CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Scheme of Teaching & Examination

M.E. (Civil) with Specialization in Structural Engg.

II SEMESTER

S. No.	Board of Study	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical			Total Marks	Credit L+(T+P)/2
				L	T	P	ESE	CT	TA		
1	Civil Engg.	550211 (20)	Advanced Design of Concrete Structures	3	1	-	100	20	20	140	4
2	Civil Engg.	550212 (20)	Earthquake Effects on Structures	3	1	-	100	20	20	140	4
3	Civil Engg.	550213 (20)	Finite Element Analysis of Structures	3	1	-	100	20	20	140	4
4	Civil Engg.	550214 (20)	Maintenance and Rehabilitation of Structures	3	1	-	100	20	20	140	4
5	Refer Table - II		Elective II	3	1	-	100	20	20	140	4
6	Civil Engg.	550221 (20)	Advanced Design of Structures Lab	-	-	10	75		75	150	5
7	Civil Engg.	550222 (20)	Structural Experimentation Lab	-	-	10	75		75	150	5
	Total			**15**	**5**	**20**	**650**	**100**	**250**	**1000**	**30**

L- Lecture   T- Tutorial
P- Practical ,   ESE- End Semester Exam
CT- Class Test   TA- Teacher's Assessment

Table -II

	ELECTIVE II		
S.No.	Board of Study	Subject Code	Subject
1	Civil Engg.	550231 (20)	Advance Foundation Engineering
2	Civil Engg.	550232 (20)	Design of Industrial Structures
3	Civil Engg.	550233 (20)	Fabrication and Erection of Structures
4	Civil Engg.	550234 (20)	Composite Construction using Structural Steel

Note (1) –   1/4th of total strength of students subject to minimum of twenty students is required to offer an elective in the college in a Particular academic session .

Note (2) –   Choice of elective course once made for an examination cannot be changed in future examinations.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E. II**   Branch: **Civil Engineering**
Subject: **Advanced Design of Concrete Structures**   Code: **550211(20)**
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

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.

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 Boks:

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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E. II**   Branch: **Civil Engineering**
Subject: **Earthquake Effects on Structures**   Code: **550212 (20)**
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

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

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 Eqartquake 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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E. II**   Branch: **Civil Engineering**
Subject: **Finite Element Analysis of Structures**   Code**: 550213 (20)**
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

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.

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

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E. II**   Branch: **Civil Engineering**
Subject: **Maintenance and Rehabilitation of Structures**   Code: **550214(20)**
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

UNIT I: QUALITY ASSURANCE
Quality assurance for Concrete and Steel construction, Properties such as strength, permeability, thermal properties and cracking. Corrosion prevention.

UNIT II: INFLUENCE ON SERVICEBILITY 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.

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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **ME II**
Subject: **Advance Foundation Engineering**
Total Theory Periods: **40**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

Branch: **Civil Engineering**
Code**: 550231(20)**
Total Tutorial Periods: **12**

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, interaction 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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E. II**   Branch: **Civil Engineering**
Subject: **Design of Industrial Structures**   Code: 550232 (20)
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

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.

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 Publications 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.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **ME - II**   Branch: **Civil Engineering**
Subject: **Fabrication and Erection of Structures**   Code: **550233 (20)**
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

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 2: 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 3: 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 4: 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 5: 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, Blackwell Scientific Publications, London.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester:- **ME II**   Branch: **Civil Engineering**
Subject: **Composite Construction using Structural Steel**   Code: **550234 (20**)
Total Theory Periods: **40**   Total Tutorial Periods: **12**
Total Marks in End Semester Exam: **100**
Minimum number of class tests to be conducted: **02**

UNIT I: INTRODUCTION
Introduction to steel - Concrete composite construction, Theory of composite structures, Seismic behaviour of composite structures.

UNIT II: DESIGN OF COMPOSITE MEMBERS
Behaviour of composite beams and Columns, Design of composite beams, Steel - Concrete composite columns, Design of composite trusses.

UNIT III: DESIGN OF CONNECTIONS
Types of connections, Design of connections in the composite structures, Shear connections, Design of connections in composite trusses.

UNIT IV: COMPOSITE BRIDGERS
Introduction, Behaviour of composite bridges, Design concepts.

UNIT V: CASE STUDIES
Case studies on steel - Concrete composite construction in buildings and bridges.

Text Books:

1. Johnson R.P., Composite structures of steel and concrete, Blackwell Scientific Publications (Second Edition), UK, 1994.
2. Handbooks Published by Institute for Steel Development and Growth, Kolkata

Reference Books:

1. Owens, G.W. and Knowels.P. Steel Designers manual (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.
2. Proceedings of recent seminars / workshops / conferences and Papers from relevant National and International Journals.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E.II**   Branch: **Civil Engineering**

Subject: **Advanced Design of Structures Lab**   Code: **550221 (20)**

Total Marks in End Semester Exam: **75**

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

   a. Introduction to latest version of a Standard Structural Engineering Design Package such as STAAD Pro.

   b. 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.

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

   e. 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.

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

   h. 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.

   i. Introduction to latest version of Finite Element Package such as ANSYS.

   j. Modeling of an Steel Angle section on ANSYS and viewing the results.

   k. Design of Multistorey Building for Dead Loads and Live Loads.

   l. Design of Multistorey Building for Dead Loads, Live Loads and Wind Loads.

   m. Design of Multistorey Building for Dead Loads, Live Loads and Earthquake Loads.

   n. Modelling of Steel Connections in Finite Element Package ANSYS.

   o. Introduction to Non-Linear Finite Element analysis of structures on ANSYS

List of Equipments / Machine Required:

   a. PIV Computers with 17" Colour Monitors & UPS

   b. STAAD Pro Software

   c. ANSYS Software

Recommended Books:

   1. Users Manuals for STAAD Pro Software.

   2. Users Manuals for ANSYS Software.

CHHATTISGARH SWAMI VIVEKANAND TECHNICAL UNIVERSITY, BHILAI (C.G.)

Semester: **M.E**. **II**   Branch: **Civil Engineering**
Subject: **Structural Experimentation Lab**   Code: **550222 (20)**
Total Marks in End Semester Exam: **75**

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

(i)   Study of Strain gauges – Principles and applications, mechanical, optical and electrical strain gauges,

(ii)   Study of Strain recording instruments.

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

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

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

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

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

(VIII)   Testing and recording of stress strain curve of steel specimens on Universal Testing Machine.

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

(x)   Use of static and dynamic data recording and processing systems.

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

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

(xiii)   Preparation of moment-rotation curves for framed steel connections.

(XIV)   Preparation of moment-rotation curves seated steel connections.

(XV)   Preparation of moment-rotation curves for moment-resistant connections.

List of Equipments / Machine Required:

a. Loading frame (50T capacity)

b. Universal testing machine 100 T capacity

c. Strain gauges

d. Dial gauges

e. Load cells

Recommended 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.

.