Kalinga University Atal Nagar (C.G.)

SCHEME OF EXAMINATION
& SYLLABUS

of
M.Tech Civil
Structural Engineering

UNDER

Faculty of Engineering and Technology

w.e.f. Session 2021-22

Kalinga University, Raipur
M.Tech Civil Structural Engineering (2 yrs Programme)
w.e.f 2021-22 Session

Semester -I					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTCSE101	Advanced Concrete Technology and Admixtures	4	100	50	150
MTCSE102	Matrix Methods of Structural Analysis	4	100	50	150
MTCSE103	Instrumentation and Experimental Techniques	4	100	50	150
MTCSE104	Advanced Construction Management	4	100	50	150
MTCSE105	**Elective-1**	4	100	50	150
MTCSE105A	Limit State Design of Steel Structures				
MTCSE105B	Advanced Design of Steel Structures				
MTCSE105C	Theory of Elastic Stability				
MTCSE106-P	Advanced Concrete Technology and Admixtures Lab	1	30	20	50
MTCSE107-P	Matrix Methods of Structural Analysis Lab	1	30	20	50
	Total	**22**	**560**	**290**	**850**
Semester -II					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTCSE201	Advanced Design of Concrete Structures	4	100	50	150
MTCSE202	Earthquake Effects on Structures	4	100	50	150
MTCSE203	Finite Element Analysis of Structures	4	100	50	150
MTCSE204	Maintenance and Rehabilitation of Structures	4	100	50	150
MTCSE205	**Elective-2**	4	100	50	150
MTCSE205A	Advance Fundamental Engineering				
MTCSE205B	Design of Industrial Structures				
MTCSE205C	Fabrication and Erection of Structures				
MTCSE206-P	Advanced Design of Structures Lab	1	30	20	50
MTCSE207-P	Structural Experimentation Lab	1	30	20	50
	Total	**22**	**560**	**290**	**850**

Semester -III					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTCSE301	Structural Dynamics	4	100	50	150
MTCSE302	Communication & Research Methodology	4	100	50	150
MTCSE303	**Elective-3**	4	100	50	150
MTCSE303A	Optimization Techniques				
MTCSE303B	Theory of Plates and Shells				
MTCSE303C	Pre-Stressed Concrete				
MTCSE304	Preliminary work on Dissertation	9	100	50	150
MTCSE305	Seminar Based on Dissertation	1	100	50	150
	Total	**22**	**500**	**250**	**750**
Semester -IV					
Code No.	**Paper**	**Credits**	**End Semester Exam**	**Internal Marks**	**Total Marks**
MTCSE401P	Dissertation	18	300	200	500
	Total	**18**	**300**	**200**	**500**

Semester-1

MTCSE101

Advanced Concrete Technology and Admixtures

Course Objectives & outcomes

The objective of this course is to make students to learn principles of Concrete mix design, To differentiate between different types of concrete. To characterize the high Performance concrete.

Unit: I
MATERIALS AND PROPERTIES
IS specifications for materials and testing of concrete making materials, Properties, Grading, Methods of combining aggregates, Properties of fresh and hardened concrete, Variability of concrete strength, Elasticity, creep and shrinkage of concrete, Durability and factors affecting durability, behavior of concrete under aggressive environmental conditions including temperature.

Unit: II
ADMIXTURES
Different types of admixtures for improving properties of concrete such as strength, workability, durability etc. Necessity & benefit of Mineral admixtures, Suitability in different conditions.

Unit: III
CONCRETE MIX PROPORTIONING

Principles of concrete mix proportioning, Methods of concrete mix proportioning (with and without admixtures), Trial mixes, Testing of concrete mixes.

Unit: IV
SPECIAL CONCRETE

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Polymer Concrete, High performance concrete, Self compacting concrete, Concrete containing Silica Fumes, Concrete containing GGBS, No fines concrete, Reactive powder concrete.

Unit: V
CONCRETING METHODS

Process of manufacturing of concrete, Methods of transportation, placing and curing - Extreme weather concreting, special concreting methods, Vacuum dewatering - underwater concrete, special from work.

Text Books:

1. Neville A.M., Properties of Concrete, Pearson Education.
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd., Delhi

Reference Books:

1. Ramachandran V.S., Concrete Admixtures Handbook, Standard Publishers Distributors, Delhi.
2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

MTCSE102

Matrix Methods of Structural Analysis

Course Objectives & outcomes

The objective of this course is to make students to learn principles of Structural Analysis, To implement these principles through different methods and to analyse various types of structures. To evaluate the force and displacement parameters of the structures.

Unit: I
INTRODUCTION

Review of force and displacement methods of structural analysis, Degree of Static Indeterminacy, Degree of Kinematic Indeterminacy, Basic Concepts of Matrix methods in structural analysis, Determinants and Matrices.

Unit: II
FLEXIBILITY METHOD FOR BEAMS

Flexibility coefficients, development of flexibility matrix, Analysis of continuous beams by flexibility method.

Unit: III
FLEXIBILITY METHOD FOR FRAMES

Analysis of rigid jointed plane frame and pin jointed plane frame by flexibility method.

Unit: IV
STIFFNESS METHOD FOR BEAMS

Stiffness coefficient, development of stiffness matrix, relationship between flexibility matrix and stiffness matrix, Analysis of continuous beams by stiffness method.

Unit: V
STIFFNESS METHOD FOR FRAMES

Analysis of rigid jointed plane frame and pin jointed plane frame by stiffness method.

