SIDDHARTHA
ACADEMY OF HIGHER EDUCATION
An Institution DEEMED TO BE UNIVERSITY
(Under Section 3 of UGC Act, 1956)
Kanuru, Vijayawada - 520 007, AP. www.vrsiddhartha.ac.in
91 866 2582333
866 2582334
866 2584930

Ph.D. CIVIL ENGINEERING

POOL I Courses:

S.No	Course Code	Title of the Course	L	T	P	C	SE
1	24CE710A	Soil Stabilization Methods	3	0	0	3	100
2	24CE710B	Applied Geomorphology	3	0	0	3	100
3	24CE710C	Pavement Material Characterization	3	0	0	3	100
4	24CE710D	Advanced Construction Techniques	3	0	0	3	100
5	24CE710E	Development and Applications of Special Concretes	3	0	0	3	100
6	24CE710F	Modern Construction Materials (NPTEL – 12 Weeks)	0	0	3	3	100
7	24CE710G	Environmental Remediation of Contaminated Sites (NPTEL – 12 Weeks)	0	0	3	3	100
8	24CE710H	Environmental Impact Assessment (NPTEL – 12 Weeks)	0	0	3	3	100

POOL II Courses:

S.No	Course Code	Title of the Course	L	T	P	C	SE
1	24CE720A	Building with Stabilized Mud	3	0	0	3	100
2	24CE720B	Geospatial Technologies	3	0	0	3	100
3	24CE720C	Construction Demolition and Waste Management	3	0	0	3	100
4	24CE720D	Sustainable Materials and Green Building	3	0	0	3	100
5	24CE720E	Characterization of Construction Materials	3	0	0	3	100
6	24CE720F	Multimodal Urban Transportation System (NPTEL – 12 Weeks)	0	0	3	3	100
7	24CE720G	Environmental Geomechanics (NPTEL – 12 Weeks)	0	0	3	3	100
8	24CE720H	Applied Environmental Microbiology (NPTEL – 12 Weeks)	0	0	3	3	100

Legend:

L – Lecture, **T** – Tutorial, **P** – Practical, **C** – Credits, **SE** – Semester End Exam

POOL I — COURSES SYLLABUS

24CE710A
SOIL STABILISATION METHODS

Course Category: PhD	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Ground Improvement Techniques	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1. Impart fundamental knowledge of soil stabilisation.

CO2. Design and construction of lime stabilised soil courses.

CO3. Recognise the construction method of cement stabilisation.

CO4. Identify the industrial wastes/by-products for soil stabilisation.

CO5. Analyse the suitability of different grouting techniques and grout materials used for construction.

Course Content

UNIT I: Introduction of Soil Stabilisation

Definition of soil stabilisation, Purpose of soil stabilisation, Requirements of soil stabilisation, Methods of soil stabilisation, Mechanical/granular stabilisation-Principle and Applications, Factors affecting mechanical stabilisation.

UNIT II: Lime Stabilisation

Definition of lime stabilisation, Types of limes, lime-soil reactions, Benefits of lime stabilisation, Design of soil-lime mix, Construction process involved in lime stabilized pavement courses.

UNIT III: Cement Stabilisation - 1

Definition of cement stabilisation, Types of soil-cements, lime-soil reactions, Factors affecting cement stabilisation, Design of soil-cement mix.

UNIT IV: Cement Stabilisation - 2

Construction process involved in cement stabilized pavement courses, Use of industrial wastes/by-products for soil stabilisation.

UNIT V: Grouting

Grouting in soil, Applications of grouting, Types of grouts, Desirable characteristics of grouts, Methods of grouting, Post grout test.

Text Books

- M.R. Hausmann, *Engineering Principles of Ground Modification*, McGraw-Hill Pub.
- P. Purushothama Raj, *Ground Improvement Techniques*, Laxmi Publications.
- S.K. Gulhati and M. Datta, *Geotechnical Engineering*, Tata McGraw Hill.
- J. Maity and B.C. Chattopadhyay, *Ground Improvement Techniques*, PHI Learning Pvt. Ltd.

Reference Books

- L.R. Kadiyali and N.B. Lal, *Principles and Practice of Highway Engineering*, Khanna Publications.
- S.K. Khanna and C.E.G. Justo, *Highway Engineering*, Nem Chand and Brothers.
- HRB SR.No.1, 2000, *State-of-the-Art-Report: Lime-Soil Stabilisation*, Indian Road Congress.

E-resources and Digital Material

https://onlinecourses.nptel.ac.in/noc21_ce65/preview

24CE710B
APPLIED GEOMORPHOLOGY

Course Category: PhD	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: M. Tech Civil Engineering / Remote sensing and GIS / Environmental Sciences	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1. understanding the fundamental concepts of geomorphology and its significance, geomorphic agents and processes (exogenic and endogenic), weathering, soil processes, mass wasting

CO2. understanding the landforms associated with igneous activities, fluvial geomorphic cycle, drainage system; evolution of landforms in aeolian, coastal (marine erosion), glacial, and karst landscapes

CO3. understanding the tools of geomorphologists, introduction to applied geomorphology, structural geomorphology, global geomorphology and tectonics, geomorphology of india - peninsular, extra-peninsular, and indo-gangetic plains.

CO4. understanding drainage systems, sequent drainage systems, sequent drainage systems, and river capture drainage patterns. morphometry of drainage basins, drainage basin hydrological cycle, linear aspects, areal aspects, drainage texture, relief aspects, hypsometric analysis.

CO5. understanding climate change and quaternary geomorphology, indicators of climatic changes; causes and theories of climatic changes; quaternary climatic changes and landforms, anthropogenic geomorphology, man's impacts on environmental processes, periglacial geomorphology, genetic classification of periglacial landforms.

Course Content

UNIT I

Fundamental concepts of Geomorphology and its significance, Geomorphic agents and processes (Exogenic and Endogenic), Weathering, Soil processes, Mass wasting.

UNIT II

Landforms associated with igneous activities, Fluvial Geomorphic Cycle, drainage system; Evolution of landforms in Aeolian, coastal (marine erosion), glacial, and Karst landscapes

UNIT III

Tools of Geomorphologist, Introduction to Applied Geomorphology, Structural Geomorphology, Global Geomorphology and Tectonics, Geomorphology of India - Peninsular, extra-peninsular, and Indo-Gangetic Plains.

UNIT IV

Drainage Systems, Sequent drainage systems, insequent drainage system, river capture Drainage Pattern. Morphometry of Drainage Basins, drainage basin hydrological cycle, linear aspects, areal aspects, drainage texture, relief aspects, hypsometric analysis.

UNIT V

Climate Change and Quaternary Geomorphology, Indicators of climatic changes; causes and theories of climatic changes; quaternary climatic changes and landforms. Anthropogenic Geomorphology, man's impacts on environmental processes, Periglacial Geomorphology, genetic classification of periglacial landforms.

