WALCHAND INSTITUTE OF TECHNOLOGY, SOLAPUR
(AN AUTONOMOUS INSTITUTE)

Affiliated to
Punyashlok Ahilyadevi Holkar Solapur University,
Solapur

CHOICE BASED CREDIT SYSTEM (CBCS)

Structure and Syllabus for
M. Tech. in Civil (Structural Engineering)

F. Y. M. Tech. Civil (Structural Engineering) W.E.F. 2023-24
S. Y. M. Tech. Civil (Structural Engineering) W.E.F. 2024-25

Dr. M. G. Kalyanshetti
Chairman, BOS in Civil Engg.
W.I.T. (Autonomous), Solapur

WALCHAND INSTITUTE OF TECHNOLOGY WIT SOLAPUR

Civil Engineering Department

Department Vision

The Department of Civil Engineering, Walchand Institute of Technology Solapur, will excel and lead in education, research and innovation; contributing to the advancement of design, construction and maintenance of infrastructure, to enhance the quality of life for humankind in a sustainable way.

Department Mission

1. To create an outstanding learning experience through a rigorous curriculum of theory, laboratory, and practice that develops students' technical and professional skills to succeed in a wide range of careers.
2. To continually advance research through a culture of research, creativity, and innovation to benefit humankind.
3. To serve as highly capable resources to society, the profession through professional organizations, consultancy, and continuing education.

Civil Engineering
Post Graduate Program

Program Educational Objectives (PEOs)

The Program Educational Objectives for M. Tech. Civil (Structural Engineering) program are designed to produce competent civil engineers who are ready to contribute effectively to the advancement of civil Engineering and to fulfill the needs of the community. These objectives are as follows:

1. **PEO1**: Postgraduate will excel in professional career and/or higher education by acquiring knowledge in engineering and mathematical principles along with state of art computing skills
2. **PEO2**: Postgraduate will analyze real-life problems and design technically sound, economically feasible, and socially acceptable structural systems.
3. **PEO3**: Postgraduate will exhibit professionalism, ethical attitude, effective communication, teamwork in their profession, and adapt to the latest trends and technology by engaging in lifelong learning.

Program Outcomes (POs)

The program outcomes of M. Tech. Civil (Structural Engineering) Program are summarized as follows:

PO-1: Apply the knowledge of science, mathematics, and engineering principles for developing problem-solving attitude.

PO-2: Write and present a substantial technical report/ document.

PO-3: Demonstrate a degree of mastery in Structural Engineering. The mastery at a level higher than the requirements in the appropriate bachelor program.

PO- 4 An ability to use modern tools and techniques, skills, instrumentation and software packages necessary to predict and solve complex engineering problems.

PO- 5 An ability to create an innovative design for civil engineering structures and execute the projects.

PO- 6 Recognize the need for, and have the ability in lifelong learning independently for professional advancement, demonstrate professional ethics, work culture, and understanding of responsibility to contribute to the community for sustainable development of society

Legends Used-

L	Lecture
T	Tutorial
P	Practical
D	Drawing
FA	Formative Assessment
SA	Summative Assessment
ESE	End Semester Examination
ISE	In Semester Evaluation
ICA	Internal Continuous Assessment
F.Y.	First Year
S.Y.	Second Year
M. Tech.	Master of Technology

Course Code Format:

2	1	S	E	U/P	2	C	C	1	T/L
Batch Entry Year		Program Code		U-Undergraduate, P-Post Graduate	Semester No. / Year 1/2/3/4	Course Type		Course Serial No. 1-9	T-Theory, L-Lab session

Program Code SE	M. Tech. Civil -Structural Engineering
Course Type	
CC	Core Compulsory Course
EN*	Core Elective **N*** *indicates the serial number of electives offered in the respective category*
ON*	Open Elective **N*** *indicates the serial number of electives offered in the respective category*
SM	Seminar
MP	Mini project
PR	Project

Sample Course Code:

23SEP1CC1T	Advanced Structural Analysis

Walchand Institute of Technology, Solapur

Structure of F.Y. M. Tech. Civil (Structural Engineering)

(W.E.F.. 2023-24)