Text Books:

1. Pandit G.S. and Gupta S.P., Structural Analysis – A Matrix Approach, Tata McGraw- Hill Publishing Company Limited, New Delhi
2. Weaver W. and Gere J. M., Matrix Analysis of Framed Structures, CBS Publishers and Distributors, Delhi

Reference Books:

1. Krishanmurthy C.S., Finite Element Analysis – Theory and Programming, Tata McGraw- Hill Publishing Company Limited, New Delhi.
2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

MTCSE103

Instrumentation and Experimental Techniques

Course Objectives & outcomes

The objectives of this course is to make students to learn principles of qualitative and quantitative analysis & study various spectro – scopic techniques and its instrumentation.

Unit: I
MEASUREMENT

Basic Concept in Measurements, Measurement of displacement, strain pressure, force, torque etc, Types of strain gauges (Mechanical, Electrical resistance, Acoustical etc.)

Unit: II
STRAIN GAUGES

Strain gauge circuits, The potentiometer and Wheatstone bridge, use of lead wires switches etc. Use of strain gauges in structural applications.

Unit: III
DATA PROCESSING

Indicating and recording devices, Static and dynamic data recording, Data (Digital and Analogue) acquisition and processing systems. Strain analysis methods, Rosette analysis. Static and dynamic testing techniques. Equipment for loading-Moire's techniques.

Unit: IV
NON DESTRUCTIVE TECHNIQUES

Non destructive testing techniques. Photo elasticity, optics of photo elasticity, Polari scope, Iso clinics and Iso chromatics, methods of stress separation.

Unit: V
MODEL ANALYSIS

Laws of similitude, model materials, model testing, testing large scale structures, holographic techniques, Assumptions and uses of Indirect model study.

Text Books :

1. Dally J W and Riley W.F, Experimental stress Analysis, McGraw-Hill Inc. New York, 1991.
2. Srinath L S et al, Experimental Stress Analysis, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1984.

Reference Books :

1. Rangan C S et al., Instrumentation – Devices and Systems, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1983.
2. Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 1996.

MTCSE104

Advanced Construction Management

Course Objectives & outcomes:

The objectives of this course is to make students to learn principles of project management and cost control and learn about various techniques of project planning, scheduling and monitoring also understand the awareness of safety and quality control.

Unit: I
ORGANIZING FOR PROJECT MANAGEMENT
Project Management, Trends in Modern Management, Strategic Planning and Project Programming, Effects of Project Risks on Organization, Organization of Project Participants, Traditional Designer, Constructor Sequence, Professional Construction Management, Owner-Builder Operation, Turnkey Operation, Leadership and Motivation for the Project Team, Interpersonal Behavior in Project Organizations, Perceptions of Owners and Contractors.

Unit: II
DESIGN AND CONSTRUCTION PROCESS
Design and Construction as an Integrated System, Innovation and Technological Feasibility, Innovation and Economic Feasibility, Design Methodology, Functional Design, Physical Structures, Geo-technical Engineering Investigation, Construction Site Environment, Value Engineering, Construction Planning, Industrialized Construction and Pre-fabrication.

Unit: III
LABOR, MATERIAL AND EQUIPMENT UTILIZATION
Labor Productivity, Factors Affecting Job, Site Productivity, Labor Relations in Construction, Problems in Collective Bargaining, Materials Management, Material Procu rement and Delivery, Inventory Control, Tradeoffs of Costs in Materials Management, Construction Equipment, Choice of Equipment and Standard Production Rates, Construction Processes Queues and Resource Bottlenecks.

Unit: IV
COST ESTIMATION
Costs Associated with Constructed Facilities, Approaches to Cost Estimation, Type of Construction Cost Estimates, Effects of Scale on Construction Cost, Unit Cost Method of Estimation, Methods for Allocation of Joint Costs, Historical Cost Data, Cost Indices, Applications of Cost Indices to Estimating, Estimate Based on Engineer's List of Quantities, Allocation of Construction Costs Over Time, Estimation of Operating Costs.

Unit: V
SAFETY IN CONSTRUCTION
Causes, classification, cost and measurement of an accident, safety programme for construction, protective equipment, accident report, safety measures for storage and handling of building materials, Construction of elements of a building, demolition of buildings. Safety lacuna in Indian scenario, Safety of scaffolding & working platforms.

Text Books :
1. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 1998.
2. Choudhury, S, Project Management, Tata McGraw-Hill Publishing Company, New Delhi, 1988.

Reference Books :

1. Harold Kerzner, Project Management – A Systems Approach to Planning, Scheduling and Controlling, CBS Publishers & Distributors, Delhi, 1988.
2. Joy, P.K., Total Project Management – The Indian Context, Macmillan India Ltd., New Delhi, 1992.

Elective-I
MTCSE105A

Limit State Design of Steel Structures

Course Objectives & outcomes:

The objective of this course is to make students to learn principle of steel structures & to know about shapes and grade of structural steel available. To understand the behavior of structural steel under tension, compression and flexure.

Unit: I

MATERIALS AND METHODS OF ANALYSIS

Properties of Structural Steel, I. S. Specification for Rolled Sections, Elastic Analysis, Plastic Analysis for steel beams and frames - plastic hinges, Collapse mechanism, plastic modulus, shape factor.
Introduction to working stress method and Limit state method of design of steel structures, Classification of rolled sections, types of loads and load combinations.

Unit: II

FASTENERS AND TENSION MEMBERS

Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Advantages and Disadvantages of Welded Joints, Design of Fillet and Butt Welds, Design of Eccentric Connections, High strength friction grip bolts. Net Sectional Area of Tension Members, Design of Axially Loaded Tension Member, Steel Angles under tension

Unit: III

COMPRESSION MEMBERS

Modes of Failure of a Column, Buckling Failure: Euler's Theory, Effective Length, Slenderness Ratio, I.S. Code approach for design of Compression Members, Design of Built-Up Compression Members.