Text Books

- Thornbury, W.D., *Principles of Geomorphology*, Wiley Easton Ltd., New York, 10th Edition, 631p.
- Richard John Huggett, *Fundamentals of Geomorphology*, Third Edition, Routledge Taylor & Francis Group, 533p.
- Michael A. Summerfield, *Global Geomorphology - An Introduction to the Study of Landforms*, Routledge Taylor & Francis Group, 560p.
- Savindra Singh, *Geomorphology*, Pravalika Publications, Allahabad, 664p.
- *Bgyet 147 Geomorphology and Geotectonics*, Indira Gandhi National Open University, Volume 1 Geomorphology, Block 1 Basic Concepts of Geomorphology, Unit 2 Geomorphology of India, 13-50p.
- Vijay K. Sharma, *Introduction to Process Geomorphology*, CRC Press Taylor & Francis Group, 438p.

- Small, R.J., *Study of Landforms: A Textbook of Geomorphology*, 2nd Edition, Cambridge University Press.
- Gautam, A., *Geomorphology*, 5th Edition, Sharda Pustak Bhavan, Allahabad.
- Bloom, A.L., *Geomorphology: A Systematic Analysis of Late Cenozoic Landforms*, 3rd Edition.
- Gautam, A., *Geomorphology*, 5th Edition, Sharda Pustak Bhavan, Allahabad.
- Halis, J.R., *Applied Geomorphology*, Hall, London.
- Allision, R.J., *Applied Geomorphology*, John Wiley and Sons Ltd., England.
- Huggett, R.J., *Routledge Fundamentals of Geomorphology*, Taylor & Francis Group, New York.
- Verma, V.K., *Geomorphology (with Indian Examples)*, Rawat Publications, 408p.

Reference Books

- Condie, Kent C., *Plate Tectonics and Crustal Evolution*, Pergamon Press Inc.
- Drury, S.A., *Image Interpretation in Geology*, Allen and Unwin.
- Holmes, A., *Holmes Principles of Physical Geology*, Edited by P. McL. D. Duff, Chapman and Hall, London.
- Sharma, H.S., *Indian Geomorphology*, Concept Publishing Co., New Delhi.
- Siddhartha, K., *The Earth's Dynamic Surface - A Book of Geomorphology*, Kitab Mahal.
- Summerfield, M.A., *Geomorphology and Global Tectonics*, Wiley India Pvt Ltd.
- Kale, V.S., and Avijit Gupta, *Introduction to Geomorphology*, University Press.
- Slaymaker, O., Spencer, T., and Hamann, C.E., *Geomorphology and Global Environmental Change*, Cambridge University Press, New York.
- Anbazhagan, S., Subramanian, S.K., and Yang, X., *Geoinformatics in Applied Geomorphology*, CRC Press, Taylor & Francis Group, London and New York.
- Davies, R.J., Posamentier, H.W., Wood, L.J., and Cartwright, J.A., *Seismic Geomorphology: Application to Hydrocarbon Exploration and Production*, The Geological Society of London.

E-resources and Digital Material

- Geomorphology - Course (nptel.ac.inhttps://onlinecourses.nptel.ac.in/noc21_ce29/preview
- *E-book on Applied Geomorphology*: https://www.scribd.com/document/416267411/Applied-Geomorphology
- *E-book on Fundamentals of Geomorphology*: https://sudartomas.wordpress.com/wpcontent/uploads/2012/11/fundamentalsofgeomorphology_routledgefundamentalsofphysicalgeography.pdf

24CE710C
PAVEMENT MATERIAL CHARACTERIZATION

Course Category: PhD	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: NIL	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

CO1. Understand the properties of subgrade layers.

CO2. Understand the Stabilization Techniques.

CO3. Understand Aggregate characterization.

CO4. Understand the desirable properties of bitumen and bituminous mixes.

CO5. Understand the properties of cement and Pavement Quality Concrete.

Course Content

UNIT I: Subgrade Soil Characterization

Properties of subgrade layers; different types of soils, Mechanical response of soil; SPT, DCPT, CPT, CBR, Plate Load test & resilient modulus; Field compaction and control. Dynamic properties of soil: FWD test. Introduction to Ground improvement techniques; Introduction to Geo textiles and geo synthetics applications.

UNIT II: Introduction to Soil Stabilization

Physical and Chemical modification: Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen. Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control. Introduction to Ground improvement techniques; Introduction to Geo textiles and synthetics applications.

UNIT III: Aggregate Characterization

Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation, Fuller and Thompson's Equation, 0.45 power maximum density graph; Use of locally available materials in lieu of aggregates.

UNIT IV: Bitumen

Bitumen Sources and Manufacturing, Chemistry of bitumen, Bitumen structure, Basic properties of bitumen, rheological properties of bitumen, Superpave specifications for bituminous binder including aging protocols like RTFOT, PAV; Bending Beam Rheometer test, Dynamic Shear Rheometer; Bitumen emulsions: SS, MS and RS types with applications; Characterisation of bitumen emulsions; modified bituminous binders like CRMB, PMB, NRMB and their application for highways.

Bituminous Concrete Mix Characterization: Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications, Introduction to super pave mix design procedure; Marshall's Mix Design (as per MS 2 Manual), Superpave Mix Design as per Superpave series 2; Indirect tensile strength, Tensile strength ratio; Performance Tests on Bituminous Mixes: Rutting Tests, Fatigue Tests, Dynamic Modulus Tests, moisture resistance tests, and microstructural investigations; Special Mixes and alternative materials like Stone Matrix Asphalt, Porous Asphalt, Warm Mix Asphalt, Half Warm Mix Asphalt and RAP based mixes.

UNIT V: Cement and Cement Concrete Mix Characterization

Types of cements and basic cement properties, mineral admixtures like fly ash, GGBS, and other pozzolanic materials; Quality tests on cement. Introduction to advanced concretes: porous concrete, fiber-reinforced concrete, block pavement, light-weight concrete, roller-compacted concrete for pavement application; white topping, Nano technology applications in cement concrete.

Text Books

- Atkins, N. Harold, *Highway Materials, Soils and Concretes*, Fourth Edition, 2002, Prentice-Hall.
- Kerbs Robert D. and Richard D. Walker, *Highway Materials*, McGraw-Hill, 1971.
- Prithvi Singh Kandhal, *Bituminous Road Construction in India*, PHI, 2016.
- Relevant IRC and IS Codes of Practices.

Reference Books

- L.R. Kadyali, *Principles and Practices of Highway Engineering*, Khanna Publishers, 2015.
- Shin Che Huang and Herve Di Benedetto, *Advances in Asphalt Materials – Road and Pavement Construction*, Woodhouse Publishing, 2015.

- Khanna S.K., Justo, C.E.G., and Veeraragavan, A., *Highway Material Testing Laboratory Manual*, Nem Chand & Bros.
- A.M. Neville, *Properties of Concrete*, 5th Edition, Pearson Publications, 2012.

