S. No.	Course Code	Course Name	Category	Type	Credit	L	T	P
1		Management*	PC	Theory				
2		Major Project	Project	Theory				
3			AEC	Theory				
4			AEC	Theory				
5			OE	Theory				
6			OE	Theory				

List of Programme Electives (PE), 03 Credits		
S.NO.	**COURSE**	**COURSE CODE**
1	Concrete Technology	CET 401
2	Design of Hydraulic Structures	CET 402
3	Ground Improvement Techniques	CET 403
4	Air & Noise Pollution	CET 404
5	System Analysis	CET 405
6	Industrial Waste Treatment	CET 406
7	Prestressed Concrete	CET 407
8	Urban Water Conveyance System Design	CET 408
9	Traffic Engineering and Traffic Planning	CET 409
10	Sustainable Building Project Delivery	CET 410
11	Construction Project Management	CET 411
12	Solid Waste Management	CET 412

List of Advanced Elective Courses (AEC), 03 Credits		
S.NO.	**COURSE**	**COURSE CODE**
1	Introduction of Spatial Data Collection and Analysis	CET 420
2	Construction Information System	CET 421
3	Structural Dynamics	CET 422
4	Finite Element Method	CET 423
5	Advanced Foundation Design	CET 424
6	Design of Steel Structural Systems	CET 425

List of Open Elective Courses (OE) for students of other departments.		**COURSE CODE**
S.NO.	**COURSE**	
1	Introduction to Remote Sensing & GIS	CET 431
2	Numerical Methods	CET 432
3	Earthquake Disaster Mitigation	CET 433
4	Water Conservation Techniques	CET 434

PROGRAMME ELECTIVES (PE)

UG	**Department:** Civil Engineering
Course Code:CET 401	**Course Name:** Concrete Technology
Credit:4	**L-T-P:** 2-1-0
Version:	**Approved on:**
Pre-requisite course: Building Technology	

Syllabus

Review of constituent materials and mix design, admixtures, Properties of concrete in fresh and hardened state, Special concretes, Durability of concrete subjected to extreme environment, Deterioration mechanisms, assessment and control of corrosion in concrete structures, In-situ assessment of concrete structures, Various NDT techniques and their applications, Repair of concrete structures.

Text Books

1. Concrete technology by A. M. Neville, Pearson education India.
2. Concrete Technology by Krishnaraju
3. Concrete Technology by Gambhir

UG	Department: Civil Engineering
Course Code: CET 402	Course Name: Design of Hydraulic Structures
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Water Resources Engineering, Hydrology	

Syllabus

Introduction; type of hydraulic structures and their function; consideration for their selection.

Dams; Design principles of gravity and earth dams; spillway; types of spillway: Ogee, chute, shaft, side channel and siphon spillway; spillway aerators; spillways; Design of ogee spillway.

Diversion headworks; Components of diversion head work and their design.

Channel transitions; Design of channel transitions for sub critical and super critical flows; cross and distributory head regulators; energy dissipation downstream of falls; Cross drainage structures: Super passage, aqueducts, design of cross drainage structures, Design of outlets.

Books:

1. Water Resources Engineering by Linsley&Franzini
2. Irrigation Engineering by G.L. Asawa
3. Water Resources & Water Power Engg. By P.N. Modi.

UG/PG: UG	Department: Civil Engineering
Course Code: CET 403	Course Name: Ground Improvement Techniques
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Soil Mechanics and Design of Foundations	

Syllabus

Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement, Shallow and deep compaction requirements, Principles and methods of soil compaction. Shallow compaction and methods, properties of compacted soil and compaction control, deep compaction and vibratory methods, dynamic compaction. Ground Improvement by drainage, Dewatering methods, Design of dewatering systems, Preloading, Vertical drains, vacuum consolidation, Electro-kinetic dewatering, design and construction methods. Cement stabilization and cement columns, Lime stabilization and lime columns, Stabilization using bitumen and emulsions, Stabilization using industrial wastes. Construction techniques and applications, Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions, Soil nailing, rock anchoring, micro-piles, design methods, construction techniques, Case studies of ground improvement projects. Soil Reinforcement and Geosynthetics, design principles and influencing factors, Use of geosynthetics for filtration, drainage, roads, and landfills.