Unit: IV

BEAMS

Design Procedure, laterally supported and laterally unsupported beams, Web Crippling, Web Buckling, Design of Built-Up Beams, Curtailment of Flange Plates

Unit: V

BEAM COLUMNS AND CLOUMN BASES

Design of Member Subjected to combined forces, Eccentricity of Load, Interaction Formulae. Slab and Gusseted Bases, Eccentrically Loaded Base Plates.

Text Books:

1. Teaching Resource for Structural Steel Design, Volumes I – III, Institute for Steel Development and Growth, Kolkata.
2. Various Indian Standard codes of practice on steel structures.

Reference Books:

1. Davidson B. and Owens, G.W., Steel Designers' Manual, Blackwell Publishing, UK
2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

Elective-I
MTCSE105B

Advanced Design of Steel Structures

Course Objectives & outcomes:

The objective of this course is to make students to learn principle of steel structures & to know about shapes and grade of structural steel available. To understand the behavior and design of structural steel under tension, compression and flexure

Unit: I
PLATE AND GANTRY GIRDERS
Design of Plate Girders, Vertical and Horizontal Stiffeners for plate girders, Connections and Splices. Forces acting on gantry girders, Cross sections for Gantry Girders, Design Considerations.

Unit: II
INDUSTRIAL BUILDINGS
Single storey Industrial buildings and bents, Design of Trusses, Purlins, Louver rails, Gable column etc., Analysis of Gable Frames, check for deflection.

Unit: III
HIGH RISE BUILDINGS
Design of members subjected to lateral loads and axial loads, Sway and non-sway frames, Permissible sway.

Unit: IV
CONNECTIONS
Types of connections, Design of framed and seated beam connections, Unstiffened and Stiffened seat connections, Continuous beam-to-beam connections and continuous beam-to-column connection, moment resisting connections, welded and bolted connections.

Unit: V
LIGHT GAUGE STEEL STRUCTURES
Types of cross sections, local bucking and ateral bucking, concepts of Effective width, Design of compression and tension members, Beams, Deflection of beams and design of beam webs. Combined stresses and connections.

Text Books:

1. Teaching Resource for Structural Steel Design, Volumes I – III, Institute for Steel Development and Growth, Kolkata.
2. Various Indian Standard codes of practice on steel structures.

Reference Books:

1. Davidson B. and Owens, G.W., Steel Designers' Manual, Blackwell Publishing, UK
2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

Elective-I
MTCSE105C

Theory of Elastic Stability

Course Objectives & outcomes:

The main objective of this course is to make students learn the various principles of elastic stability for all the structural members.

Unit: I
STABILITY OF COLUMNS

Concepts of Elastic Structural stability, Analytical approaches to stability, characteristics of stability analysis, Elastic Buckling of columns, Equilibrium, Energy and Imperfection approaches, Non-prismatic columns, Built up columns, orthogonality of buckling modes, Effect of shear on buckling load, Large deflection theory.

Unit: II
METHODS OF ANALYSIS

Approximate methods, Rayleigh and Galerkin methods, numerical methods, Finite difference and finite Element, analysis of columns, Experimental study of column behaviour, South well plot, Column curves, Derivation of Column design formula, Effective length of Columns.

Unit: III
BEAM COLUMNS AND FRAMES

Beam column behaviour, standard cases, Continuous columns and beam columns, Column on elastic foundation, Buckling of frames, Single storey portal frames with and without side sway, Classical and stiffness methods, Approximate evaluation of critical loads in multistoried frames

Unit: IV
BUCKLING OF BEAMS

Lateral buckling of beams, Energy method, Application to Symmetric and simply symmetric I beams, simply supported and Cantilever beams, Narrow rectangular cross sections, Numerical solutions, Torsional buckling, Uniform and non uniform Torsion on open cross section, Flexural torsional buckling, Equilibrium and energy approach.

Unit: V
BUCKLING OF THIN PLATES

Isotropic rectangular plates, Governing Differential equations, Simply Supported on all edges, Use of Energy methods, Plates with stiffeners, Numerical Techniques.

TEXT BOOKS:

1. Ashwini kumar, "Stability of Structures", Allied Publishers Ltd.
2. Stephen P. Timoshenko and Gere "Theory of Elastic stability", McGraw-Hill Company.

REFERENCES BOOKS:

1. Smitses, Elastic Stability of Structures, Prentice Hall.
2. NGR Iyengar, "Structural Stability of Columns and Plates" Affiliated East- West Press Pvt. Ltd

MTCSE106-P

Advanced Concrete Technology and Admixtures Lab

Course Objectives & outcomes

The objective of this course is to make students to learn principles of Concrete mix design, To differentiate between different types of concrete. To characterize the high Performance concrete.

Experiments to be performed (Minimum 10 experiments to be performed)

1. Tests for properties of Cement.
2. Tests for properties of Fine Aggregates.
3. Tests for properties of Coarse Aggregates.
4. Tests for properties of Admixtures.
5. Tests for strength of Concrete.
6. Tests for Flexural Strength of Concrete
7. Tests for Modulus of Elasticity of Concrete.
8. Concrete mix design (without Admixtures) and Trial Mixes.
9. Concrete mix design (with Admixtures) and Trial Mixes.
10. Non-destructive testing methods.
11. Behaviour of Concrete under different curing conditions.
12. Behaviour of Concrete under different exposure conditions.
13. Behaviour of Concrete under different placing conditions.
14. Residual Strength of existing concrete structures.
15. Comparison of properties of concrete prepared with materials from different locations.