E-resources and Digital Material

- https://nptel.ac.in/courses/105107219

24CE710D
ADVANCED CONSTRUCTION TECHNIQUES

Course Category: PhD	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Building materials, concrete technology	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1. Understand and analyze the concepts of substructure and superstructure construction, including groundwater control, tunneling, and formwork techniques.

CO2. Demonstrate knowledge of demolition and temporary works, including shoring and portal frame theories in concrete, steel, and timber.

CO3. Explore and apply modern cladding techniques for framed structures and understand stair designs in various materials.

CO4. Examine and implement principles of prestressed concrete and repair/rehabilitation methods for structural components.

CO5. Design and evaluate buildings for industrial and storage use, considering roofs, walls, wind pressure, and rain-related challenges.

Course Content

UNIT I:

Substructure: Groundwater control, deep trench excavations, cofferdams and caissons, tunneling and culverts, underpinning, pile foundations, subsoil analysis, and deep basements.
Superstructure: Masonry, arches, DPC (Damp Proof Course), waterproofing, concreting, formwork, scaffolding, floors, roofs, roof drainage, and common construction equipment.

UNIT II:

Demolition and Temporary Works,Demolition techniques and temporary works, including shoring.
Portal frame construction and theory: Concrete, steel, and timber portal frames.

UNIT III:

Cladding for framed structures: Cladding panels, infill panels, joints, mastics, sealants, and gaskets.
Advanced cladding types: Curtain walling, rainscreen cladding, structural glass cladding.
Stair design: Concrete stairs and metal stairs.

UNIT IV:

Prestressed concrete: Principles, applications, and systems.
Repair and rehabilitation methods: Strengthening beams, columns, slabs, masonry walls, jacketing, and grouting.

UNIT V:

Factory buildings: Roofs and walls.
Wind pressure, driving rain, and roof structures in industrial design.

Text Books

- Roy Chudley and Roger Greeno, *Advanced Construction Technology*, 2006, Pearson Education Limited.
- Director General Works, CPWD GOI, *Handbook on Repair and Rehabilitation of RCC Buildings*, 2002, New Delhi.
- P.C. Varghese, *Building Construction*, 2008, PHI Learning Private Limited.

Reference Books

- Jerry Irvine, *Advanced Construction Techniques*, CA Rocketr, 1984.
- Patrick Powers. J., *Construction Dewatering: New Methods and Applications*, John Wiley & Sons, 1992.
- Peter H. Emmons, *Concrete Repair and Maintenance Illustrated*, Galgotia Publications Pvt. Ltd., 2001.
- Robert Wade Brown, *Practical Foundation Engineering Handbook*, McGraw Hill Publications, 1995.
- Sankar, S.K., and Saraswati, S., *Construction Technology*, Oxford University.

E-resources and Digital Material

- NPTEL Course: Advanced Construction Techniques

24CE710E
DEVELOPMENT AND APPLICATIONS OF SPECIAL CONCRETES

Course Category: PhD	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Building materials, concrete technology	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1. Apply the use of material properties, mix proportioning, and admixture techniques necessary for creating durable and functional normal concrete.

CO2. Gain knowledge of various special concretes and the methods of curing and handling required to manage their unique properties under different environmental conditions.

CO3. Develop proficiency in the design, testing, and application of self-compacting concrete, focusing on its unique rheological properties and mix proportioning.

CO4. Comprehend the advantages of fiber-reinforced concrete, including fiber selection, mix handling, and the impact on concrete's structural properties in its hardened state.

CO5. Describe the concept of batching, mixing, shotcrete, and steam curing methods to improve concrete quality.

Course Content

UNIT I: Basic Properties of Concrete

Basic properties of fresh concrete and hardened concrete, proportioning of normal concrete mixes, mix proportions analysis and adjustments, pores and porosity in concrete, admixtures in concrete.

UNIT II: Special Concretes and Curing

Basic understanding of high-strength concrete, mass concrete, and shotcrete. Curing of concrete: cold weather concreting, hot weather concreting, importance of right methods and specifications, heat of hydration, thermal stresses. Anti-washout underwater concrete, roller compacted concrete.

UNIT III: Self-Compacting Concrete

Self-compacting nature of concrete and the proportioning and testing of self-compacting concrete, characteristics and testing of fresh self-compacting concrete, proportioning of self-compacting concrete mix, rheology.

UNIT IV: Fiber-Reinforced Concrete

Introduction to fiber-reinforced concrete, need, properties of fibers, proportioning and handling of fiber-reinforced concrete, properties of fiber-reinforced concrete in its hardened state.

UNIT V: Batching, Mixing, and Advanced Techniques

Different methods of batching and mixing, introduction to shotcrete along with its characteristics. Shotcreting operations, high-strength concrete, use of polymers in concrete, cover concrete, its importance, and considerations for improvement of quality. Compaction of concrete with different methods, precast concrete, and steam curing of concrete.

Text Books

- Mehta, P.K., and Monteiro P.J.M., *Concrete – Microstructure, Properties and Materials*, 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, Prentice-Hall, Inc., 2006.
- Neville, A.M., *Properties of Concrete*, 5th Edition, Pitman Publishers, New Delhi, India, 1996.
- Shetty, M.S., *Concrete Technology (Theory and Practice)*, 7th Edition, S. Chand & Company Ltd., New Delhi, 2013.

Reference Books

- Sidney, M., Young, J.F., and Darwin, D., *Concrete*, 2nd Edition, Prentice-Hall, Pearson Education, Inc., New Jersey, 2003.
- Kosmatka, S.H., Kerkhoff, B., and Panarese, W.C., *Design and Control of Concrete Mixtures*, 14th Edition, Portland Cement Association, Skokie, Illinois, USA, 2003.
- JSCE Subcommittee, *Standard Specifications for Concrete Structures – 2007 "Materials and Construction"*, Report: JSCE Guidelines for Concrete (No. 16), Japan Society of Civil Engineers, Tokyo, Japan, 2010.

E-resources and Digital Material

- NPTEL Course: Concrete Technology

24CE710F
MODERN CONSTRUCTION MATERIALS

Course Category:	PhD	**Credits:**	3
Course Type:	**Theory (NPTEL)**	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Civil Engineering Materials	**Continuous Evaluation:**	00
		Semester end Evaluation:	100
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1. Demonstrate an understanding of modern construction materials by explaining their science, engineering principles, and technological applications.

CO2. Analyze the atomic bonding, structure of solids, and microstructural development to predict the behavior of construction materials.

CO3. Evaluate surface properties, stress response, failure theories, and thermal properties to assess the performance of construction materials under different conditions.

CO4. Select appropriate structural materials, including wood, polymers, metals, concrete, and glass, based on their properties and performance requirements for construction applications.

CO5. Identify and apply suitable non-structural materials, finishes, and accessories, such as waterproofing, floor finishes, and anchors, to enhance functionality and aesthetics in construction projects.

