COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7141	STRUCTURAL STABILITY	2-1-0-3	2015

COURSE OBJECTIVES:

To impart a thorough foundation on the behaviour structural members undergoing form failure with emphasis on buckling in the elastic range. To give theoretical background on buckling of skeletal structures like columns, beam columns, portal frames and rigid members. Introduce the available analytical and numerical solution techniques to stability problems with various geometries, loading and boundary conditions. To provide an understanding of buckling phenomena in plates under in plane and transverse loading. Integration of finite element method for buckling analysis of beams and plates.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Appreciate and Understand the principles of strength and stability
- To understand the behaviour of basic structural components and plates susceptible to instability and apply stability concepts for solving diverse problems in civil engineering.
- Appreciate the relevance of the finite element approach in stability analysis

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Introduction to stability analysis:**–Stable, unstable and neutral equilibrium–Stability Criteria. Fourth order Elastica – large deflection of bars differential equation for generalized bending problems–elastic instability of columns–Euler's theory–assumptions–limitations. Energy principles.	8
	INTERNAL TEST 1 (Module 1)	
II	**General treatment of column:-** Stability problem as an Eigen value problem–various modes of failure for various end conditions– both ends hinged – both ends fixed – one end fixed other end free – one end fixed other end hinged –Energy approach – Rayleigh Ritz – Galerkin's method.	8
	INTERNAL TEST 2 (Module 2)	
III	**Beam column:**–beam column equation–solution of differential equation for various lateral loads–udl and concentrated loads– Energy method – solutions for various end conditions–bottom fixed– bottom hinged – horizontal compression members, buckling of frames.	9
IV	**Stability of plates:–**in plane and lateral loads– boundary conditions– critical buckling pressure–aspect ratio **Finite element application to stability analysis**– finite element stability analysis–element stiffness matrix –geometric stiffness matrix–derivation of	7

	element stiffness matrix and geometric stiffness matrix for a beam element.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Ziegler H, “Principles of structural stability”, Blarsdell, Wallham, Mass, 1963.
2. Thompson J M, G W Hunt, “General stability of elastic stability”, Wiley, New York.
3. Timoshenko, Gere, “Theory of elastic stability”, McGraw Hill, New York.
4. Don O Brush, B O OAlmorth, Buckling of Bars, plates and shells,
5. Cox H L, The buckling of plates and shells, Macmillan, New York, 1963.
6. O C Zienkiewicz ,Finite Element Method, fourth Edition, McGraw Hill,
7. R.D. Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7143	ADVANCED THEORY OF CONCRETE STRUCTURES	2-1-0-3	2015

COURSE OBJECTIVES:

- To develop a capability in the students to apply the fundamentals of reinforced concrete behaviour to the design of reinforced concrete systems
- To understand background of provisions made in codes of design and to familiarize with the design of some important structures

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Have higher level of understanding about behaviour of structural concrete
- Do the proper design and detailing of structural members

MODULE	COURSE CONTENT (32 hrs)	HRS
I	The nature of concrete, stress–strain relationships of concrete, stress–strain relationships of reinforcing steel, stress block parameters. Failure criteria for concrete. Behaviour of concrete flexural members, general equations for calculation of moment capacities at ultimate limit state and at limit state of local damage, flexural rigidity, calculation of deflection, redistribution of moments, design examples.	8
INTERNAL TEST 1 (Module 1)		
II	Axially loaded compression members, combined axial load and uniaxial bending. Interaction diagrams, combined axial load and biaxial bending, slender compression members, design example using I.S.456–2000.	8
INTERNAL TEST 2 (Module 2)		
III	Shear cracking of ordinary reinforced concrete members, web reinforcement, design examples, shear in tapered beams. Development length of reinforcement, anchorage. Significance of Torsion, Torsional resistance of concrete beams, reinforcement for torsion, design examples using I.S. 456-2000.	9
IV	General principles of detailing of reinforcement, effective depth, design of main reinforcement, design of transverse reinforcement, conditions at	7

	loads and at supports.	
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Varghese P.C, "Design of Reinforced Concrete Structures", Prentice hall of India.
2. Krishnamurthy, K.T, Gharpure S.C. and A.B. Kulkarni– "Limit design of reinforced concrete structures",Khanna Publishers, 1985.
3. Unnikrishna Pillai and Devdasmenon, "Reinforced Concrete Design", Tata-McGraw Hill publishers
4. Subramanian, N., Design of Reinforced concrete structures", Oxford University press