List of Equipments / Machine Required:

1 Compression Testing Machine 100 T capacity
2 Cube Moulds 150 x 150 x 150 mm 12 nos.
3 Cube Moulds 100 x 100 x 100 mm 6 nos.
4 Cube Moulds 70 x 70 x 70 mm 12 nos.
5 Sieves of Various Sizes
6 Slump Cone Apparatus
7 Compaction Factor Apparatus
8 Moulds for Flexural Strength of Concrete
9 Cylindrical Moulds for Compressive Strength of Concrete
10 Mixing Tray, Trovels etc.

-Reference Books:

1. Neville A.M., Properties of Concrete, Pearson Education
2. SP23, Handbook on Concrete Mixes, Bureau of Indian Standards, New Delhi.

MTCSE107-P

Matrix Methods of Structural Analysis Lab

Course Objectives & outcomes

The objective of this course is to make students to learn principles of Structural Analysis, To implement these principles through different methods and to analyse various types of structures. To evaluate the force and displacement parameters of the structures.

Experiments to be performed (Minimum 10 experiments to be performed)

a. Introduction to Software for Structural Analysis, such as SAP2000
b. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type I)
c. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type II)
d. Analysis of Continuous Beams on SAP2000 (Support Conditions and Loading type III)
e. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type I)
f. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type II)
g. Analysis of Plane Frames (Rigid Jointed) on SAP2000 (Support Conditions and Loading type III)
h. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type I)
i. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type II)
j. Analysis of Plane Frames (Pin Jointed) on SAP2000 (Support Conditions and Loading type III).
k. Behaviour of Frames under Dead and Live Loads.
l. Behaviour of Frames under Wind Loads.
m. Behaviour of Frames under Earthquake Loads.
n. Behaviour of Frames under combinations of Dead Load, Live Load and Wind Load.
o. Behaviour of Frames under combinations of Dead Load, Live Load and Earthquake Load.

List of Equipments / Machine Required:

a. PIV Computers with 17" Colour Monitors & UPS
b. SAP2000 Software.

Reference Books:

1. Users Manual for SAP2000 Software Package, Computers and Structures Inc., Berkley.
2. Verification Manual for SAP2000 Software Package, Computers and Structures Inc., Berkley.

Semester-II

MTCSE201

Advanced Design of Concrete Structures

Course Objectives & Outcomes

To make students learn principles of structural design .To design deferent types of structures and to detail the structures also evaluate the performance of the structures.

Unit: I
DESIGN OF BEAMS
Behaviour of RCC beams under combined Shear, Torsion and Bending, Modes of Failures, Inter action effects, Analysis and design of beams circular in plan, Design calculation of deflections and crack width.

Unit: II
DESIGN OF SLENDER COLUMNS
Behaviour of slender RCC Columns, Failure modes and Interaction curves, Additional Moment method, Comparison of codal provisions, calculation of design moments for braced and unbraced columns, Principles of Moment magnification method, design of slender columns.

Unit: III
DESIGN OF SPECIAL RC ELEMENTS
Design and detailing of Concrete walls according to IS code, Classification of shear walls, design principles, design of rectangular shear walls, Analysis of forces, Approximate analysis and design of Grid floors.

Unit: IV
DESIGN OF FLAT SLABS
Design of Flat slabs according to IS method, Shear in Flat Slabs, Equivalent frame method.

Unit: V
INELASTIC BEHAVIOUR
Inelastic behaviour of concrete beams-moment-rotation curves, moment redistribution, Design of cast-in-situ joints in frames. Detailing requirements for ductility, durability and fire resistance

Text Books:

1. Varghese, P.C. “Advanced Reinforced Concrete Design”, Prentice Hall of India.
2. Krishna Raju, N., “Advanced Reinforced Concrete Design”, CBS Publishers and Distributers.

Reference Books:

1. Purushothaman, P, Reinforced Concrete Structure Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill.
2. Arthur H.Nilson "Design of Concrete Structures", Tata McGraw-Hill.

MTCSE202

Earthquake Effects on Structures

Course Objectives & Outcomes

The objective of this course is to make students to learn principles of engineering seismology, To design the reinforced concrete buildings for earthquake resistance. To evaluate the seismic response of the structures

Unit: I
ENGINEERING SEISMOLOGY
Elements of Engineering Seismology, Characterization of ground motion, Earthquake intensity and magnitude, Recording instruments and base line correction, Predominant period and amplification through soil, Earthquake spectra for elastic and inelastic systems, Response Spectrum, Indian Standard Codes on Earthquake Engineering, Seismic Zoning Map of India.

Unit: II
CASE STUDIES
Earthquake History, Behaviour of Structures in the past Earthquakes, Case Studies and Remidial Measures.

Unit: III
DESIGN CONCEPTS
Seismic Design Concepts, Cyclic load behaviour of structural elements, Design spectrum, Principles of capacity design.

Unit: IV
CODAL PROVISIONS
Idealization of structural systems for low, medium and high rise buildings, Provisions of Seismic Code (IS 1893), Building systems frames, shear walls, Braced Frames. Ductility requirements for framed structures.

Unit: V
SPECIAL PROBLEMS
Structural Configuration, Seismic performance, Irregular Buildings, Soil performance, Modern Concepts, Base Isolation, Adoptive system, Behaviour of beams, columns & joints in RC buildings during earthquake.

Text Books:

1. Agrawal P. and Srikhande M., Earthquake Resistant Design of Structures, Prentice hall of India Private Limited, New Delhi.
2. Indian Standard Codes / Handbooks on Earthquake Engineering.

Reference Books:

1. Chopra A.K., Dynamics of Structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc.
2. Proceedings of recent seminars / workshops / conferences, Papers from relevant National and International Journals and Material from NICEE, IIT Kanpur.

MTCSE203

Finite Element Analysis of Structures

Course Objectives & Outcomes

To make students to learn principles and analysis of stress and strain. To apply the finite element method for the analysis of 1D, 2D and 3 dimensional problems. Students will also study continuum of structures.