Course Content

UNIT I: Basics

Introduction to Modern Construction Materials - Science, Engineering, and Technology of Materials.

UNIT II: Microstructure

Atomic Bonding - Structure of Solids - Movement of Atoms - Development of Microstructure.

UNIT III: Material Behaviour

Surface Properties - Response to Stress - Failure Theories - Fracture Mechanics - Rheology and Thermal Properties.

UNIT IV: Structural Materials

Review of Construction Materials and Criteria for Selection - Wood and Wood Products - Polymers - Fibre Reinforced Polymers - Metals - Bituminous Materials - Concrete - Glass.

UNIT V: Non-Structural Materials, Accessories, and Finishes

Perception of Non-Structural Materials - Waterproofing - Floor Finishes - Anchors.

E-resources and Digital Material

- NPTEL: Modern Construction Materials

24CE710G
ENVIRONMENTAL REMEDIATION OF CONTAMINATED SITES

Course Category:	PhD	**Credits:**	3
Course Type:	**Theory (NPTEL)**	**Lecture - Tutorial - Practice:** 3 - 0 - 0	
Prerequisites:	Basics in Geotechnical Engineering	**Continuous Evaluation:**	00
		Semester end Evaluation:	100
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the principles of environmental remediation, including regulatory frameworks and waste classification.
2. **CO2:** Evaluate risk assessment methodologies for human health and ecological systems in contaminated sites.
3. **CO3:** Analyze and design remediation strategies for contaminated groundwater using appropriate technologies.
4. **CO4:** Develop solutions for soil and sediment remediation, integrating advanced techniques like solidification and chemical treatments.
5. **CO5:** Apply innovative approaches such as bioremediation, phytoremediation, and thermal processes to real-world remediation challenges.

Course Content

UNIT I: Introduction to Environmental Remediation

Concept of environmental remediation: Overview of laws, regulations, and remediation. Definitions: hazardous waste, waste classification, and corrective action.

UNIT II: Risk Assessment in Contaminated Sites

Human health risk assessment: data collection, exposure assessment, toxicity assessment, and risk characterization. Ecological risk assessment. Risk-based corrective actions and communication strategies.

UNIT III: Remedial Options for Groundwater

Plume containment: extraction wells, trenches, and barriers. Pump and treat techniques. Permeable reactive barriers: redox reactions, design considerations. Monitored natural attenuation: evaluation, monitoring, and case studies.

UNIT IV: Remedial Options for Soil and Sediments

Soil excavation and landfilling. Solidification/stabilization: leaching mechanisms and design considerations. Chemical treatment processes and soil vapor extraction techniques. Advanced techniques: surfactant extraction and soil washing.

UNIT V: Bioremediation, Phytoremediation, and Thermal Processes

Bioremediation: principles, processes, and applications.Phytoremediation: mechanisms and examples. Thermal processes: incineration, thermal desorption, and soil oxidation.

E-resources and Digital Material

https://onlinecourses.nptel.ac.in/noc23_ce11/preview

24CE710H
ENVIRONMENTAL IMPACT ASSESSMENT

Course Category: phd	**Credits:** 3
Course Type: Theory(NPTEL)	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Environmental Engineering and Environmental studies	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the environment management and concept of EIA.
2. **CO2:** Understand the world sustainable development, EIA law and process.
3. **CO3:** Analyse the EIA assessment methods on natural parameters.
4. **CO4:** Analyse the EIA assessment methods on socio-economic parameters.
5. **CO5:** Interpret the Strategic Environmental Assessment and case studies.

Course Content

UNIT I: Introduction to Environment Management & EIA

State and global environment (Air, Biodiversity, Oceans, Land, Freshwater), Definition, process, & purpose, EIA Impact Areas, EIA origin in the US, EIA in India.

UNIT II: World Sustainable Development and EIA Law

World sustainable development timeline, EIA law, policy and institutional arrangements for EIA systems (Air, Geology, Ecology, Noise, Geomorphology); EIA process, impact prediction, evaluation, mitigation and enhancement, participation, presentation and review, follow-up.

UNIT III: EIA Assessment Methods

EIA Assessment Methods – Air, water, soil, land & geology, climate change; EIA Methods for Ecology (Definitions and Concepts), baseline study, impact prediction and evaluation.

UNIT IV: EIA Methods Assessment on Various Parameters

EIA Methods Assessment on ecology services, coastal ecology, noise, transport, cultural heritage, health, socio-economic impacts, Land Acquisition, Resettlement and Livelihoods, Resource Efficiency, Risk and Risk Assessment, Cumulative Effects, Environmental Management Plans.

UNIT V: Strategic Environmental Assessment and Case Studies

EIA widening the scope: Strategic Environmental Assessment, Reporting and Review. Case study – Mumbai metro line 3 Colaba - Bandra - SEEPZ, Development of water aerodrome, Andaman and Nicobar.

E-resources and Digital Material

https://archive.nptel.ac.in/courses/124/107/124107160/

POOL II — COURSES

SYLLABUS

24CE720A
BUILDING WITH STABILISED MUD

Course Category: phd	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Ground Improvement Techniques	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Impart fundamental knowledge of building with stabilised mud.
2. **CO2:** Recognise the process of manufacturing stabilised mud blocks.
3. **CO3:** Evolution of strength of stabilised mud blocks.
4. **CO4:** Evolution of durability of stabilised mud blocks.
5. **CO5:** Impart fundamental knowledge of rammed earth.

Course Content

UNIT I: Introduction to Building with Stabilised Mud

Concept of Stabilized Mud Blocks (SMB), Purpose of building with stabilised mud, Selection of soils for SMB manufacture, Stabilisers and Waste materials for SMB manufacture.

UNIT II: The Process of Stabilised Mud Block Manufacture

Soil preparation, mixing of soil and stabiliser, Addition of moisture to mixture, Block pressing in Mardini, Stacking and curing the blocks, Labor utilization in block production, troubleshooting in block making.

UNIT III: Evolution of Stabilized Mud Blocks - Strength Criteria

Strength of Blocks, The wet compressive strength test.

UNIT IV: Evolution of Stabilized Mud Blocks - Durability Criteria

Durability test - The alternate wetting and drying test, Expansion on saturation test.

UNIT V: Rammed Earth

Rammed Earth as an alternative for wall construction, Equipment for Rammed Earth, The process of ramming.

Text Books

T1. Building with stabilized earth by KS Jagadeesh, I.K. International Pvt Ltd.

T2. Jagadish K.S., Venkatarama Reddy B.V. and Nanjunda Rao K.S. (2017). Alternative Building Materials and Technologies, New-Age International Publishers.

T3. Laurie Baker, Mud, Center of Science and Technology for Rural Development (COSTFORD).

T4. Laurie Baker, Houses How to Reduce Building Costs, CAPART.

Reference Books

R1. B.V. Venkatarama Reddy, Compressed earth block & rammed earth structures, Springer.