Books

1. Ground Improvement Techniques by Dr. P. Purushottam, Laxmi Publications, New Delhi
2. Construction and Geotechnical methods in foundation engineering, by Koerner, MGH
3. Engineering with Geo-synthetics, by GV Rao & GVSS Raju, Tata McGraw Hill, New Delhi.
4. G. Venkatappa Rao, "Geosynthetics an Introduction", Sai Master Geoenvironmental Pvt Ltd.
5. Nainan P. Kurian, "An Introduction to Modern Techniques in Geotechnical and Foundation Engineering", Narosa Publishing House, New Delhi.
6. G.L. Sivakumar Babu, "An Introduction to Soil Reinforcement and Geosynthetics", Universities Press (India) Pvt Ltd, Hyderabad, A.P, India.

UG	**Department:** Civil Engineering
Course Code: CET 404	**Course Name:** Air and Noise Pollution
Credit: 3	**L-T-P:** 3-0-0
Version:	**Approved on:**

Pre-requisite course:

Syllabus

Sources of air pollution; Classification of aerosols, Gases vapors, natural pollutants; Properties of air pollutants; Standards of air quality. Emission inventories & Emission factor; Meteorological factors influencing dispersion of air pollutants; Gaussian plume model for dispersion of air pollutants and its applications; Effects on man, material, vegetation, art treasure; Air pollution disasters; Economic Effects of air pollution; Global Effects of Air pollution; Air pollution Due to Automobiles and emission control; General concept of transport planning for prevention of air pollution; Control technology for particulate and gaseous pollutants. Basics of noise Pollution; Measurement of noise; permissible noise levels in different zones; effects of noise, Control of Noise Pollution.

Books:

1. Air Pollution: Its Origin & Control: Wark, Warner & Davis
2. Air Pollution: Perkins.
3. Noise Pollution and Control: S P. Singhal
4. Air pollution and control, KVSG Muralikrishna, Kaushal and Co., ND.

UG	**Department:** Civil Engineering
Course Code: CET 405	**Course Name:** System Analysis
Credit: 4	**L-T-P:** 2-1-0
Version:	**Approved on:**
Pre-requisite course:	

Syllabus

Definitions; synthesis and control; linear time variant systems; transfer function; impulse response; state transition matrix; system synthesis; objectives of a design, direct and indirect method of optimization; optimality conditions for unconstrained problem; linear programming; dual sensitivity; gradient method; steepest descent method. Dynamic programming; single degree of difficult problems; examples from Civil Engineering design; stochastic processes; decision process in engineering; decision making under uncertainty and under risk.

Books:
1. Optimisation by S.S. Rao
2. Optimisation by Wagner

UG	**Department:** Civil Engineering
Course Code: CET 406	**Course Name:** Industrial Waste Treatment
Credit: 3	**L-T-P:** 3-0-0
Version:	**Approved on:**
Pre-requisite course: Sanitary Engineering	

Syllabus

Sources and characteristics, Effects of Discharges of Industrial Waste on receiving bodies of water, land and Sewer. Effluent and stream standards. Specific Industrial treatment Processes: Neutralization, Equalization and proportioning, Volume and strength Reduction. Raw Materials, water Requirement, Flow Sheet and treatment of Industrial Wastewater Generated form: Textile Tannery, Pulp and Paper, Dairy, Distillery, Dying and Printing, and electro-plating Industry. Provisions of various Indian standards for above Industries.

Potentials for Wastewater recycle and reuse in industries, Concept of Common effluent treatment plants.

Books:

1. Industrial Wastewater by Nelson L Nemerow
2. Industrial water pollution control, William Wesley Eckenfelder
3. Industrial Wastewater Treatment by Rao & Dutta

UG	Department: Civil Engineering
Course Code: CET 407	Course Name: Prestressed Concrete
Credit: 3	L-T-P: 3-0-0
Version:	Approved on:
Pre-requisite course: Design of RC Structures	

Syllabus

Basic philosophy of prestressing; various techniques of prestressing; different systems of prestressing; Prestressing of concrete structures; losses in prestress; deflection of prestressed concrete members; analysis and design of prestress beams; camber; deflection; cable layouts; stretching in stages, ultimate strength in flexure and shear. Design of end blocks; Statically indeterminate structures; concordant cables; linear transformation, Analysis and design of continuous beams. Tension members; circular prestressing-prestressed tanks and prestressed pipes. Compression members; piles. Partial prestressing; composite construction, analysis of composite beams, prestress slabs; Introduction to pre-cast prestressed elements like poles, railway sleepers, beams, slabs and wall panels etc. planning and economical aspects of prestressed structures, construction of prestressed concrete structures-techniques, materials and management