Unit: I
BASIC CONCEPTS
Review of solid mechanics, Displacement model, shape functions, Lagrange and Serendipity elements. Element properties, isoperimetric elements, numerical integration technique assemblage of elements and solution technique for static analysis.

Unit: II
ANALYSIS OF BEAMS
Finite Element formulation and Analysis of beams by Finite Element method,**shear locking in beam elements.**

Unit: III
ANALYSIS OF RIGID JOINTED PLANE FRAME
Finite Element formulation and Analysis of rigid jointed plane frame by Finite Element method.

Unit: IV
ANALYSIS OF PIN JOINTED PLANE FRAME
Finite Element formulation and Analysis of pin jointed plane frame by Finite Element method.

Unit: V
INTRODUCTION TO PLATE AND SHELL ELEMENTS
Analysis of plane stress / strain and ax symmetric solids-triangular, quadrilateral and isoperametric elements, Analysis of plate bending, basic equations of thin plate theory, Reissinner-Mindlin theory, plate elements and applications. Analysis of shells, degenerated shell elements.

Text Books:
1. Chandrupatla T.R., Belegundu A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Private Limited, New Delhi.
2. Desai C.S., Abel J.F., Introduction to the Finite Element Method, CBS Publishers & Distributors, Delhi.

Reference Books:
1. Krishanmurthy, C.S., Finite Element Analysis – Theory and Programming, Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Finite Element Analysis – Theory and Programming by Cook R.D. et.al., Concepts and Applications of Finite Element Analysis, John Wiley

MTCSE204

Maintenance and Rehabilitation of Structures

Course Objectives & Outcomes:

The objective of this course is to make students to investigate the cause of deterioration of concrete structures, To strategize different repair and rehabilitation of structures. To evaluate the performance of the materials for repair

Unit: I
QUALITY ASSURANCE
Quality assurance for Concrete and Steel construction, Properties such as strength, permeability, thermal properties and cracking. Corrosion prevention, Chemical disruption, weathering wear.

Unit: II
INFLUENCE ON SERVICEBILITY AND DURABILITY
Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, co rrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.

Unit: III
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.

Unit: IV
MATERIALS FOR REPAIR
Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, Fiber reinforced concrete.

Unit: V
TECHNIQUES FOR REPAIR
Rust eliminators and polymers coating for rebar's during repair foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

Text Books:

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.

Reference Books:

1. M.S.Shetty, "Concrete Technology - Theory and Practice", S.Chand and Company, New Delhi, 1992.
2. Raikar, R.N., "Learning from failures - Deficiencies in Design", Construction and Service - R & D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

Elective-II
MTCSE205A

Advance Fundamental Engineering

Course Objectives & Outcomes:
To learn about the stability of soils and its effects on interaction with structures. To evaluate the type of foundation required for the soil and its mechanism.

UNIT I: PRINCIPLES OF FOUNDATION ENGINEERING
Functions of foundations, Types of foundations, Principal modes of failure, Estimation of allowable bearing pressures, calculation of ultimate bearing capacity by theoretical and empirical methods, settlement of foundations, Factors to be considered in foundation design.

UNIT II: SOIL STRUCTURE INTERACTION
Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

UNIT III: BEAMS ON ELASTIC FOUNDATION
Infinite beam, two parameters, Isotropic elastic half -space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

UNIT IV: PILE FOUNDATIONS
Purpose/Uses of pile foundations, Classification of piles, Concrete and Steel Piles, their advantages and disadvantages, behaviour of pile and pile groups under load, inte raction analysis, Estimation of carrying capacity of piles and pile groups. Load deflection prediction for laterally loaded piles.

UNIT V: SPECIAL CONSIDERATIONS
Improvement of foundation soils - Purpose, Improvement of Granular Soils, Improvement of Cohesive soils, Grouting, Geosynthetics, Specific Applications.

Text Books:
1. Bowles J.E., Foundation Analysis and Design, Mc-Graw Hill International Edition.
2. Varghese P.C., Foundation Engineering, Printice Hall of India Private Limited.

Reference Books:
1. Tomlinson, Foundation Design and Construction, ELBS Longman, 1996.
2. A. Singh & G.R. Chowdhry, Soil Engineering in Theory and practice, CBS Publishers, 1990.

Elective-II
MTCSE205B

Design of Industrial Structures

Course Objectives & Outcomes:
To understand and have the knowledge of various industial structures functions, designs and its mechanics.

Unit: I
PLANNING AND FUNCTIONAL REQIREMENTS
Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines from Factories Act.

Unit: II
INDUSTRIAL BUILDINGS
Roofs for Industrial Buildings, Trusses and domes, Gantry Girders, Machine Foundations.

Unit: III
BUNKERS AND SILOS
Analysis and Design of Bunkers and Silos.

UNIT: IV
POWER PLANT STRUCTURES
Chimneys and Cooling Towers, High Pressure boilers and piping design, Nuclear containment structures,**artificial intellegence methods.**

UNIT: V
POWER TRANSMISSION STRUCTURES
Cables, Transmission Line Towers, Substation Structures, Tower Foundations, Testing Towers.

Text Books:

1. Indian Standard Codes and Handbooks on Industrial Structures
2. Relevant Publica tions from Institute for Steel Development and Growth, Kolkata

Reference Books:

1. P.Srinivasulu and C.V. Vaidyanathan, Handbook of Machine Foundations, Tata McGraw-Hill 1976.
2. S.N. Manohar, Tall Chimneys – Design and Construction, Tata McGraw-Hill, 1985.
3. A.R. Santhakumar and S.S. Murthy, Transmision Line Structures, Tata McGraw-Hill 1992.
4. Dr. K. Rajagopalan – Storage Structures – Oxford IBH Publishing Company Ltd.