R2. B.V. Venkatarama Reddy, Sustainable building technologies, Special section: Application of S & T to rural areas, Current Science, Vol. 87, No. 7, 2004, pp. 899-907.

R3. B.V. Venkatarama Reddy, A manual for laboratory tests on masonry materials and masonry elements, Bharat Ratna Sir M Visvesvaraya National Training Facility for Skills for All, Government of Karnataka, India.

E-resources and Digital Material

--

24CE720B
GEOSPATIAL TECHNOLOGIES

Course Category: phd	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites:M. Tech Civil Engineering / Remote sensing and GIS / Environmental Sciences	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the fundamental concepts of Geographical Information System (GIS) and Geospatial Analysis – Functions and Advantages.
2. **CO2:** Understand the Remote Sensing - Basic Principles and Applications.
3. **CO3:** Understand the Geographical Information System (GIS) and Geospatial Analysis – Functions and Advantages.
4. **CO4:** Understand the Ground-truth Data and Global Positioning System (GPS).
5. **CO5:** Understand the Spatial Data Modelling, GIS Data Management, Data Input, Editing, Data Quality, Data Analysis, and Spatial Data Modelling.

Course Content

UNIT I: Geographical Information System (GIS) and Geospatial Analysis – Functions and Advantages

Definition of GIS, Key Components, GIS-an integration of spatial and attribute information, GIS-three views of information system, Database view, Map view, Model view, GIS-a knowledge hub, Geography, Cartography, Remote sensing, Photogrammetry, Surveying, Geodesy, Global Navigation Satellite System, Civil Engineering, Origin of GIS, Functions of GIS, Application areas of GIS, Advantages of GIS, Functional requirement of GIS, Data capture, Database storage and Management, Data integration, Data structures, Spatial Analysis, Data Modelling, Presenting Results, Limitations of GIS, Geospatial Data Analysis, Integration and Modelling of Spatial data, Geospatial data Analysis Methods, Database Query, Geospatial measurements, Overlay Operations, Network Analysis, Surface Analysis, Geo-visualization, Urban and Municipal Applications, Forest resources Applications, Watershed Management, Natural Disaster management.

UNIT II: Remote Sensing - Basic Principles and Applications

Introduction to Remote Sensing, Electromagnetic Remote Sensing Process, Physics of Radiant Energy, Nature of Electromagnetic Radiation, Electromagnetic Spectrum, Energy interactions with Earth's surface materials, Microwave Remote sensing, The Radar principle, Factors affecting Microwave measurements, Side looking Airborne Radar (SLAR),

Synthetic Aperture Radar (SAR), Interaction between Microwaves and Earth Surfaces, Interpreting SAR Images, Geometric Characteristics, Applications of Remote Sensing, Land Cover and Land Use applications, Land Use and Land Cover Changes, Land Cover mapping, Agriculture applications, Crop type mapping, Crop monitoring and crop damage assessment, Forestry applications, Geology applications, Structural mapping and Terrain analysis, Lineament extraction, Geologic Unit mapping, Geomorphology applications, Urban applications, Hydrology applications, Flood delineation mapping, Soil Moisture, Groundwater prospects and Recharge, Digital Elevation Models (DEM), Digital Terrain Models (DTM), Ocean and Coastal monitoring applications, monitoring Atmospheric Constituents, Image Classification (Supervised, Unsupervised), Triangulated irregular network (TIN) Model.

UNIT III: Geographical Information System (GIS) and Geospatial Analysis – Functions and Advantages

Geographical Information System (GIS) and Geospatial Analysis – Functions and Advantages, Definition of GIS, Key Components, GIS-an integration of spatial and attribute information, GIS-three views of information system, Database view, Map view, Model view, GIS-a knowledge hub, Geography, Cartography, Remote sensing, Photogrammetry, Surveying, Geodesy, Global Navigation Satellite System, Civil Engineering, Origin of GIS, Functions of GIS, Application areas of GIS, Advantages of GIS, Functional requirement of GIS, Data capture, Database storage and Management, Data integration, Data structures, Spatial Analysis, Data Modelling, Presenting Results, Limitations of GIS, Geospatial Data Analysis, Integration and Modelling of Spatial data Geospatial data Analysis Methods, Database Query, Geospatial measurements, Overlay Operations, Network Analysis, Surface Analysis, Geo-visualization, Urban and Municipal Applications, Forest resources Applications, Watershed Management Natural Disaster management.

UNIT IV: Ground-truth Data and Global Positioning System (GPS)

Introduction, Requirement of Ground-Truth Data, Instruments for Ground-Truthing, Parameters of Ground Truthing, Atmospheric Conditions, Surface water, Vegetation, Soil, Bare ground and Rock Dark and light Calibration Targets, Factors of Spectral Measurement, Sun Angle, Cloud Conditions, Aerosol, Haze, and Water Vapour, Topography, Shadows, Global Navigation Satellite System, Satellite-based Navigation and Positioning System, Functional Segments of GPS, Working Principles of GPS, GPS Signals, Errors of GPS, Positioning Methods, Differential Global Positioning System, GPS Receivers, Applications of GNSS, GPS System design Considerations, GPS System Elements, Space Segment, Control segment, Applications of User Segment, Positioning Principles of User segment, GPS Satellite Constellation and Signals, GPS measurements, GPS Instrumentation.

UNIT V: Spatial Data Modelling, GIS Data Management, Data Input, Editing, Data Quality, Data Analysis, Spatial Data Modelling

Introduction, Stages of GIS Data Modelling, Graphical Representation of Spatial Data, Raster data Representation, Vector Data Representation, Spatial Data Models, Raster GIS Models, Vector GIS Models, Comparison of Raster and Vector Models, GIS Data Management, Database Management System, GIS Data File management, Database Models, Storage of GIS Data, Object-Based GIS Models, Temporal topology, Organizational strategy of BDMS in GIS, Data Input and Editing, Data Stream, Data Input Methods, GPS for GIS Data Capture, Data Editing, Data Quality Issues, Components of Data Quality, Accuracy of Data Quality, Precision and Resolution of Data Quality, Consistency, Completeness, Sources of Error in GIS, Modelling Errors, Error Evaluation by Graphical methods, Data Analysis and Modelling, Format Conversion, Data Medium Conversion, Spatial Measurement Methods, Reclassification, Buffering Techniques, Overlay Analysis, Modelling Surfaces, Modelling Networks, GIS Output, Maps as Output, Graphical Output.

Text Books

T1. Bradley A. Shellito, *Introduction to Geospatial Technologies*, 2022, 5th Edition, W.H. Freeman, Macmillan Learning Publishing, New York, 1073p.

T2. John Stillwell and Abraham Clarke, (Editors), *Applied GIS and Spatial Analysis*, 2004, John Wiley and Sons Inc, USA, 406p.