Books:

1. Prestressed Concrete Structures by T.Y. Lin

2. Prestressed Concrete Structures by Krishnaraju

3. Prestressed Concrete Structures by G.S. Pandit & S.P. Gupta.

UG/PG : UG/PG	**Department:** Civil Engineering
Course Code: CET 408	**Course Name:** Urban Water Conveyance System Design
Credit: 4	**L-T-P:** 2-1-0
Version:	**Approved on:**
Pre-requisite course: Pipe and Channel Hydraulics	

Syllabus

Urban hydrological cycle and components; Impact of urbanisation on hydrological cycle; Anomalies & characterisation of rainfall; Time and scale effects; Urban hydrological data requirements and analysis; Rainfall-runoff modelling and simulation using TR-20, TR-55 and SWMM/EPANET/HEC models; Planning & design aspects of storm water/drainage infrastructure; Water supply conveyance system analysis and design. Operation and maintenance of urban water conveyance system.

Text Books

1. Hall, M.J., Urban Hydrology, Elsevier, 1984.
2. Optimal Design of Water Distribution Networks, P. R. Bhave, Narosa Publishing House, 2003.
3. Butler, D. & Davies, J.W. Urban Drainage, Spon Press, 2nd Edn., 20004.

Reference Books

1. Leonard, O.J. & Sherrif, J. Scope for the Control of Urban Runoff. Report 124, CIRIA, 1992.
2. DOE/NWC Design and Analysis of Urban Storm Drainage. The Wallingford Procedure. Dept. of the Environment, Standing technical Committee Report 28, 1981.
3. Shaw, E.M. Hydrology in Practice. 3rd Edn., Chapman & Hall, 1994

UG/PG: UG	Department: Civil Engineering
Course Code: CET 409	Course Name: Traffic Engineering and Transport Planning
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Highway Engineering	

Syllabus

Traffic Engineering: Volumetric traffic studies, Traffic-volume study, traffic-speed study, Origin and Destination studies, Parking studies and accident study, their objectives, methods, analysis and interpretation. Roadway capacity and level of service concept. Geometric improvement of intersections. Street lighting. Impact of traffic on environment. Traffic flow characteristics; Traffic Control & Parking Studies: Traffic & parking problems, requirements & design standards for on street parking, off-street parking . Importance of traffic signs, general principles & types of traffic signs, advantages & disadvantages of traffic signals, signal phases, number and location of signal phases. Transport Planning: Various transportation systems, their classification, suitability, merits & demerits. Methodologies of planning transport systems, transport surveys. Trip-generation & distribution. Traffic assignment and model split. Mass transit systems, planning, design and operation.

Books
1. Transport Engineering and Transport Planning By L.R.Khadyali
2. Highway Engineering By S.K.Khanna and C.E.G Justo
3. IRC 93,
4. Transportation Engineering by James H Banks

UG/PG: UG	Department: Civil Engineering
Course Code: CET 410	Course Name: Sustainable Building Project Delivery
Credit: 3	L-T-P: 3-0-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Introduction to sustainable development ; Energy and environmental issues in built environment; Concept of eco friendly materials and designs, Reuse-reduce and recycling of material, waste utilization in construction materials; Professionals associated in a sustainable building project, roles and responsibilities of engineers and managers, integrated project management, certified professionals for sustainable projects, project delivery and documentation for certification of sustainable buildings; Introduction to green movement and sustainable buildings, sustainable building economics, concepts of life cycle costing ; Introduction to sustainable building design and rating systems, Requirements and submittals, national and international certification processes (LEED, LEED India, GRIHA-TERI, etc), exposure to related standards and organizations, associated tools and terminology, continual improvement, case studies.

Text Books

1. Sustainable construction, design and delivery by Charles Kibert
2. LEED Green building rating System
3. GRIHA Building rating system

UG	**Department:** Civil Engineering
Course Code: CET 411	**Course Name:** Construction Project Management
Credit: 3	**L-T-P:** 3-0-0
Pre-requisite course:	

Syllabus

Project management concepts, construction firms- management hierarchy, Architect-Engineers-Contractors/Managers relationships, Roles of construction managers; Construction contracts, project delivery methods; Project proposal, project feasibility, request for proposal, project drawings, estimation and bidding, job site layout, contracting the project, sub contractors procurement, resources procurement; Fundamental concepts of equipment economics and equipment management, equipment selection ; Construction plans, work study, work breakdown structure (WBS), construction job-site layout, construction procurements, Time estimates, PERT, CPM, linear scheduling, project scheduling, monitoring, updating, cost functions, time –cost trade off, resource planning leveling and allocation, resource based networks, project cost and schedule of values, change orders, cost budgeting ; Concepts of Risk management, safety management, and quality management; Project monitoring and reporting; Construction claims, Arbitration, project closeout ; Concept of lean construction. Introduction to BIM.