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7145	MAINTENANCE AND REHABILITATION OF STRUCTURES	2-1-0-3	2015

COURSE OBJECTIVES:

- This course is to make students to investigate the cause of deterioration of concrete structures.
- To strategies different repair and rehabilitation of structures.
- To evaluate the performance of the materials for repair.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Understand the cause of deterioration of concrete structures.
- Design and develop analytical skills.
- Summarize the principles of repair and rehabilitation of structures.
- Understands the concept of Serviceability and Durability.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**General:–**Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. **Influence on serviceability and durability:–**Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.	8
INTERNAL TEST 1 (Module 1)		
II	**Maintenance and repair strategies:–** Definitions : Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance, Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration , testing techniques.	8
INTERNAL TEST 2 (Module 2)		

III	**Materials for repair:–** Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.	9
IV	**Techniques for repair:–** Rust eliminators and polymers coating for rebars during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. **Examples of repair to structures:–**Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure–case studies.	7
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures , Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.
2. R.T. Allen and S.C. Edwards, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.
3. M.S. Shetty, "Concrete Technology – Theory and Practice" ,S. Chand and Company, New Delhi, 1992.
4. Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July, 1992.
5. Raikar, R.N., "Learning from failures – Deficiencies in Design ", Construction and Service – R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7151	NUMERICAL METHODS IN STRUCTURAL ENGINEERING	2-1-0-3	2015

COURSE OBJECTIVES:

The purpose of numerical analysis is two-fold:

(1) To find acceptable approximate solutions when exact solutions are either impossible or as arduous and time-consuming as to be impractical, and (2) To devise alternate methods of solution better suited to the capabilities of computers.

- Define and perform Gaussian elimination to solve a linear system and Identify pitfalls of Gaussian elimination.
- Demonstrate the relative performance of Newton-Raphson and Modified Newton-Raphson's methods.
- Derive and apply the trapezoidal rule and Simpson's rule of integration and Distinguish Simpson's method from the trapezoidal rule.
- Introduce students to the area of numerical methods and illustrate the far reaching nature and usefulness of these methods for structural engineering applications.
- An appreciation of the application of numerical methods to "real world" problems in the analysis of structural engineering.

COURSE OUTCOMES:

On successful completion of this course, students are able to

- Understand various computational methods available to solve practical problems.
- Enhance the capacity to select the most appropriate techniques for tackling problems in structural engineering.
- Select from alternative methods the one method that is most appropriate for a specific problem.
- Inculcate an ability to solve numerically many types of problems such as Roots of equations, Systems of linear simultaneous equations, Numerical Differentiation and integration, Eigen value problems etc., applied in structural engineering.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Solution of Linear and Non-linear equations:-**Linear system of equations:- Gaussian Elimination, Cholesky's method and Cholesky's Decomposition method-Numerical examples. Non linear system of	8

	equations:- Newton-Raphson's method for single and multiples variables, Limitations. Modified-Newton Raphson's methods-Numerical examples **Solution Techniques for Eigen Value Problems:**-Eigen value problems in structural engineering, Solution by characteristics polynomial-Numerical examples. **Storage schemes -** Semi band and Skyline storage schemes, Sub-Structure Method of Analysis (Methods and Concept only).	
INTERNAL TEST 1 (Module 1)		
II	**Numerical Integration:**-Trapezoidal and Simpson's Rule for Areas, Trapezoidal Rule for Volumes- Related problems. Newmark's Method: - Equivalent Loads, Newmark's Procedure, Application of Newmark's method for the, slope and deflection of beams (Simply supported, Cantilever and Over hanging) having uniform and varying flexural rigidity with different loading cases (Concentrated, Uniformly distributed and uniformly varying). Slope and deflection of propped cantilevers and fixed beams having uniform flexural rigidity with uniformly distributed loads. Application of Newmark's integration procedure for buckling of straight columns (ends hinged, one end fixed and other hinged) having uniform and non-uniform flexural rigidity.	8
INTERNAL TEST 2 (Module 2)		
III	**Finite Difference Technique for Ordinary Differential Equations and its Applications in Structural Engineering:**-Forward, Backward and central difference. Initial and boundary value problems. Application of finite difference method for statically determinate beam problems: - Calculation of bending moment and deflection of beams (simply supported and cantilever) having uniform and varying flexural rigidity subjected to loads (concentrated, uniformly distributed, uniformly varying and parabolic). Application of finite difference method for statically indeterminate beam problems: - Calculation of bending moment and deflection of beams (propped cantilevers, fixed and two span continuous) having uniform and	9