T3. Paul Bolstad, *GIS Fundamentals: A First Text on Geographic Information Systems*, 5th Edition, Eider Press, White Bear Lake, Minnesota, USA, 739p.

T4. Poonam Sharma (Editor), *Geospatial Technologies and Smart Cities*, ICT, Geoscience Modeling, GIS and Remote Sensing, The Urban Book Series, Springer, 493p.

T5. Basudeb Bhatta, *Remote Sensing and GIS*, 2nd Edition, Oxford University Press, London, 705p.

T6. Anji Reddy, M, *Text Book of Remote Sensing and Geographical Information System*, 2012, 4th Edition, BS Publications, Hyderabad, 601p.

T7. Alpana Bora and Rathi, RS, *Geospatial Technology Textbook*, CBSE Publications, New Delhi, 159p.

Reference Books

R1. Remote Sensing and Image Interpretation, Lillesand, T.M., R.W. Kiefer, and J.W. Chipman, Wiley India Pvt. Ltd., New Delhi, 7th Edition, 2015.

R2. Remote Sensing and GIS, Basude Bhatta, Oxford University Press, 2nd Edition, 2011.

R3. P.S. Roy, R.S. Dwivedi, D. Vijayan, *Remote Sensing Applications NRSA Resources Knowledge E-book*, 351 pages.

R4. Goodchild, M.F., Parks, B.O., and Stayaert, L.T., 1993, *Environmental Modelling with GIS*, Oxford University Press, Oxford, New York.

R5. Hall, E.L., 1978, *Computer Image Processing and Recognition*, Academic Press, New York.

R6. Wolf, P.R., 1983, *Elements of Photogrammetry, 2nd Edition*, McGraw-Hill Book Co.

R7. Turner, A.K., 1992, *Three Dimensional Modelling with Geoscientific Information System*, Dordrecht, Kluwer Academic Publications, 443p.

E-resources and Digital Material

--

24CE720C
CONSTRUCTION DEMOLITION AND WASTE MANAGEMENT

Course Category: phd	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Building materials	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the fundamentals of waste and recycling processes.
2. **CO2:** Understand demolition waste and reuses.
3. **CO3:** Understand the recycling waste management plan.
4. **CO4:** Understand the economic aspects of recycling.
5. **CO5:** Understand the recycling marketing process.

Course Content

UNIT I:

Recycling Waste: The Fundamentals Types of wastes, Types of recycling and reuse, The Jobsite Recycling Centre, Transportation of Recycled Materials, Hazardous Materials, Automated Equipment, Recycling New Construction Waste, Waste Assessment, Waste assessment Rules of Thumb, Waste Types, Residential Construction Waste Management.

UNIT II:

Recycling Demolition Wastez: The Site Audit, The Market Audit, Demolition Recyclables, Hazardous Waste, Reuse of Existing Materials ABC: Asphalt, Brick, and Concrete Recycling, Structural Steel, Wood Framing and Heavy Timber, Glass, Plastics and Composites, Rubber, Gypsum Wallboard.

UNIT III:

The Recycling Waste Management Plan: Create the Plan, Define the Goals, Define the Waste Products, Plan the work, Educate subcontractors and suppliers, Recycling Zone management.
Compliance Connection: Waste management Credits under LEED, Innovation and Design process Credits, Waste Management Policy Compliance.

UNIT IV:

Recycling : Reasons to Recycle, The Waste Management Streams, The Economic Case About LEED and other Certification, The Choice of Method, The Recycling Method, Buy Recycled Products, Repair and Rehabilitation Methods, Documenting Compliance; Contractor-Generated Information, Outside Information Management, Special Items Documentation.

UNIT V:

Resources: Contaminants in CD waste Equipment, Salvage Materials, Checklist, Density Conversion Factors, Marketing Construction Site Recycling; Recycling Marketing and Public Relations, Marketing to the Public, Marketing to Recyclers, Recycling to Unusual Materials.

Text Books

T1. Greg Winkler, *Recycling Construction and Demolition Waste: A LEED-Based Toolkit (Green Source)*, 2006 (Google ebook), McGraw-Hill Professional.

T2. Springer, *Recycling and Resource Recovery Engineering*, Springer-Verlag Berlin Heidelberg (1996), CPWD GOI, New Delhi.

Reference Books

R1. William P. Spence, *Construction Materials, Methods & Techniques*, Yesdee Publication, 2012.

E-resources and Digital Material

--

24CE720D
SUSTAINABLE MATERIALS AND GREEN BUILDING

Course Category: phd	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Building materials and Concrete technology	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand principles of sustainability and apply life-cycle analysis to evaluate construction materials and techniques.
2. **CO2:** Analyze intrinsic properties of materials affecting sustainability and durability in construction.
3. **CO3:** Evaluate sustainable alternatives for aggregates, cement, and concrete, incorporating innovative materials and recycling strategies.
4. **CO4:** Assess durability and sustainability of advanced materials like FRPs, steel, and masonry, emphasizing life-cycle performance.
5. **CO5:** Design green and energy-efficient buildings through advancements in nanotechnology and sustainable building practices.

Course Content

UNIT I: Introduction to Sustainability in Construction

Sustainable construction principles and material selection. Life-cycle analysis (LCA): Origins, processes, and challenges in construction. Key intrinsic properties influencing sustainability: Diffusion coefficient, porosity, permeability, and heat-mass interaction. Durability of bio-based materials.

UNIT II: Aggregates, Cement, and Concrete

Aggregates: Types, production substitutes, and recycling strategies. Innovations in alternative aggregates and sustainable management practices. Environmental, economic, and societal responsibilities in aggregate sourcing. Cement and concrete: Environmental impacts, CO emissions, and resource depletion. Role of cement replacement materials and strategies for sustainable concrete structures.

UNIT III: Durability in Sustainable Materials

Environmental exposure and material properties. Methods for assessing and improving durability in recycled aggregates and bio-based materials. Impact of durability on life-cycle assessments. Fibre-Reinforced Polymers (FRPs): Durability, sustainability concepts, embodied energy, and life-cycle cost analysis.

UNIT IV: Metals and Nanotechnology in Construction

Metals in construction: Sustainability aspects, types, and corrosion protection. Masonry materials: Properties, sustainability, and design life of buildings. Nanotechnology applications in construction: Recent advances, special properties, and sustainable solutions.

UNIT V: Energy-Efficient Building Development

Passive and low-energy designs. Sustainability through improved energy efficiency and embodied energy in construction. Advances in HVAC systems and simulation studies for sustainable building practices. Challenges and opportunities in achieving energy-efficient buildings.

Text Books

T1. Jamal M. Khatib, *Sustainability of Construction Materials*, CRC Press, 2009.

T2. Amritanshu Shukla and Atul Sharma, *Sustainability through Energy-Efficient Buildings*, CRC Press, 2018.

Reference Books

R1. William P. Spence, *Construction Materials, Methods & Techniques*, Yesdee Publication, 2012.