Text Books:
1. Construction Management and Planning by Sengupta and Guha TMH Publications
2. Construction project management by Kumar Neeraj Jha Pearson Publications
3. Construction planning equipment and methods by Peurifoy TMH publications

Reference Material:

1. Construction management fundamentals Knutson MGH publications
2. IS 15883 : 2009 Construction Project Management

UG	Department: Civil Engineering
Course Code: CET 412	Course Name: Solid Waste Management
Credit: 3	L-T-P: 3-0-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Problems associated with solid waste disposal; generation of solid wastes; Classification of solid; characteristics of solid waste; analysis of solid waste; Onsite handling, storage and processing of solid waste; Solid waste collection systems; options for transfer and transport systems; processing and disposal methods;   Recovery of resources, conversion products and energy generation from solid waste, Biomedical waste definition; Biomedical Handling Rules; Waste Category; waste minimization; Handling and Disposal; Biomedical waste treatment; Electronic waste and its management.

Books:

1. Integrated Solid Waste Management: Tchobanoglous, Theisen and Vigil

2. Hazardous Waste Management: Wentz

3. Environmental Engineering, Howard Peavy, D. Rowe.

ADVANCED ELECTIVE COURSES

UG/PG : UG (Advance Elective Course)	Department: Civil Engineering
Course Code: CET 420	Course Name: Introduction to spatial data collection & analysis
Credit: 3	L-T-P: 3-0-0
Version:	Approved on:
Pre-requisite course: Surveying	

Syllabus

Remote Sensing: Basic concepts, Remote Sensing Platforms & Sensors; Remote sensing data products; Geometric & Radiometric corrections; Visual interpretation and digital image processing; Image Classification, Accuracy Assessment; Image Processing Software.

Overview of GNSS techniques, Introduction to the GNSS functions, Components and operation of GNSS; Surveying and data collection using GNSS; Overview of 3D Terrestrial Scanners and Ground Penetrating Radar.

Geographic al Information System; Basic concepts and components of GIS; Digital representation of geographic data, Database creation, Raster and Vector based GIS data and analysis, Database management; Operations and analysis in GIS; Introduction of GIS software.

Application case studies of spatial data collection and analysis techniques.

Basic Textbooks
1. Remote Sensing & Digital Image Processing: by Lillesand & Keifer, John Wiley & Sons, Inc.
2. Introductory digital image processing: a remote sensing perspective, J. R., Jensen, Prentice Hall
3. Global Navigation Satellite Systems (GNSS), G. S. Rao, Tata McGrahill publications.
4. Principles of geographical information system, P. Burrough, Oxford University Press.

Reference Books
1. Chou, Yue-Hong. 1997, Exploring spatial analysis in geographical information systems, OnWord Press, USA
2. Christopher Jones. 2002, Geographical information systems and computer cartography Longman, London.

UG/PG: UG	**Department:** Civil Engineering
Course Code: CET 421	**Course Name:** Construction Information systems
Credit: 3	**L-T-P:** 2-0-2
Version:	**Approved on:**
Pre-requisite course:	

Syllabus

Introduction to IT in construction, ERP in construction, use of IT in improving productivity and communication in construction, Management information systems in construction industry, computerized project management systems, internet technology, web applications and e- business in construction; Building Information modelling concepts, software(s) used for BIM, REVIT working platform, Detailed project work based on REVIT Arch and MEP, Integration of REVIT with other project management software e.g. AUTO CAD, and NavisWorks, introduction to green building software

Text Books:
1. Understanding IT in construction by Ming sun
2. BIM Handbook by Chuck Eastman
3. REVIT Tool Manuals by Autodesk

UG/PG: UG	Department: Civil Engineering
Course Code: CET 422	Course Name: Structural Dynamics
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Structural Analysis	

Syllabus

Systems with one degree of freedom; undamped system free and forced vibrations, dynamic load factor, different load pulses, damped systems, free and forced vibration response to a pulsating force of damped and damped system. Vibration of multi-degree freedom systems numerical techniques for finding natural frequencies and mode shapes; orthogonal relationship of principle modes; Rayleigh's principle and its application for determination of fundamental frequency. Evaluation of dynamic response by mode superposition method. Application of structural dynamics to civil engineering problems.