	varying flexural rigidity subjected to loads (concentrated and uniformly distributed). Application of finite difference method for buckling of columns: - Calculation of buckling load of columns (ends hinged, one end hinged and other fixed) with uniform and non uniform flexural rigidity. Application of finite difference method for vibration of beams: - Calculation of natural frequency of beams (simply supported, propped cantilever and fixed) of uniform flexural rigidity subjected to concentrated load and uniformly distributed loads.	
IV	**Finite Difference Technique for Partial Differential Equations and its Applications in Structural Engineering:-** Application of finite difference technique for partial differential equation for membrane problems:- Derivation of module, Calculation of slope and deflection of laterally loaded square, triangular, L and T shaped membrane. Application of finite difference technique for partial differential equation for bending of laterally loaded thin plates:- Derivation of module, Calculation of deflection of laterally loaded square, and rectangular plates with fixed and simply supported boundaries subjected to uniformly distributed and varying loads.	7
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. Rajasekaran S., "Numerical Methods in Science and Engineering-A practical approach", S. Chand Publishing; 2nd Edition 2003 edition
2. Grewal B.S., "Numerical Methods in Engineering and Science", Khanna Publishers.
3. Krishna Raju N., and Muthu K.U, "Numerical Methods for Engineering Problems", Macmillan India Limited.
4. Bathe K.J., "Finite Element Proceedings in Engineering Analysis" Prentice Hall Inc.
5. James M.L, Smith G.M. and Wolford J.C., "Applied Numerical Methods for Digital Computation", Harper and Row Publishers.
6. Wang P.C., "Numerical and Matrix Methods in Structural Mechanics", John Wiley

&Sons.

7. Meghre A.S. and Deshmukh S.K., ”Matrix Methods of Structural Analysis (Theory, Examples and Programs), Charotar Publishing House.
8. James B. Scarborough, “Numerical Mathematical Analysis”,
9. Radha Kanta Sarkar, “Numerical Methods for Science and Engineering” Eswar Press,

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7153	CONSTRUCTION PROJECT MANAGEMENT	2-1-0-3	2015

COURSE OBJECTIVES:

- To develop awareness about selection of projects, preparation of projects reports and feasibility study of construction projects.
- To understand planning, procurement and management of materials
- To understand construction accounts and its management
- To learn concepts of risk and insurance in construction

COURSE OUTCOMES:

On completion of the course, the students

- Acquire knowledge about identification of project, preparation of project reports and feasibility study of various construction projects.
- Acquire knowledge about material management
- Acquire knowledge about current practices in construction accounts and its management
- Acquire knowledge about risks and insurance in construction

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Preparation of Project:** Meaning of project- Project identification- Project selection- Project report-Need and significance of project- Contents- Formulation- Guidelines by Planning Commissioning for project report- Network analysis- Errors of project report- Project appraisal- Identification of business opportunities- Market feasibility study- Technical feasibility study- Financial feasibility study- Social feasibility study.	8
	INTERNAL TEST 1 (Module 1)	
II	**Construction material Management:** Material procurement process in construction organization – materials management functions- planning, procurement, custody, accounting, transportation, inventory monitoring and control, codification, computerization-inventory management- functions, policies, inventory control, inventory models.	8
	INTERNAL TEST 2 (Module 2)	
III	**Construction accounts management:** Principles of accounting- accounting process-Construction contract revenue recognition- Construction contract status report- limitations of accounting- balance	9

	sheet-profit and loss account-working capital- need, operating cycle, components, determination and financing sources of working capital- ratio analysis- liquidity, capital structure profitability, activity, supplementary- funds flow statement.	
IV	**Risk and Insurance in Construction:** Definition - risk identification process- check list, consequences, mapping, classification-risk analysis and evaluation process- data collection, modelling uncertainty, evaluation of potential impact of risk- response management process – insurance in construction industry- principles, insurance policies- project insurance- contractor's All- risk insurance, transit insurance, fire policy, liquidity damages insurance.	7
END SEMESTER EXAM (All Modules)		

REFERENCES:

1. N V R Naidu & T Krishna Rao., "Management & Entrepreneurship", I K International Publishing House Pvt. Ltd. 1st edition.
2. Stephen Robbins., "Management", Pearson Education/PHI- 17th Edition.
3. Kumar Neeraj Jha., "Construction Project Management- Theory and Practice", Pearson Education.
4. K Anbuvelan., "Management Concepts for Civil Engineers", University Science Press.
5. K K Chitkara., "Construction Project Management-Planning, Scheduling and Controlling" , Tata McGraw Hill Education Private Limited.
6. Stuart H Bartholomew., "Construction contracting: Business and Legal Principles", Prentice Hall.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7155	REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM	2-1-0-3	2015

COURSE OBJECTIVES:

1. To provide exposure to students in gaining knowledge on concepts and applications leading to modelling of earth resources management using Remote Sensing.
2. To acquire skills in storing, managing digital data for planning and development.
3. To acquire skills in advance techniques such as hyper spectral, thermal and LiDAR scanning for mapping, modelling and monitoring.