Semester-I

Course Code	*Name of the Course*	*Engagement Hrs*				*Credits*	*FA*	*SA*		*Total*
		L	*T*	*P*	*D*		*ESE*	*ISE*	*ICA*	
23SEP1CC1T	Advanced Structural Analysis	3	1	-	-	4	60	40	25	125
23SEP1CC2T	Advanced Solid Mechanics	3	1	-	-	4	60	40	25	125
23SEP1CC3T	Structural Dynamics	3	1	-	-	4	60	40	25	125
23SEP1EAN*T	Core Elective- I	3	1	-	-	4	60	40	25	125
23SEP1CC5T	Research Methodology and IPR©	3	-	-	-	3	60	40	-	100
23SEP1CC6L	Computer aided Structural Design Lab.	-		4		2	50	-	-	50
	Grand Total	**15**	**4**	**4**	**-**	**21**	**350**	**200**	**100**	**650**

N* indicates the serial number of elective offered in the respective category

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Structure of F.Y. M. Tech. Civil (Structural Engineering)

(W.E.F.. 2023-24)

Semester-II

Course Code	*Name of the Course*	*Engagement Hrs*				*Credits*	*FA*	*SA*		*Total*
		L	*T*	*P*	*D*		*ESE*	*ISE*	*ICA*	
23SEP2CC1T	Finite Element Method	3	1	-	-	4	60	40	25	125
23SEP2CC2T	Theory of Plates and Shells	3	1	-	-	4	60	40	25	125
23SEP2CC3T	Seismic Design of Multistoried Buildings	3	1	-	-	4	60	40	25	125
23SEP2EBN*T	Core Elective – II	3	1			4	60	40	25	125
23SEP2ECN*T	Core Elective – III	3	1	-	-	4	60	40	25	125
23SEP2CC6L	Advanced Concrete Technology Lab.	-	-	2	-	2	-	-	50	50
23SEP2MP7L	Mini Project	-	-	2	-	2	50	-	-	50
	Grand Total	**15**	**5**	**4**	**-**	**24**	**350**	**200**	**175**	**725**

N* indicates the serial number of elective offered in the respective category

List of core elective courses for semester I and II

Course code	Core Elective- I (Sem-I)
23SEP1EA1T	Advanced Design of Concrete Structures
23SEP1EA2T	Design of Formwork
23SEP1EA3T	Advanced Design of Foundation
23SEP1EA4T	Structural Optimization
	Core Elective-II (Sem-II)
23SEP2EB1T	Design of Prestressed Concrete Structures
23SEP2EB2T	Structural Audits
23SEP2EB3T	Concrete Composites
23SEP2EB4T	Design of Industrial Structures
23SEP2EB5T	Design of Tall buildings
	Core Elective-III (Sem-II)
23SEP2EC1T	Theory of Structural Stability
23SEP2EC2T	Design of RCC Bridges
23SEP2EC3T	Advanced Steel Design
23SEP2EC4T	Soil Structure Interaction

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Structure of S.Y. M. Tech. Civil (Structural Engineering)

(W.E.F.. 2024-25)

Semester-III

Course Code	*Name of the Course*	*Engagement Hrs*				*Credits*	*FA*	*SA*		*Total*
		L	*T*	*P*	*D*		*ESE*	*ISE*	*ICA*	
23SEP3CC1L	Lab. Practice	-	-	2	-	2	-	-	50	50
23SEP3OAN*T	Open Elective Course#	3	-	-	-	3	60	40	-	100
23SEP3DS3L	Dissertation Phase I :Synopsis Submission Seminar*	-	-	@ 4	-	2	-	-	50	50
23SEP3DS4L	Dissertation Phase II ICA*	-	-		-	4	100	-	-	100
23SEP3DS5L	Dissertation Phase II Progress Seminar*	-	-		-	4	100	-	-	100
	Grand Total	**3**	**-**	**8**	**-**	**15**	**260**	**40**	**100**	**400**

Note –

- Lab Practice shall include any of the below activities as recommended by Advisor and student shall submit a report after completion of the activity to Advisor along with other details if any. Software / hardware assignments, learning new software, literature survey, filed work, industrial training etc. related to dissertation work.
- *- For all activities related to dissertation Phase I (synopsis submission seminar and progress seminar) student must interact regularly every week with the advisor.
- # - This course is common for all branches of Technology (i.e. for all M. Tech. Programs)
- Synopsis submission seminar shall cover detailed synopsis of the proposed work. Student shall submit synopsis of the dissertation work only after delivering this seminar.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any
- @ Indicates contact hours of students for interaction with advisor.