Text Books
1. Structural Dynamics by A.K. Chopra.
2. Structural Dynamics by Mario Paz.

UG/PG: UG	Department: Civil Engineering
Course Code: CET 423	Course Name: Finite Element Method
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Structural Analysis-I & Structural Analysis-II	

Syllabus

Introduction, Variational principle, Principle of virtual work, Theory of minimum potential energy, Ritz Method, Interpolation & Representation of curves, elements of elasticity, finite element formulation, Various types of elements, solution procedures, convergence criterion, Isoparametric formulation, Lagrange & Serendipity elements, One dimensional and two dimensional elements

Books:
1. Matrix & Finite element displacement analysis of structures by D. J. Dave
2. Concepts & applications of Finite Element Method by R. D. Cook
3. Finite Element procedures in Engineering Analysis by K. J. Bathe
4. Finite Element Method vs Classical Methods by H.S. Govindarao
5. The Finite Element Method in Engineering by S. S. Rao

UG/PG: UG	Department: Civil Engineering
Course Code: CET 424	Course Name: Advanced Foundation Design
Credit: 4	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: Soil Mechanics, Design of Foundations and Earth Structures.	

Syllabus

Introduction, Foundation Choice, Definitions, Requirements, Types of foundations, Shallow foundations, Types of failures, bearing capacity, Settlement analysis, Contact stress beneath foundations, Beams on elastic foundations, Modulus of subgrade reaction, Special foundations, Foundations in expansive soils (CNS concept), Underreamed pile foundations, Remedial measures for cracked buildings. Foundation of transmission line towers, Under pinning of foundations, Importance and situations for underpinning, methodology, Typical examples of under pinning, Pile Foundation, Bridge substructures, Maximum depth of scour, Depth of foundation, Allowable bearing pressure, loads to be considered, Well Foundation, Lateral stability of well foundation, Design of pier cap, Design of pier, Sinking stresses in wells, Design of well components, Reinforced earth.

Books

1 A.P.S. Selvadurai, "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific Publishing Company.
2. Braja M. Das, "Principles of Foundation Engineering", PWS Publishing Company.
3. Joseph Bowles, "Foundation Analysis and Design", McGraw-Hill Book Company.
4. V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors, New Delhi.
5. Tomlinson, M.J. " Foundation Design and Construction", English Language Book Society, Longman.
6. Swami Saran, "Analysis and Design of Substructures", Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

UG	**Department:** Civil Engineering
Course Code: CET 425	**Course Name:** Design of Steel Structural Systems
Credit:4	**L-T-P:** 2-1-0
Version:	**Approved on:**
Pre-requisite course: Design of Steel Structures	

Syllabus

Structural Steels, Brittle fracture and fatigue ,Stability of Beam Columns, frames and plates, advanced Plastic design of Steel Structures, design of Gantry Girders, Plate Girder bridge, Truss Girder Bridge, Steel Tanks ,using latest IS codes.

References

1. Plastic Analysis & Design Of Steel Structures : Wong
2. Design of Steel Structures: N Subramanium
3. Limit State Design of Steel Structures: S.K.Duggal
4. Design of Steel Structures: P Dayaratnam.

OPEN ELECTIVES

UG/PG : UG	Department: CIVIL ENGINEERING
Course Code: CET 431	Course Name: Introduction of remote sensing & GIS
Credit: 3	L-T-P: 3-0-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Remote Sensing: Basic concepts, Multi-Concepts in Remote Sensing, Advantages of Remote Sensing data, Applications of Remote Sensing; Remote Sensing Platforms & Sensors; Remote sensing data products; Referencing scheme, Digital data Format and characteristics;, High Resolution Images, Image Processing Software; Geometric & Radiometric corrections, Visual Image Interpretation Methods, Digital Image Enhancement, Digital Image Classification Methods, Accuracy Assessment; Geographical Information System; Basic concepts of GIS, Digital representation of geographic data, Digitization of features, Database creation, Raster and Vector based GIS data, Overlay analysis, Buffering, Query, Spatial analysis- 3-D Analysis, Introduction of GIS software, Applications of GIS, National Map policy, National Spatial Data Infrastructure in India.