Elective-II
MTCSE205C

Fabrication and Erection of Structures

Course Objectives & Outcomes:

To ensure students about various methods of fabrication and erection methods. Students will understand various process involved in fabrication and erection of steel structures.

Unit: 1

GENERAL

Various slopes, size and properties of rolled steel sections, tubes and hollow rectangular sections: Chemical composition, physical properties and weldability of various types of structures steel, their suitability for various purposes.Various operations like interpretation of drawings, shop-floor operations, fastenings, assembling, finishing and shipping, sub -assemblies and main assemblies.

Unit: II

FABRICATION DRAWINGS

Structural connections, their classification, symbols for their representation, layout of an industrial building, preparation of fabrication drawing and detailing for columns, trusses, beams and cladding, detailing of truss-joints, column bases, beam to beam and column to beam connection (Seated and framed).

Unit: III

ERECTION PROCESS

Principle of erection, Erection organisation, Preparation and reading of erection drawing, Assembly marks, common types of structures to be erected, erection of tackle and false work equipments for lifting and rigging, Code provisions for erection.

Methods of erection, levelling and alignment, setting out and grouting, allowable tolerances for plumbing, levelling and alignment.

Unit: IV

TOOLS FOR ERECTION

Miscellaneous small tools for erection like drifts, shakles and grips, erection of shed type buildings, portal frames, multi-storeyed buildings, prefabricated tanks, towers and chimneys.

Unit: V

INSPECTION, QUALITY CONTROL AND SAFETY

Code provisions for tolerances and deviations, Inspection of welds, radiographic and ultrasonic techniques, Various stages of inspection, Quality control departments, methods of rectification of defects.

Accidents and their causes, Various unsafe acts and precautions for their prevention, Rules for safety for cranes, winches, etc. Safety during electrical operations and while using X-ray equipments, Maintenance of erected structures, surface treatment against corrosion, etc.

Text Books:

Structural Steel Fabrication and Erection – S.K. Saxena and R.B. Asthane (Somaiya Publications, 172, Mumbai Marathi Granth, Sangrahalaya Marg, Dadar, Bombay-14)

Guide Book for Fabrication and Erection of Steel Structures, Institute for Steel Development and Growth, Kolkata

Reference Books:

Shivagunde R.B. and Asthana R.B., Structural Steel Drafting and Detailing, Somaiya Publications, New Delhi.

Steel Designer's Manual: Edited by Graham W. Owens & Peter R. Knowles, 5th Edition, Blakwell Scientific Publications, London.

MTCSE206-P

Advanced Design of Structures Lab

Course Objectives & Outcomes

To make students learn principles of structural design .To design deferent types of structures and to detail the structures also evaluate the performance of the structures using software STAAD PRO.

Experiments to be performed (Minimum 10 experiment to be performed)

1. Introduction to latest version of a Standard Structural Engineering Design Package such as STAAD Pro.
2. Modelling of RCC Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro. (including Earthquake and Wind Loads)

c. Analysis and Interpretation of Results of Analysis on RCC Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro.

4. Design and Interpretation of Results of Design of RCC Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro.
5. Modelling, of Steel Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro. (including Earthquake and Wind Loads)

f. Analysis and Interpretation of Results of Analysis on Steel Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro.

7. Design and Interpretation of Results of Design of Steel Frame on latest version of a Standard Structural Engineering Design Package such as STAAD Pro.
8. Case Study of design of a RCC Multistorey Building / Steel Industrial Building on latest version of a Standard Structural Engineering Design Package such as STAAD Pro.
9. Introduction to latest version of Finite Element Package such as ANSYS.
10. Modeling of an Steel Angle section on ANSYS and viewing the results.
11. Design of Multistorey Building for Dead Loads and Live Loads.
12. Design of Multistorey Building for Dead Loads, Live Loads and Wind Loads.
13. Design of Multistorey Building for Dead Loads, Live Loads and Earthquake Loads.
14. Modelling of Steel Connections in Finite Element Package ANSYS.
15. Introduction to Non-Linear Finite Element analysis of structures on ANSYS

List of Equipments / Machine Required:

1 PIV Computers with 17" Colour Monitors & UPS

2 STAAD Pro Software

3 ANSYS Software

Reference Books:

1. Users Manuals for STAAD Pro Software.
2. Users Manuals for ANSYS Software.

MTCSE207-P

Structural Experimentation Lab

Course Objectives & Outcomes

The main purpose of this course is to understand the various mechanism of the structural members and learn its application and responses at different loading conditions

Experiments to be performed (Minimum 10 experiment to be performed)

a. Study of Strain gauges – Principles and applications, mechanical, optical and electrical strain gauges,

b. Study of Strain recording instruments.

c. Study the response of RCC Beams using dial gauges, load cells etc. on a loading Frame.

d. Study the response of structural members RCC Columns using dial gauges, load cells etc. on a loading Frame.

e. Study the response of Steel Beams using dial gauges, load cells etc. on a loading Frame.

f. Study the response of Steel Columns using dial gauges, load cells etc. on a loading Frame.

g. Study the response of Steel Trusses using dial gauges, load cells etc. on a loading Frame.

h. Testing and recording of stress strain curve of steel specimens on Universal Testing Machine.

i. Testing of steel connections to demonstrate single shear / Double shear failure of bolts on Universal Testing Machine.

j. Use of static and dynamic data recording and processing systems.

k. Comparison of behaviour of steel beam (laterally supported and laterally unsupported) on a loading frame

l. Load carrying capacity of RCC Columns of various cross-sections such as plus shape, circular shape, etc.

m. Preparation of moment -rotation curves for framed steel connections.

n. Preparation of moment -rotation curves seated steel connections.

o. Preparation of moment -rotation curves for moment-resistant connections.