List of Open Elective Courses - 23SEP3OAN*T

Course code	Subject
23SEP3OA1T	Business Analytics
23SEP3OA2T	Operation Research
23SEP3OA3T	Cost Management of Engineering Projects
23SEP3OA4T	Non-conventional Energy

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Semester-IV

Course Code	*Name of the Course*	*Engagement Hrs*				*Credits*	*FA*	*SA*		*Total*
		L	*T*	*P*	*D*		*ESE*	*ISE*	*ICA*	
23SEP4DS1L	Dissertation Phase III : Progress Report	-	-	3	-	3	-	-	100	100
23SEP4DS2L	Dissertation Phase IV: submission of report #	-	-	4	-	4	-	-	100	100
23SEP4DS3L	Dissertation Viva –Voce	-	-	8	-	8	200	-	-	200
	Grand Total	**-**	**-**	**15**	**-**	**15**	**200**	**-**	**200**	**400**

Note –

- #- For all activities related to dissertation Phase III & IV student must interact regularly every week with the advisor.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any.
- Student must submit a hard copy of Project Report to the department
- Details of modes of assessment of seminar and dissertation shall be as specified in 7 (III) of PG Engineering Ordinance of Solapur University, Solapur.
- @ indicates contact hours of the student for interaction with the advisor

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-I
23SEP1CC1T -ADVANCED STRUCTURAL ANALYSIS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per week, 3 Credits	ESE: 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per week, 1 Credit	ISE: 40 marks
	ICA: 25marks

Course outcome: At the end of the course, students will be able to,

1. Draw ILD for indeterminate structures
2. Analyze the beams curved in plan
3. Analyze the structure resting on elastic foundation
4. Analyze the skeleton structures using stiffness method

SECTION-I

Unit 1 - Influence Line Diagrams for Indeterminate Structures [8Hrs]

Continuous beams, portal frames and two hinged arches. Muller- Breslau's Principle and Moment Distribution Method

Unit 2 - Beams curved in plane [5Hrs)

Determinate and indeterminate beams curved in plan.

Unit 3 - Beams on elastic foundations [8Hrs]

Analysis of infinite, Semi-infinite and finite beams

SECTION-II

Unit 4 - Beam columns [6Hrs]

Concept of geometric and material non linearity, Governing differential equation, Analysis of beam- columns subjected to different loadings and support conditions, Stiffness and carry-over factors for beam-columns, fixed end actions due to various loads

Unit 5 - Stiffness method of structural analysis [10Hrs]

Analysis of continuous beams, trusses and plane frames by structure oriented stiffness approach.

Unit 6 - Member oriented stiffness Method [6Hrs]

Stiffness matrices of beam, truss, plane frame, grid, pin and rigid jointed space frame elements on member axes. Transformation of matrices on structure axes. Over-all joint stiffness matrix and nodal load vector, assembly rules, Calculation of member end forces, Bandwidth.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOKS:

1. Advanced Theory of Structures by Vazirani and Ratwani.
2. Analysis of structure by Vazirani and Ratwani,Vol.II
3. Mechanics of Structures Vol. I, II and III by Junnarkar and Shah.

REFERENCE BOOKS:

1. Structural Analysis by Negiand Jangid
2. Theory of Elastic Stability by Timoshenko and Gere.
3. Matrix Analysis of Framed structures by Gere and Weaver.
4. Structural Analysis–A Matrix approach by Pandit and Gupta.
5. Basic structural Analysis by C. S. Reddy.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1CC2T -ADVANCED SOLID MECHANICS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per week, 3 Credits	ESE: 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per week, 1 Credit	ISE: 40 marks
	ICA: 25 marks

Course Outcomes: - At the end of the course, student will be able to,

1. Identify and Solve problems of elasticity understanding the basic concepts
2. Apply numerical methods to solve continuum problems.
3. Identify and Solve problems of plasticity understanding the basic concepts.

SECTION- I

Unit 1 - Introduction to Elasticity **[6Hrs]**

Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity

Unit 2 - Three-Dimensional Problems of Elasticity **[10Hrs]**

Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components, Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations.