Text Books:
1. Remote Sensing & DIP: by Lillesand & Keifer, John Wiley & Sons, Inc.
1. Principles of Geographical Information Systems, by Burrough, P. A. / Burrough, P. A., Oxford University Press.

Reference Books:
1. Principles of Remote Sensing: by Curran, P. J.
2. Introduction of Digital Image Processing: by J. R. Jhonson, John Wiley & Sons, Inc.
3. Fundamentals of Geographical Information System, by DeMers, Michael N, John Wiley & Sons, Inc.
4. The GIS Book, 5th Edition, by Korte, George, Thomson Learning.

UG/PG : UG	Department: Civil Engineering
Course Code: CET 432	Course Name: Numerical Method
Credit: 3	L-T-P: 2-1-0
Version:	Approved on:
Pre-requisite course: NO & Open Elective for ALL branches VII/VIII semester (Final year) only	

Syllabus

Interpolation And Approximation: Laplace, Poisson's, Bi-harmonic and Taylors equations; Solution of equation; Fixed point iteration: $x=g(x)$ method; Newton's method; Solution of linear system by Gaussian elimination and Gauss-Jordon method; Iterative method-Gauss Seidel method, Inverse of a matrix by Gauss Jordon method; Eigen value of matrix by power method and by Jacobi method for symmetric matrix.

Numerical Differentiation And Integration: Pascal triangle for one and two dimensions, Lagrangian Polynomials; Divided differences; Interpolating with a cubic spline; Newton's forward and backward difference formulas. Differentiation using interpolation formulae; Numerical integration by trapezoidal and Simpson's rules; Romberg's method.

Integration Methods For Ode's: Describe the Adams-Bashforth, Adams-Moulton, and Backwards Differentiation families of multi-step methods; Describe the form of the Runge-Kutta family of multi-stage methods; and Explain the relative computational costs of multi-step versus multi-stage methods.

Explain the concept of stiffness of a system of equations, and describe how it impacts the choice of numerical method for solving the equations.

Explain the differences and relative advantages between explicit and implicit methods to integrate systems of ordinary differential equations; and for nonlinear systems of equations, explain how a Newton-Raphson can be used in the solution of an implicit method.

Define a convergent method; Define a consistent method; Explain what (zero) stability is; and Demonstrate an understanding of the Dahlquist Equivalence Theorem by describing the relationship between a convergent method, consistency, and stability.

Determine if a multi-step method is stable and consistent.

Define global and local order of accuracy for an ODE integration method, Describe the relationship between global and local order of accuracy, and

Calculate the local order of accuracy for a given method using a Taylor series analysis.

Define eigenvalue stability, and determine the stability boundary for a multi-step or multi-stage method applied to a linear system of ODE's.

Recommend an appropriate ODE integration method based on the features of the problem being solved.

Implement multi-step and multi-stage methods to solve a representative system of ODE's from an engineering application.

Finite Difference And Finite Volume Methods For Ode's/ Pde's: Define the physical domain of dependence for a problem, Define and determine the numerical domain of dependence for a discretization, and Explain the CFL condition and determine the time step constraints resulting from the CFL conditions.

Determine the local truncation error for a finite difference approximation of a ODE using a Taylor series analysis.

Explain the difference between a centered and a one-sided (e.g. upwind) discretization.

Describe the Godunov finite volume discretization of one/two-dimensional convection on an unstructured mesh.

Perform an eigenvalue stability analysis of a finite difference approximation of a ODE using either Von Neumann analysis or a semi-discrete (method of lines) analysis.

Implement a finite difference or finite volume discretization to solve a representative PDE (or set of ODE's) from an engineering application.

Explain how Dirichlet and Neumann boundary conditions are implemented for Laplace's equation discretized by FDM.

Describe how the FDM discretization results in a system of discrete equations and, for linear problems band describe the meaning of the entries (rows and columns) of the stiffness matrix and of the right-hand side vector for linear problems.

Incremental Nonlinear Analysis: Nonlinear ordinary differential equations & partial differential equations. Nonlinear optimization. FFTs and wavelet analysis.

The IEEE floating point standard, sparse and structured matrices and linear algebra software.