R2. P.K. Mehta and P.J.M. Mantreio, *Concrete Structure Properties & Materials*, Prentice Hall.

R3. M.L. Gambhir and Neha Jamwal, *Building Materials*, Tata McGraw Hill.

R4. *New Building Materials and Construction World Magazine.*

R5. C.J. Kibert, *Sustainable Construction: Green Building Design and Delivery*, 3rd Ed., John Wiley, 2008.

R6. *Energy Conservation Building Code (ECBC).*

R7. *Sustainable Engineering Practice*, ASCE Publication, 2010.

R8. *Sustainable Industrial Design and Waste Management*, Hagger Techniz Book, 2010.

R9. *Energy Economics and Building Design*, Willan T. Mayer.

R10. *National Building Code, Part 0-10*, Bureau of Indian Standards, 2005.

R11. G.T. Miller Jr., *Living in the Environment: Principles, Connections, and Solutions*, 14th Ed., Brooks Cole, 2004.

E-resources and Digital Material

https://nptel.ac.in/courses/105107219

24CE720E
CHARACTERIZATION OF CONSTRUCTION MATERIALS

Course Category: phd	**Credits:** 3
Course Type: Theory	**Lecture - Tutorial - Practice:** 3 - 0 - 0
Prerequisites: Building materials	**Continuous Evaluation:** 40 **Semester End Evaluation:** 60 **Total Marks:** 100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:**understand and classify construction materials based on their physical, mechanical, and chemical properties for specific construction applications.
2. **CO2:** analyze the mechanical properties of materials, such as strength, elasticity, and hardness, to ensure their suitability for structural requirements.
3. **CO3:** evaluate the thermal and durability characteristics of construction materials to predict their performance under varying environmental conditions.
4. **CO4:**apply advanced material characterization techniques, including microscopy, spectroscopy, and non-destructive testing, to investigate material behavior.
5. **CO5:**integrate sustainable and innovative materials into construction practices by understanding modern trends and addressing real-world challenges.

Course Content

UNIT I: Introduction

Overview of Construction Materials - Role of Material Characterization - Physical Properties - Standards and Codes.

UNIT II: Mechanical Properties of Construction Materials

Strength Analysis - Elastic and Plastic Behavior - Hardness and Toughness - Fatigue and Creep

UNIT III: Thermal and Durability Properties

Thermal Properties - Durability Factors - Aging and Service Life - Case Studies

UNIT IV: Advanced Characterization Techniques

Microscopy methods - Spectroscopy techniques - Non-destructive testing - Thermal analysis

UNIT V: Case Studies and Modern Innovations

Sustainable materials - Advanced materials - Field applications - Emerging trends

Text Books

T1. William D. Callister and David G. Rethwisch, "Materials Science and Engineering: An Introduction (10th Edition)", Wiley Publishing.

T2. P. Kumar Mehta and Paulo J.M. Monteiro, "Concrete: Microstructure, Properties, and Materials (4th Edition), McGraw-Hill Education Publishing.

T3. Sam Zhang, Lin Li, and Ashok Kumar, "Material Characterization Techniques", CRC Press Publishing.

T4. Zongjin Li, "Advanced Concrete Technology", Wiley Publishing.

Reference Books

R1. Ferdinand P. Beer, E. Russell Johnston Jr., and John T. DeWolf, "Mechanics of Materials (7th Edition)", McGraw-Hill Education Publishing.

R2. R. Chudley and R. Greeno, "Building Construction Handbook (11th Edition)", Routledge Publishing.

R3. Neville A.M, " Properties of Concrete (5th Edition)", Pearson Publishing

E-resources and Digital Material

E-resources and digital material Characterization of Construction Materials - Course (nptel.ac.in)

24CE720F
URBAN TRANSPORTATION SYSTEMS PLANNING

Course Category:	PhD	**Credits:**	3
Course Type:	**Theory (NPTEL)**	**Lecture - Tutorial - Practice:** 3 - 0 - 0	
Prerequisites:	NIL	**Continuous Evaluation:**	00
		Semester end Evaluation:	100
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Analyze various stages in the transport planning process.
2. **CO2:** Apply various methods for data collection by trip generated.
3. **CO3:** Apply traditional and synthetic methods of trip distribution.
4. **CO4:** Apply and finalize the route choice and network design.
5. **CO5:** Understand urban transportation modeling and forecasting.

Course Content

UNIT I:

Introduction to Urban Transportation Planning Urbanization, Urban Transportation: Impacts, Behavioral Changes, Urban Transportation problems & Externalities (Congestion, Safety, Emissions, etc.). Introduction to Transport planning; Transport Planning Morphology: Problem definition, Solution generation, solution analysis, Evaluation and choice, Implementation. Hierarchical levels of Urban Transport Planning: Conceptual Plan, Outline plan, Master plans, statutory or advisory plans, detailed development plan.

Overview of 4-Stage Urban Transportation Planning Process: Urban Activity forecasts, Trip generation, Trip Distribution, Mode Choice, Traffic assignment Specification, Calibration, Validation and Forecasting. Information needs for Travel Demand Forecasting: Study Area, Urban Activities, Zoning, Urban Activities, Transportation System, Travel information, Types of Movements. Data Collection Techniques (Home-interview survey, Commercial vehicle survey, Innovative Commercial Vehicle Tracking Methods, Intermediate Public Transport Survey, Cordon-Line Survey, Post-Card Questionnaire Survey, Registration – Number Survey, License Plate Follow-Up Survey Technique, Tag-on-Vehicle Survey).

UNIT II: Trip Generation

Introduction; Basic considerations in trip generation - amount of urban activity, character of urban activity, other considerations, special generators. Trip classification; Factors affecting trip generation Methods of trip Generation- Regression analysis, trip rate analysis,

cross classification analysis. Multiple Linear Regression: Regression analysis concept; The stepwise approach with examples.

Considerations for zonal-based multiple regression, household-based multiple regression, matching productions and attractions. Category analysis - Basic approach, specifying trip generation model (trip production model structure, trip attraction model structure, Internal-External trip generation), Trip generation model calibration (developing trip production rates, developing trip attraction rates), advantages and disadvantages. Stability of trip generation model- Temporal stability, geographical stability; Trip generation model application- Trip production model application, Trip attraction model application.

UNIT III: Trip Distribution

Introduction, Basic considerations in Trip Distribution, P-A Matrix to O-D Matrix, Factors affecting trip distribution: Properties of transport network, spatial separation between various zones. Growth factor methods: Uniform factor method, Average factor method, Detroit Method, Fratar method, Furness method. Synthetic methods: Introduction to Gravity Model, Gravity Model Calibration, BPR Approach of Calibration, Intervening opportunities model: Concept, Advantages, Limitations, Illustrative example. Competing opportunities model, Limitations. Doubly restrained model: Concept, Calibration, Linear programming approach to Trip Distribution: Concept, limitations.