Unit 3 - Two-Dimensional Problems of Elasticity **[6Hrs]**

Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

SECTION- II

Unit 4 - Torsion of Prismatic Bars [8Hrs]

Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes

Unit 5 - Plastic Deformation [7Hrs]

Strain Hardening, Idealized Stress- Strain curve, Yield Criterion, Von Mises Yield Criterion

Unit 6 - Plastic Deformation [7Hrs]

Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOKS:

1. Theory of Plasticity by Chakraborty

REFERENCE BOOKS:

1. Theory of Elasticity: Timoshenko S. and Goodier J. N., McGraw Hill,1961.
2. Elasticity: SaddM.H.,Elsevier,2005.
3. Engineering Solid Mechanics: Ragab A.R., Bayoumi S.E., CRC Press,1999.
4. Computational Elasticity: Ameen M., Narosa,2005.
5. Solid Mechanics: Kazimi S. M. A., Tata McGraw Hill,1994.
6. Advanced Mechanics of Solids: Srinath L.S., Tata McGraw Hill,2000.
7. Introduction to Mechanics of Solids by Venkatraman &Patel

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F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1CC3T -STRUCTURAL DYNAMICS

Teaching Scheme	**Examination Scheme:**
Lectures: 3 hours per week, 3Credits	**ESE**: 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per week, 1Credit	**ISE**: 40 marks
	ICA: 25marks

Course Outcomes: - At the end of the course, student will be able to,

1. Analyze dynamic response of SDOF system using fundamental theory and equation of motion
2. Analyze dynamic response of MDOF system using fundamental theory and equation of motion
3. Analyze beams in flexure by applying the theory of free and forced vibration

SECTION-I

Unit 1 - Single-Degree-of-Freedom System [9Hrs]

Single-Degree-of-Freedom System, Analysis models, Equations of motion, Free vibration, Damping, Types of Damping, Response to harmonic loading, Resonance, Support motion, Transmissibility, Vibration isolation

Unit 2 - SDOF systems subjected to periodic and impulsive loading [7Hrs]

SDOF systems subjected to periodic and impulsive loading, and other different loading conditions, introduction to frequency-Domain Analysis.

Unit 3 - SDOF system subjected to general dynamic loading [6Hrs]

SDOF system subjected to general dynamic loading, Numerical evaluation of SDOF – Duhamal's Integral, Application to simple loading cases

SECTION-II

Unit 4 - MDOF System, Selection of DOFs [8Hrs]

MDOF System, Selection of DOFs, Formulation of Equation of motion, Structure matrices, Static condensation, Free vibrations, Frequencies and Mode Shapes, Determination of natural frequencies and mode shapes, Orthogonality conditions.

Unit 5 - Discrete systems [8Hrs]

Discrete systems, Fundamental mode analysis, Rayleigh method, Dunkerly's Method, Response of MDOF systems to dynamic loading, Mode superposition Method.

Unit 6 - Distributed Parameter Systems [6Hrs]

Distributed Parameter Systems, Partial differential equations of motion, free and forced vibrations, Application to beams in flexure.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOK:

1. Structural Dynamics–Mario Paz

REFERENCE BOOKS:

1. Dynamics of structures-R.W. Cloughand J. Penxiene, McGraw-Hill Pub.
2. Structural Dynamics–Roy Craig, John-Wiley & Sons
3. Dynamics of Structures–Theory & Application to Earthquake Engineering- A.K. Chopra, Prentice Hall Publications
4. Dynamics of Structures–Mukhopadhyay
5. Elements of Earthquake Engineering by Jaikrishna, A. R. Chandrashekharan, Brijesh Chandra, Standard Publishers & Distributors.

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F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1EA1T - ELECTIVE- I

ADVANCED DESIGN OF CONCRETE STRUCTURES

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per week, 3 Credits	**ESE**: 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per week, 1 Credit	**ISE**: 40 marks
	ICA: 25marks

Course Outcomes: - At the end of the course, student will be able to,

1. Analyze and Design various special types of slabs
2. Analyze and Design Combined Footing and Raft foundation
3. Analyze and Design Overhead water tanks.
4. Design of Deep beam, Corbel, Chimneys ,Silos and Bunkers

SECTION-I

Unit 1 - Analysis and Design of Flat slab, Grid Slab and Circular slab **[8Hrs]**