List of Equipments / Machine Required:

1. Loading frame (50T capacity)
2. Universal testing machine 100 T capacity
3. Strain gauges
4. Dial gauges
5. Load cells

Reference Books:

1. Dally J.W. and Riley W.F., Experimental stress analysis, McGraw-Hill Inc., New York.
2. Rangan Csetal, Instrumentation-Devices & Systems, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Semester-III

MTCSE301

Structural Dynamics

Course Objectives & Outcomes

The objectives of this course is to make students to learn principles of structural dynamics to implement there principles through different methods and to apply the same for free and forced vibration of structures. To evaluate the dynamic characteristics of the structure

Unit: I
BASIC CONCEPTS
Introduction- Elements of vibratory system, Types and sources of dynamic loads, Methodology for dynamic analysis, Study of IS- 1893, fundamentals of rigid and deformable dynamics.

Unit: II
SINGLE DEGREE OF FREEDOM SYSTEMS
Free and forced response, effect of damping, Analysis of undamped and viscously damped single degree of freedom. Response of single degree freedom systems to Harmonic loading, support motions and Transmissibility, Duhamel's integral.

Unit: III
MULTI –DEGREE OF FREEDOM SYSTEMS
Free vibrations of lumped mass multi degree freedom systems, analysis of undamped and viscously damped multi degree of freedom. Rayleigh's method, Orthogonality criteria.

Unit: IV
IDEALIZATION OF STRUCTURES
Mathematical models, Mode superposition methods, Distributed mass properties.

Unit: V
APPLICATION TO EARTHQUKE ENGINEERING
Introduction to vibrations due to earthquake, Response spectra. Response spectrum method for seismic design of structures,**dynamic response,damage estimation.**

Text books:

1. Chopra, A. K., Dynamics of Structures - Theory and Applications to Earthquake Engineering, Second Edition, Prentice Hall, 2001.

2. Rao, S. S., Mechanical Vibrations, Third Edition, Addison-Wesley Publishing Co., 1995

Reference Books:

1. Clough, R. W., and J. Penzien, Dynamics of Structures, Second Edition, McGraw-Hill, 1993.

2. Mario Paz, Structural Dynamics – Theory and Computations, Third Edition, CBS publishers, 1990.

MTCSE302

Communication and Research Methodology

Course Objectives & Outcomes

To make students aware about behavior science, communication skills, writing skills etc; students will be able to study various research methods and tools.

Unit :I

Concepts of Communications: Definition, Forms of Communication, Objectives of Communication, Characteristics of Communication, Process of Communication, Communication, Roadblocks, Role of Verbal and Non-verbal Symbols in Communication, Barriers to Effective Communication, Overcoming Communication Barriers.

Nonverbal communication: Body Language, Gestures, Postures, Facial Expressions, Dress codes; the Cross Cultural Dimensions of Business Communication; Listening and Speaking, techniques of electing response, probing questions, Observation. Business and social etiquettes;

Listening Skills: Definition, Anatomy of poor Listening, Features of a good Listener, Role Play, Group Discussion and Interviews, Meetings: Ways and Means of conducting meetings effectively, Mock Meetings and Interviews

Unit: II

Reading and language skills: The reading process, purpose, different kinds of texts, reference material, scientific and technical texts, active and passive reading, strategies - vocabulary skills, eye reading and visual perception, prediction techniques, scanning skills, distinguishing facts and opinions, drawing inferences and conclusions, comprehension of technical material - scientific and technical texts, instructions and technical manuals, graphic information.

Forms of Communication in Written mode: Basics Body language of Business Letters and Memos, Tone of writing,

Enquiries, orders and replying to them, sales letters, Job applications and resume, E-mail: How to make smart e-mail, Writing Business Reports and Proposals, Practice for Writing.

Unit:III

Referencing and Writing skills: Business letters: Enquiries, Circulars, Quotations, Orders, Acknowledgments, Executions, Complaints, Claims and adjustments, Collection letter, Banking correspondence, Agency correspondence, Bad news and persuading letters, Sales letters, Job application letters - Biodata, Covering Letter, Interview Letters, Letter of Reference, Memos, minutes, Circulars & notices.

Types of Business Reports - Format, Choice of vocabulary, coherence and cohesion, paragraph writing, organization reports by individual, Report by committee.

Unit:IV

Introduction to Research and Research Design: Nature and scope of research, information based decision making and source of knowledge. The research process; basic approaches and terminologies used in research. Defining research question and framing of hypotheses, preparing a research plan, qualitative and quantitative research designs, Experimentation, Observational studies, Exploring secondary data.

Measurement and Scaling, Data Source and Data Collection Field research: primary data collection from observations, surveys and experimentation. Measurement and scaling; commonly used scales in reliability and validity of scales. Designing instrument for data collection; testing the instrument, data collection process, Sampling methods and procedures and sample size decisions.

Unit:V

Data Analysis and Presentation Editing and coding of data, tabulation, graphic presentation of data, cross tabulation, Testing of hypotheses; type I and II errors, one tailed and two tailed tests of significance, Parametric and nonparametric tests for Univariate and Bivariate data. Tests of association; simple linear regression and other non parametric tests.

Technical Writing: Technical Proposal writing: Definition, Purpose, types, characteristics, Elements of structure, style and appearance, evaluation, exercises, Research report writing, Proposal writing, referencing, forms of reports, bibliography, etc. Research paper, Dissertation, and Thesis, Instruction Manuals, Type of instructions, Writing Instructions, Technical Descriptions, Process descriptions, Guidelines for Writing Good Descriptions.