COURSE OUTCOMES:

At the end of the course, the students will be

1. Fully equipped with concepts, methodologies and applications of Remote Sensing Technology.
2. Prepared for National and Global Employability.
3. Acquiring skills in handling instruments, tools, techniques and modelling while using Remote Sensing Technology.

MODULE	COURSE CONTENT (32 hrs)	HRS
I	**Principles of Remote Sensing:** Introduction to remote sensing, Remote sensing system, Electromagnetic spectrum, Black body, Atmospheric windows, Spectral characteristics of earth surface, Range of sensing system. **Platforms, Sensors and Data Products:** Ground aircraft, space craft platforms – photographic sensors, scanners, radiometers, Radar and Mission planning, Data Types and format, Scale and Legend. **Photogrammetry:** Photogrammetry basics – applications, applications of aerial photo interpretation to planning and management.	8
INTERNAL TEST 1 (Module 1)		
II	**Data Interpretation and Analysis:** Introduction, SOI Topomaps, satellite data – multispectral, multitemporal, multisensoral, multistage concepts. Types of interpretation. Photo interpretation techniques for aerial pphoto and satellite imagery. Interpretation elements. False color composition. Digital analysis. Preprocessing and processing, Image restoration/enhancement procedures, pattern recognisation concepts, classification algorithms, Post processing procedures, etc.	8

INTERNAL TEST 2 (Module 2)		
III	**Geographic Information System:** Introduction, history of GIS**,** Comparison with CAD, Nece**ssity** of GIS, components of GIS, GIS Architecture – data input, data manipulation, data output, Operation processes and capabilities, different types of GIS. GIS data – spatial and non spatial, data models with advantages and disadvantages.	9
IV	**Global Positioning Systems:** Introduction, System overview, working principles, GPS types, GPS surveying methods, survey planning and observations, GPS data processing and applications of GPS.	7
END SEMESTER EXAM (All Modules)		

REFERENCES

1. Thomas M. Lillesand and R.W. Kiefer, "Remote Sensing and Image Interpretation", John Wiley & Sons, Inc., New York
2. Philip H. Swain & Shirley M. Davis. "Remote Sensing, The Quantitative Approach", McGraw-Hill Publications,
3. John R Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", Prentice Hall, New Jersey
4. Sabins, Floyd F. Jr., "Remote Sensing Principles and Interpretation", W.H. Freeman and Company, San Francisco
5. Burrough P.A, "Principles of Geographical Information System for Land Resource Assessment", Oxford University Press
6. Satheesh Gopi, "Global Positioning System – Principles and Applications", Tata McGraw Hill. Pub. Comp. Ltd.
7. Current Literatures and publications.

OURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7167	**SEMINAR – II**	**0-0-3-2**	**2015**

Each student is required to present a technical paper on a subject approved by the department. The paper should be on a recent advancement/trend in the field of Structural Engineering or Construction Management. He/she shall submit a report of the paper presented to the department.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7187	**PROJECT (PHASE-I)**	**0-0-8-6**	**2015**

The thesis (Phase-I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation / numerical work, design and or development work that the candidate has executed.

In Phase-I of the thesis it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national and international journals, proceedings of national and international seminars. Emphasis should be given to the introduction to the topic, literature review, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic.

Student should submit Phase-I thesis report in two copies covering the content discussed above and highlighting the features of work to be carried out in Phase-II of the thesis. Student should follow standard practice of thesis writing.

The candidate will deliver a talk on the topic and the assessment will be made on the basis of the term work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in thesis work Phase-II.

COURSE CODE	COURSE NAME	L-T-P-C	YEAR
05CE 7188	**PROJECT (PHASE II)**	**0-0-21-12**	**2015**

In the fourth semester the student has to continue the thesis work. At the end of successful finishing the work he / she has to make a presentation along with a detailed report of the project and has to be present for a viva–voce. The work carried out should lead to a publication in a National / International Conference. Students should submit the paper before the evaluation of the thesis and specific weightage will be given to accepted papers in reputed conferences.