Unit 2 - Analysis and Design of Combined Footing and Raft foundation **[6Hrs]**

Unit 3 - Design of miscellaneous structures **[8Hrs]**

Design of Deep Beam and Corbel, design of Shear Walls

SECTION-II

Unit 4 - Analysis and Design of Overhead water tank [8Hrs]

Rectangular and Circular with flat bottom, Design of staging for wind and seismic loads

Unit 5 - Design of RCC Chimneys [6Hrs]

Design factors, stresses due to self weight and wind load, Temperature stresses

Unit 6 - Design of silos and bunkers [8Hrs]

Classification, Square bunkers and circular bunkers, Silos- Lateral pressure, Airy's theory, Shallow Bins, Deep Bins

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOK:

1. Reinforced Concrete StructuresVol.1 & Vol.2 by B. C. Punmia, A. K. Jain, Arun K. Jain.

REFERENCE BOOKS:

1. Reinforced concrete, Limit state Design by Ashok K. Jain, New Chandand Bros. Roorkee.
2. Advanced Reinforced Concrete Design by P. C. Varghese-Prentice Hall of India.
3. Advanced Reinforced Concrete Design by N. Krishnaraju-CBS Publishers & Distributors.
4. Reinforced Concrete Structures Vol.1 & Vol.2 by Jainand Jaikrishna.
5. Advanced Reinforced Concrete Design by Bhavikatti S.S.

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F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1EA2T - ELECTIVE- I

DESIGN OF FORMWORK

Teaching Scheme:
Lectures: 3 hours per week, 3Credits
Tutorial: 1 hour per week, 1Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, student will be able to,

1. Select proper formwork, accessories and material
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures
4. Design the flying formwork

SECTION-I

Unit 1 - Introduction to formwork **[6Hrs]**

Types of formwork, Requirement of formwork , Selection of formwork, Trenchless technology

Unit 2 - Formwork materials **[8Hrs]**

Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Types of supports, Horizontal and Vertical Formwork Supports

Unit 3 - Formwork Design **[8Hrs]**

Concepts, Formwork Systems and Design for Foundations, Walls, Columns Slab and Beams

SECTION-II

Unit 4 - Formwork Design for Special Structures [9Hrs]

Shells, Domes, Folded Plates, Overhead Water Tanks, Tower, Bridges

Unit 5 - Flying Formwork [6Hrs]

Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues – Pre- and Post-Award

Unit 6 - Causes and Case studies in Formwork Failure [9Hrs]

Causes and Case studies in Formwork Failure, Formwork Issues in Multi- Story Building Construction

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOK:

1. Formwork for Concrete Structures, Peurify, McGraw Hill Publication India

REFERENCE BOOKS:

1. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education.
2. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1EA3T -ELECTIVE– I

ADVANCED DESIGN OF FOUNDATION

Teaching Scheme:
Lectures: 3 hours per week,3 Credits
Tutorial: 1 hours per week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: -At the end of the course, student will be able to,

1. Evaluate Bearing capacity of soil by various theories
2. Design wall footing, strap footing, combined footing
3. Design Pile foundation for the given loading and site conditions
4. Design simple Machine foundation

SECTION-I

Unit 1 - Theories of failure of soil **[8Hrs]**

Theories of failure of soil, Determination of ultimate bearing capacity, Dynamic bearing capacity. Different methods of design of shallow foundations for axial and eccentric load

Unit 2 - Design of wall footing **[8Hrs]**

Design of wall footing, strap footing, combined footing, (Rectangular & Trapezoidal)

Unit 3 - Raft foundation **[5Hrs]**

Raft foundation, different types, Design considerations and various methods of analysis of raft.

SECTION-II

Unit 4 - Determination of load carrying capacity **[8Hrs]**

Determination of load carrying capacity of single pile, rock socketing, Negative skin friction, Design of axially loaded piles, design of pile groups and pile cap, under-reamed piles

Unit 5 - Analysis and design **[7Hrs]**

Analysis and design of drilled piers and well foundation.

Unit 6 - Dynamic response of soil **[6Hrs]**

Dynamic response of soil, criteria for satisfactory machine foundation, framed and massive foundation, Analysis and design of simple machine foundations using I. S. Code. Vibration isolation.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOK:

1. "Soil Dynamics," Shamsher Prakash, McGrawHill Book Co.

