 A** | **Pedagogy Studies** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *Review existing evidence on the review topic to inform programme design and policy making undertaken by the DFID, other agencies and researchers and Identify critical evidence gaps to guide the development*. |
| **Course Outcomes (CO)** |  |
| **CO1** | *What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*  |
| **CO2** | *What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*  |
| **CO3** | *How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*  |
| **CO4** | *What is the importance of identifying research gaps?* |  |

**Unit I**

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

**Unit II**

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 III**

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

**Unit IV**

**Research gaps and future directions**: Research design, Contexts , Pedagogy, Teacher education Curriculum and assessment, Dissemination and research impact.

**References**

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.

**Audit II**

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| **MTAD-106 A** | **Stress Management by Yoga** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | To achieve overall health of body and mind and to overcome stress |
| **Course Outcomes (CO)** |  |
| **CO1** | *Develop healthy mind in a healthy body thus improving social health.*  |
| **CO2** | *Improve efficiency*  |
| **CO3** |  *Learn the Yog asan* |
| **CO4** | *Learn the pranayama* |  |

**Unit I**

Definitions of Eight parts of yog (Ashtanga).

**Unit II**

Yam and Niyam, Do`s and Don’t’s in life; Ahinsa, satya, astheya, bramhacharya and aparigraha; Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

**Unit III**

Asan and Pranayam, Various yog poses and their benefits for mind & body,

**Unit IV**

Regularization of breathing techniques and its effects-Types of pranayam.

**References**

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

**Audit II**

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| **MTAD-108 A** | **Personality Development through Life Enlightenment Skills** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **2** | **0** | **0** | **0** | **-** | **100** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | To learn to achieve the highest goal happily To become a person with stable mind, pleasing personality and determination To awaken wisdom in students  |
| **Course Outcomes (CO)** |  |
| **CO1** | *Students become aware about leadership.* |
| **CO2** | *Students will learn how to perform his/her duties in day to day work.* |
| **CO3** | *Understand the team building and conflict* |
| **CO4** | *Student will learn how to become role model for the society.* |  |

**Unit I**

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’s); Verses: 71, 73, 75, 78 (do’s).

**Unit II**

Approach to day to day work and duties; Shrimad Bhagwad Geeta: 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 III**

Statements of basic knowledge; Shrimad Bhagwad Geeta: Chapter-2: Verses: 56, 62, 68; Chapter-12: Verses: 13, 14, 15, 16, 17, 18.

**Unit IV**

Personality of Role model; Shrimad Bhagwad Geeta: Chapter-2: Verses: 17; Chapter-3: Verses: 36, 37, 42: Chapter-4: Verses: 18, 38, 39; Chapter-18: Verses: 37, 38, 63.

***References:***

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

**M Tech Semester –III**

**Program Elective -V**

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| **MCG-201 A** | **STABILITY ANALYSIS OF SLOPES** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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 andembankments

**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”, CRCPress.
* Harr M.E.,” Ground Water and Seepage”, McGraw Hill.1962

**Program Elective –V**

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| **MCG-203 A** | **FOUNDATIONS AND WEAK ROCKS** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**COURSE OUTCOME**

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

**Unit I**

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

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

**Unit II**

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 III**

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 IV**

Pressure-settlement characteristics, effect of layering, anisotropy, heterogeneity andinelasticity.

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.

**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.

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| **MCG-205A** | **GEOTECHNICAL EARTHQUAKE ENGINEERING** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |

**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 localsite conditions on ground motions, Design earthquake, Design spectra, Development of sitespecification 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”.

Liquefaction and lateral spreadingLiquefaction related phenomena, Liquefactionsusceptibility: Historical, Geological, Compositional and State criteria. Evaluation ofliquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Criteria for mapping liquefaction hazard zones.

**Unit IV**

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, 2ndEdition, 2001.

Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of NavalFacilities service centre, Port Hueneme, 1997.

**Open Elective**

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| **MTOE-201 A** | **Business Analytics** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | The main objective of this course is to give the student a comprehensive understanding of business analytics methods. |
| **Course Outcomes (CO)** |  |
| **CO1** | *Able to have knowledge of various business analysis techniques.* |
| **CO2** | *Learn the requirement specification and transforming the requirement into different models.* |
| **CO3** | *Learn the requirement representation and managing requirement assests.* |
| **CO4** | *Learn the Recent Trends in Embedded and collaborative business* |  |

**Unit 1**

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.

Stakeholders: the project team, management, and the front line, Handling, Stakeholder Conflicts.

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

**Unit 2**

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

**Unit 3**

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements.

Managing Requirements Assets: Change Control, Requirements Tools

**Unit 4**

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

**References:**

1. Business Analysis by James Cadle et al.

2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

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| **MTOE-203 A** | **Industrial Safety**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *To enable students to aware about the industrial safety.* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Understand the industrial safety.* |
| **CO2** | *Analyze fundamental of maintenance engineering.* |
| **CO3** | *Understand the wear and corrosion and fault tracing.* |
| **CO4** | *Understanding that when to do periodic inceptions and apply the preventing maintenance.*  |  |

**Unit-1**

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, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

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-2**

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-3**

Fault tracing: Fault tracing-concept and importance, decision treeconcept, 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-4**

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.