UNIT IV: Modal Split

Introduction; Influencing factors of mode choice; Types of modal split models: Trip end type and trip interchange type. Types of modal split models: Trip end type (Southern Wisconsin Model) and trip interchange type (Diversion curve model), Limitations, Aggregate and disaggregate models, advantages of disaggregate over aggregate modelling. Elements of choice decision process; Framework for the choice process of an individual. Disaggregate mode choice models- Introduction, Utility theory, Probabilistic choice theory.

Binary choice models: Binary logit model, discriminant analysis, Probit analysis; Logit model; Multinomial Logit model; Nested logit model, Estimation of logit models, Two-stage modal split models.

Traffic Assignment: General, link cost function, Person-trips and vehicle Trips, diurnal patterns of demand, Trip directions. Network properties: Link, nodes, characteristics of link (capacity, free flow speed, travel time, etc.), link flows, interzonal flows, Network connectivity, Minimum spanning tree, shortest path, etc. Network Algorithms: Kruskal, Prims, Dijkstra, Floyd.

Route Choice Behavior: User equilibrium, system equilibrium, stochastic equilibrium, Diversion Curves: California diversion curves, Detroit diversion curves, Bureau of Public roads diversion curves. Deterministic traffic assignment techniques: All-or-nothing assignment, Multi-Path Traffic Assignment; Incremental assignment, capacity restraint assignment; Stochastic Traffic assignment techniques; Dynamic traffic assignment techniques: Basic Concepts and Approach.

UNIT V: Land Use and Transportation

Introduction, Urban land use planning- land use and land cover, land use classification; Land use transportation interaction; Accessibility and mobility, Land use models.

Urban Goods Movement: Introduction, Classification of urban goods movement; Factors affecting goods movement; Modelling Approaches, Data collection, Strategy for goods transport facility planning, Facilities required in goods terminals, Time series techniques for forecasting truck traffic. Emerging Trends in Transportation planning: Activity based modelling; Spatial data infrastructure (SDI); Big Data analytic.

E-resources and Digital Material

http://www.nptel.ac.in/105105208

24CE720G
ENVIRONMENTAL GEOMECHANICS

Course Category:	PhD	**Credits:**	3
Course Type:	**Theory (NPTEL)**	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Entry level chemistry course, and understanding of chemical, physical and biological processes on Environmental Engineering	**Continuous Evaluation:**	00
		Semester end Evaluation:	100
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the interdisciplinary connection between geotechnical engineering and environmental challenges.
2. **CO2:** Characterize the physico-chemical and mineralogical properties of soils and their implications on geomechanical behavior.
3. **CO3:** Analyze soil-water-air interactions and assess their influence on geomechanical properties like shrinkage, swelling, and cracking.
4. **CO4:** Evaluate mass transport phenomena and soil's thermal and electrical properties for various environmental applications.
5. **CO5:** Develop sustainable solutions for geoenvironmental issues, considering legal frameworks and societal impacts.

Course Content

UNIT I: Introduction to Environmental Geomechanics

Scope and relevance of Environmental Geomechanics - Nature of soil and its role in geoenvironmental challenges - Overview of natural and manmade environments.

UNIT II: Soil Characterization

Physico-chemical properties of soil - Mineralogical properties of soil - Soil-water-air interaction.

UNIT III: Soil Behavior and Hydraulic Properties

Shrinkage and swelling characteristics - Cracking mechanisms in soils - Hydraulic conductivity and its environmental implications.

UNIT IV: Mass Transport and Soil Properties

Mass transport phenomena in soils - Thermal and electrical properties of soils - Case studies on soil behavior in environmental contexts.

UNIT V: Applications in Geoenvironmental Engineering

Containment of pollutants: landfill design and remediation techniques - Sustainable practices in geotechnical engineering - Legal and regulatory considerations in addressing geoenvironmental issues.

E-resources and Digital Material

https://archive.nptel.ac.in/courses/105/101/105101200/

24CE720H
APPLIED ENVIRONMENTAL MICROBIOLOGY

Course Category:	PhD	**Credits:**	3
Course Type:	**Theory (NPTEL)**	**Lecture - Tutorial - Practice:**	3 - 0 - 0
Prerequisites:	Environmental Engineering and Environmental Studies	**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

1. **CO1:** Understand the basic microbiology and microbial energetics cycle.
2. **CO2:** Understand the microbial metabolism, growth and ecosystems.
3. **CO3:** Study the investigations in environmental microbiology.
4. **CO4:** Analyze the wastewater microbiology and bioremediation.
5. **CO5:** Understand the epidemiology and role of bioinformatics tools.

Course Content

UNIT I:

Introduction; cell elements and composition cell and its composition, cytoplasmic membrane prokaryotic cell division microbes and their environmental niches historical roots of microbiology, nucleic acids and amino acids DNA structure, replication, and manipulation protein and its structure; regulation microbial nutrition microscopy: light microscopy, 3D Imaging, AFM, Confocal canning laser microscopy; Microbial energetics cycle and diversity Stoichiometry and bioenergetics Oxidation-reduction NAD, energy-rich compounds and energy storage Mathematics of microbial growth Glycolysis Respiration Citric-acid Catabolic Alternatives Phototrophy, Chemolithotrophy, anaerobic respiration (Nitrate and Sulfate reduction; Acetogenesis; Methanogenesis; Metal, Chlorate, and organic electron acceptors).

UNIT II:

Microbial metabolism and functional diversity of bacteria prokaryotic diversity classical taxonomy life tree of life major catabolic pathways catalysis and enzymes energy conservation sugars and polysaccharides, amino acids, nucleotides, lipids; microbial ecosystems population, guilds, and communities environments and microenvironments microbial growth on surfaces environmental effects on microbial growth; environmental genomics and microbial ecology; genetic exchange environmental genomics microbial ecology horizontal and vertical gene transfer: replication, transformation transduction.

UNIT III:

Microbial symbiosis and virus, mutation and its rate, genetic recombination, population dynamics, virus, viroid, prion, application of environmental microbes; investigations in environmental microbiology: sampling, detection, isolation, taxonomic and functional annotation and quantification; introductory bioinformatics and data analysis microbial sampling culture based and culture independent tools molecular biology tools: cloning, amplification, sequencing, case study.

UNIT IV:

Bioremediation and wastewater microbiology, bioremediation and examples, acid mine drainage, enhanced metal recovery, wastewater microbiology, drinking water microbiology, drinking water microbiome and treatment, microbial instability, water borne microbial diseases, solid waste microbiology and antimicrobial resistance, landfills, leachate, anaerobic degradation phases, antimicrobial resistance.

UNIT V:

Epidemiology and Biosensors, Public health, epidemics, biosensors, wearable biosensors, built microbiology, exposomes and bioinformatics, exposure routes, microbes living around us, exposomes, basic bioinformatics, bioinformatics tools available online.

E-resources and Digital Material

https://archive.nptel.ac.in/courses/105/107/105107173/#