Text Books:

1. Lesikar, R. V. & Flatley, Basic Business Communication Skills for Empowering the Internet Generation. TMH.
2. Meenakshi Raman, Sangeeta Sharma, Technical Communications, Oxford Latest Edition.
3. D. K. Bhattacharyya, Research Methodology, Excel Books 2nd Edition.

Reference Books:

1. Bowman, J.P. &Branchaw, P.P. Business Communications, Process to Product Dryden Press, Chicago.
2. M Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill.
3. E. H. McGrath, Basic Managerial Skills, Prentice hall India
4. Sajitha, Technical Writing, Himalaya Latest Edition

Elective-III
MTCSE303A

Optimization Techniques

Course Objectives & Outcomes

The main objective of this course is to understand the application of various optimization techniques and programming in civil Engineering.

Unit: I
OPTIMIZATION TECHNIQUES

Basic Concepts and introduction of engineering optimization, single-variable optimization, Multivariable optimization with no constraints, equality constraints and inequality constraints.

Unit: II
LINEAR PROGRAMMING

Basic concepts of Linear programming, Applications of Linear Programming, standard forms of a Linear programming problems, solution of a system of linear simultaneous equations, Decomposition principle, Quadratic programming.

Unit: III
NON LINEAR PROGRAMMING

Basic concepts of Non-linear programming, Uni-modal function, Elimination methods, Interpolation methods, classification of unconstrained minimization methods- Direct search methods, Indirect search methods, characteristics of a constrained problem-Direct methods, Indirect methods.

Unit: IV
GEOMETRIC PROGRAMMING

Unconstrained minimization problem, constrained minimization, Applications of Geometric programming.

Unit: V
SPECIAL OPTIMIZATION TECHNIQUES

Separable programming, transformation of a non-linear function to separable form, multi objective optimization, calculus of variations, optimal control theory.

Text Books:

1. Rao S.S., Engineering Optimization Theory and Practice, New Age Publishers, Delhi
2. Deb K., Optimization for Engineering Design, Algorithms & examples, Prentice Hall of India, Delhi

Reference Books:

1. Arora J.S., Introduction to optimum Design, TMH, Delhi
2. Fox R.L., Optimization methods for Engineering Design, Addison Wesley Publishing

Elective-III
MTCSE303B

Theory of Plates and Shells

Course Objectives & Outcomes

To have the theoretical knowledge of various kinds of Plates and Shells

Unit: I
BASIC CONCEPTS

The fundamental elasticity equations. Theory of elasticity and real structures. The fundamental elasticity problems. Boundary conditions. Compatibility equations. Applications.
Calculation of displacement components. The plane stress and plane strain problem,**theory of surfaces.**

Unit: II
ANALYSIS OF PLATES

Equation of equilibrium and deformation of plates, Bending of rectangular plates and circular plates.

Energy method, finite difference and finite element methods for solution of plate bending problems.

Unit: III
FOLDED PLATES

Analysis and design of folded plates, Detailing of Reinforcement in folded plates.

Unit: IV
ANALYSIS OF SHELLS

Geometry of shells, Classification of Shells, membrane theory of circular and cylindrical shells, Introduction to the bending theory of shells,**buckling and vibration of shells.**

Unit: V
CYLINDRICAL SHELLS

Analysis and design of cylindrical shells, Detailing of Reinforcement in shells.

Text Books:

1. Timoshenko S.P. and Woinoswski-Krieger S., Theory of Plates and Shells. McGraw-Hill. 2**.**
Gould Philipp L., Analysis of Shells and Plates. Springer Verlag New York.

Reference Books:

1. Reddy J. N.,Theory and Analysis of Elastic Plates. Taylor and Francis, London.
2. Szilard R., Theory and Analysis of Plates. Prentice -Hall, Englewood Cliffs.

Elective-III
MTCSE303C

Pre-Stressed Concrete

Course Objectives & Outcomes

The objective of this course is to make students to learn about various designs of pre-stressed elements and also understand the pre-stressed elements.

Unit: I
INTRODUCTION AND CODAL PROVISIONS

Principles of Prestressing, types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts. Behaviour under flexure,- codal provisions (IS, British ACI and DIN), ultimate strength.

Unit: II
DESIGN PRINCIPLES

Design of flexural members, Design for Shear, bond and torsion. Design of End blocks and their importance, Design of tension members, application in the design of prestressed pipes and prestressed concrete cylindrical water tanks,**design of concrete flat plates.**

Unit: III
DESIGN OF COMPRESSION MEMBERS

Design of compression members with and without flexure, its application in the design piles, flag masts and similar structures.

Unit: IV
CONTINUOUS BEAMS

Application of prestressing in continuous beams, concept of linear transformation, concordant cable profile and cap cables.

Unit: V
COMPOSITE BEAMS

Composite beams, analysis and design, ultimate strength, their applications. Partial prestressing, its advantages and applications.

Text Books:

1. Prestressed Concrete by Krishna Raju, Tata McGraw Hill Publishing Co.

2. Fundamentals of Prestressed Concrete by N.C.Sinha & S.K.Roy S.Chand & Co.

Reference Books:

1. T.Y.Lin, Design of Prestressed Concrete Structures, John Wiley and Sons, Inc.
2. Evans, R.H. and Bennett, E.W., Prestressed Concrete, Champman and Hall, London.

MTCSE304

Preliminary work on Dissertation

The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports.

MTCSE305

Seminar Based on Dissertation

The student will deliver a seminar on the topic chosen by him and approved by Departmental committee for evaluation at the end of semester

Semester-IV

MTCSE401

Dissertation

The student will submit a detailed Project Report on the topic approved by Departmental committee in a specified format and will also deliver a Presentation on the topic chosen at the end of semester.