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| **MTOE-205 A** | **Operations Research**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | To enable students to aware about the dynamic programming to solve problems of discreet and continuous variables and model the real world problem and simulate it. |
| **Course Outcomes (CO)** |  |
| **CO1** | *Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.* |
| **CO2** | *Students should able to apply the concept of non-linear programming* |
| **CO3** | *Students should able to carry out sensitivity analysis* |
| **CO4** | *Student should able to model the real world problem and simulate it.* |  |

**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

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

**Unit- 3**

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

**Unit -4**

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

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| **MTOE-207 A** | **Cost Management of Engineering Projects**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *To enable students to make aware about the cost management for the engineering project and apply cost models the real world projects.* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Students should able to learn the strategic cost management process.* |
| **CO2** | *Students should able to types of project and project team types* |
| **CO3** | *Students should able to carry out Cost Behavior and Profit Planning analysis.* |
| **CO4** | *Student should able to learn the quantitative techniques for cost management.* |  |

**Unit-1**

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.

**Unit-2**

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 nontechnical 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

**Unit-3**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; 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.

**Unit-4**

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.

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| **MTOE-209 A** | **Composite Materials**  |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *To enable students to aware about the composite materials and their properties.* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Students should able to learn the Classification and characteristics of Composite materials.* |
| **CO2** | *Students should able reinforcements Composite materials.* |
| **CO3** | *Students should able to carry out the preparation of compounds.* |
| **CO4** | *Student should able to do the analysis of the composite materials.* |  |

**UNIT–1**:

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

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. Iso-strain and Iso-stress conditions.

**UNIT – 2**

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–3**

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

**UNIT – 4**

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play 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.

3. 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.

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| **MTOE-211 A** | **Waste to Energy** |  |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **60** | **40** | **100** | **3 Hrs.** |
| **Program Objective (PO)** | *To enable students to aware about the generation of energy from the waste.* |
| **Course Outcomes (CO)** |  |
| **CO1** | *Students should able to learn the Classification of waste as a fuel.* |
| **CO2** | *Students should able to learn the Manufacture of charcoal.* |
| **CO3** | *Students should able to carry out the designing of gasifiers and biomass stoves.* |
| **CO4** | *Student should able to learn the Biogas plant technology.* |  |

**Unit-1**

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

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

**Unit-2**

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-3**

 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-4**

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.

**MCG-207 A Dissertation Phase – I**

**Teaching Scheme**

Lab work : 20 hrs/week

**Course Outcomes:**

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

1. Identify Geotechnical engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

**Syllabus Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
* Relevance to value addition to existing facilities in the
* Relevance to industry need
1. Problems of national importance
2. Research and development in various domain
3. The student should complete the following:
* Literature survey Problem
* Definition Motivation for study and Objectives
* Preliminary design / feasibility / modular approaches
* Implementation and Verification

5. Report and presentation

**Guidelines for Dissertation Phase – I**

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated.

 Phase – I: July to December

The dissertation may be carried out preferably in-house i.e. department’s laboratories and centers OR in industry allotted through department’s T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The refer redliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

**M Tech Semester-IV**

**MCG202-ADissertation Phase - II**

**Teaching Scheme**

Lab work : 32 hrs/week

**Course Outcomes:**

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

1. Identify Geotechnical engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

**Syllabus Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
* Relevance to value addition to existing facilities in the
* Relevance to industry need
1. Problems of national importance
2. Research and development in various domain
3. The student should complete the following:
* Literature survey Problem
* Definition Motivation for study and Objectives
* Preliminary design / feasibility / modular approaches
* Implementation and Verification

5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

**Guidelines for Dissertation Phase-II**

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department’s laboratories and centers OR in industry allotted through department’s T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The refer red literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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**Dissertation Phase – I and Dissertation Phase - II**

**Teaching Scheme**

Lab work : 20 hrs/week for Dissertation Phase- I

**Course Outcomes:**

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

1. Identify structural engineering problems reviewing available literature.
2. Identify appropriate techniques to analyze complex structural systems.
3. Apply engineering and management principles through efficient handling of project

**Syllabus Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
* Relevance to value addition to existing facilities in the
* Relevance to industry need
1. Problems of national importance
2. Research and development in various domain
3. The student should complete the following:
* Literature survey Problem
* Definition Motivation for study and Objectives
* Preliminary design / feasibility / modular approaches
* Implementation and Verification

5. Report and presentation

The dissertation phase- II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

Experimental verification / Proof of concept.

Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

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**Guidelines for Dissertation Phase – I and Phase-II**

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department’s laboratories and centers OR in industry allotted through department’s T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referredliterature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

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