REFERENCE BOOKS:-

1. Winterkorn H.F. and FangH.Y., "Foundation Engineering Hand Book"-VanNost and ReinholdCompany,1975
2. Bowles J.E., "Foundation Analysis and Design"- McGraw Hill Book Company, 1968.
3. "Vibration Analysis and Design of Foundations for Machines and Turbines" – Major A. Collets Holding Ltd.,1962.
4. Kany M.,"Design of Raft Foundations" Elithelm Earnest and Son.1974.
5. Goodman, L. J. and Karol, R. H.,", Theory and Practice of Foundation Engineering",McMillion,1968.
6. D. D. Barkar, "Dynamics of Bases & Foundation."

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F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1EA4T -ELECTIVE- I

STRUCTURAL OPTIMIZATION

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per week, 3 Credits	**ESE**: 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per week,1 Credit	**ISE**: 40 marks
	ICA: 25 marks

Course Outcomes: -At the end of the course, student will be able to,

1. Use variational principle for optimization
2. Apply optimization techniques to structural steel and concrete members
3. Apply Linear and non linear optimization technique

SECTION-I

Unit 1 - Objective optimization **[7Hrs]**

Objective optimization, problem formulation, problem types, constrained and unconstrained problems, implications of risk & uncertainly mathematical programming, general problems of linear and non linear programming.

Unit 2 - Linear Programming **[7Hrs]**

Linear Programming-Standard linear programming form, definitions and theorem, simplex method-Algorithm canonical form, improving the basis, identifying an optimal solution, locating initial basic feasible solution, examples.

Unit 3 - Application of Linear Programming **[7Hrs]**

Application of Linear Programming-Problems on structural design trusses, plastic analysis of frame, weight minimization, transportation problem, duality, decomposition, parametric linear programming, integer linear programming examples.

SECTION-II

Unit 4 - Non-linear optimization **[7Hrs]**

Non-linear optimization-classical optimization techniques- differential calculus-Language multipliers, Newtons Raphson approximation, Kuhn Tucker conditions, examples.

Unit 5 - Geometric programming **[7Hrs]**

Geometric programming- Calculus viewpoint, polynomials, orthogonality conditions, degree of difficulty, geometric inequality, primal-dual relations, inequality constraints, examples.

Unit 6 - Search techniques **[7Hrs]**

Search techniques-altering, one dimensional or sectioning search, transforming non linear problem into linear cutting –plane method, logarithmic transformation, graphical optimization , examples. Examples on minimum route problem, minimum cost, minimum weight, optimum design of R.C.C. sections, Structural design-frame, trusses

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

TEXT BOOK:

1. Optimization in Structures by Hemp.

REFERENCE BOOKS:

1. Foundation of Optimization by Wilde & Beighter
2. Optimization Theory & Applications by S.S.Rao
3. Mechanical foundation for design by Stark and Nicholls, Mc GrawHill

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F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1CC5T -RESEARCH METHODOLOGY AND IPR

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits

Examination Assessment Scheme:
ESE: 60 marks (Duration: 3Hours)
ISE: 40 marks

Course Outcomes: - At the end of the course, student will be able to,

1. Propose and distinguish appropriate research designs and methodologies for a specific research project.
2. Develop skills in literature review, qualitative and quantitative data analysis and presentation.
3. Describe the importance of Computers, Information Technology in research and also highlight the significance of ideas, concept, and creativity in research.
4. Illustrate the importance of Intellectual Property Rights in growth of individuals &nation.
5. Exhibit knowledge about IPR protection, providing an incentive to inventors for further research work leading to creation of new and better products.

SECTION-I

Unit 1 - Introduction **[6Hrs]**

Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsor agent's requirements, Ethical, Training, Cooperation and Legal aspects

Unit 2 - Research Design **[6Hrs]**

Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research

Unit 3 - Research Problem **[6Hrs]**

Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.