List of Matlab(R) practical problems:

Laplace equation, Poisson equation, harmonic equation, bi-harmonic equation, Symbolic nonlinear ordinary differential equations, Symbolic nonlinear partial differential equations; Nonlinear optimization, FEM problems in 1 and 2D, toolboxes for PDE, curve fitting, Taylor series, and wavelet analysis.

Books

1. F B Hildebrand, Introduction to Numerical Analysis, Dover publications, Newyork.
2. RJ Schilling & Sandra L Harris, Applied Numerical Methods for Engineering using Matlab and C.
3. Erwin Kreyszig, Advanced Engineering Mathematics
4. William H Press at al., Numerical Recipes in FORTRAN, the Art of the Scient. Comp.
5. Cornahn B., Et al, Applied Numerical Methods, John Wiley.
6. Bau III, David, and Lloyd N. Trefethen. Numerical Linear Algebra. Philadelphia, PA: Society for Industrial and Applied Mathematics, 1997. ISBN: 9780898713619.
7. V. RajaRaman, Computer Oriented Numerical Methods
8. S.D. Conte, & Cari De Boor, Elementary Numerical Analysis, Mc Graw Hill.
9. R.L. Burden and T.D. Faires, 'Numerical Analysis', Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
10. Chapra, S. C and Canale, R. P., "Numerical Methods for Engineers", 5th Edition, TataMcGraw-Hill, New Delhi, 2007.
11. Gerald, C. F. and Wheatley, P.O., "Applied Numerical Analysis", 6th Edition, Pearson Education, Asia, New Delhi, 2006.
12. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
13. Bai, et al. Templates for the Solution of Algebraic Eigenvalue Problems: a Practical Guide. Philadelphia, PA: Society for Industrial and Applied Mathematics, 2000.

UG	Department: Civil Engineering
Course Code: CET 433	Course Name: Earthquake Disaster Mitigation
Credit:3	L-T-P:2-1-0
Version:	Approved on:
Pre-requisite course:	

Syllabus

Introduction to Earthquake Hazard: Seismic hazard and seismic risk definitions, Hazard estimation, Effect of site conditions on structures

Seismic Vulnerability: Seismic Evaluation, Building Types, Micro & Macro methods, Intensity Scales, Damage probability matrix, Vulnerability functions

Earthquake Disaster: Direct and indirect damages, Ground failures in the past earthquake, Damage to structures, Associated damage due to fire and flooding, failure of embankments, dams and bridges, tsunamis.

Disaster Mitigation: Earthquake warning and evacuation, Lesson learnt, Do's and don't about earthquakes, Short term and long term mitigation, post earthquake disaster surveys, Survey proformas, Maximum credible earthquake and Design basis earthquakes, Seismic evaluation of existing buildings and structures, rapid visual screening (RVS), methods of seismic retrofitting

Books

1. Richter, C. F. (1958), "Elementary Seismology, Eurasia Publishing House (Pvt.) Ltd., New Delhi.
2. Agrawal, P. N. (1992), "Engineering Seismology", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Aki, K. and Richard, P. G. (1980), "Quantitative Seismology, Theory And Methods", Vol. I and II, W. H. Freeman & Co.
4. Reiter, L (2001)., "Earthquake Hazard Analysis, Issues and Insights", Columbia University Press.
5. "Prestandard and Commentry for The Seismic Rehabilitation of Buildings," FEMA 356 (2000), Federal Emergency Management Agency, Washington, D.C.

UG	**Department:** Civil Engineering
Course Code: CET 434	**Course Name:** Water Conservation Technology
Credit: 3	**L-T-P:3-0-0**
Version:	**Approved on:**
Pre-requisite course:	

Syllabus

Introduction to water conservation and assessment. Importance of conservation for urban and rural conditions. Soil, Plant, Atmosphere Continuum (SPAC); resource assessment (hydrology cycle, surface flow assessment, groundwater recharge assessment).

Water stress: principles and indicators for assessing water stress, Water quality assessment; Water resources conservation and management measures.

Irrigation: types, scheduling, efficiency. Arid, semi arid and humid ecosystems; Water recycling and reuse leading to water conservation; Institutional mechanisms for water management: collective action and decentralization, river basin organizations, WUAs, multiple stakeholder platforms, programmes and policies for integrated water management

Books

1. Land and Water Management Principles: R. Suresh
2. Advances in Irrigation: Daniel A. Hillel.
3. Soil and Water Conservation: Schwaab, Frevert.