SECTION-II

Unit 4 - Nature of Intellectual Property **[8Hrs]**

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5 - Patent Rights **[5Hrs]**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications

Unit 6 - New Developments in IPR **[5Hrs]**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR

REFERENCE BOOKS:

1. Krishnaswamy, K.N., Sivakumar, AppaIyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, (New York, John Wiley &Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, (New Delhi, New Age International Ltd. Publishers).
4. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill2001.
5. John W Cresswell, (2009)-Research Design: Qualitative, Quantitative and Mixed Methods Approaches, (Sage Publications Pvt Ltd. 3rd Edition.)
6. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
7. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-I

23SEP1CC6L - COMPUTER AIDED STRUCTURAL DESIGN LAB

Lab work: -
Practical : 4 hours per week, 2 Credits

Examination Scheme:
ESE: -50 marks

Course Outcomes: - At the end of the course, student will be able to,

1. Design and Detail all the Structural Components of Frame Buildings.
2. Design and Detail Complete Multi-Storey Frame Buildings.

COURSE CONTENT

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes and relevant application software.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

ICA shall be based upon the Term work consisting Analysis and Design calculations of the problem. The student shall give the presentation at the end of semester based on his / her termwork. The supervisor shall assess the term work and presentation.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2CC1T -FINITE ELEMENT METHOD

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, student will be able to,

1) Analyse 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
2) Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
3) Solve 2-D problems using knowledge of theory of elasticity.
4) Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics

SECTION-I

Unit 1 - Introduction to Finite Element Method **[5Hrs]**

Principle of minimum potential energy, variation principle, Galerkin approach, Rayleigh – Ritz method, Point Collocation method, Least square method, Finite element procedure

Unit 2 - 1-D problems **[5Hrs]**

Discretization, nodes, element incidence, displacement model, shape function, selection of order of polynomials, application to bars with constant and variable cross section subjected to axial forces

Unit 3 - 2-D problems **[5Hrs]**

Development of element stiffness matrix and nodal load vector for truss, beam and plane frame elements. Transformation of matrices, relevant structural engineering applications. 2-D elements of triangular and quadrilateral shapes for plane
stress and plane strain problems. Pascal's triangle, convergence requirements and compatibility conditions, shape functions, boundary conditions, element aspect ratio

Unit 4 - 3-D problems **[5Hrs]**

Development of element stiffness matrix and nodal load vector for Tetrahedron, Hexahedral elements

SECTION-II

Unit 5 - Isoparametric Elements **[8Hrs]**

Shape function, Natural Co- Ordinate systems, classification- Isoparametric, subparametric, superparametric elements 1-D, 2D & 3DIsoparametric elements, Gauss-quadrature integration

Unit 6 - Axisymmetric Elements: **[4Hrs]**

Development of element stiffness matrix and nodal load vector.

Unit 7 - Plate and Shell Elements **[6Hrs]**

Formation of stiffness matrix for plate bending elements of triangular and quadrilateral shapes, cylindrical thin shell elements.

Unit 8 - Finite Element Applications to Structural Dynamics **[4Hrs]**

Formulation, Hamillon's principle, element mass matrices, evaluation of eigen values and eigen vectors.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

TEXT BOOKS:

1. Introduction to Finite Element method by J.N. Reddy

REFERENCE BOOKS:

1. Concepts & Applications of Finite Element Analysis by R. D. Cook.
2. The finite Element Method (Fourth Edition) Vol I &II by O. C. Zienkiewicz & R.L. Taylor
3. Fundamentals of Finite Element Techniques by C. A. Brebbin & J.J. Common.
4. Introduction to Finite Element Method by C. S. Desai & J. F. Abel.
5. Programming in Finite Element Method by Dr. C. A. Krishnamoorthy (TMH Publication).
6. Introduction to Finite Element in Engineering by T. R. Chandrapatla and Belegundu

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2CC2T - THEORY OF PLATES AND SHELLS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per Week, 3 Credits	**ESE:** 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per Week, 1 Credit	**ISE:** 40 marks
	ICA: 25 marks

Course Outcomes: - At the end of the course, students will be able to,

1. Use analytical methods for the solution of thin plates.
2. Apply the numerical techniques and tools for the complex problems in thin plates.
3. Use analytical methods for the solution of shells.
4. Apply the numerical techniques and tools for the complex problems in shells.

SECTION-I

Unit 1 Introduction **[5Hrs]**

Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using principle of Virtual Work, Boundary Conditions.

Unit 2 Static Analysis of Plates **[10Hrs]**

Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under various Loadings, Levy's solution for Rectangular Plate with other Boundary Conditions.

Unit 3 Circular Plates **[10Hrs]**

Analysis under Axi-symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates

SECTION-II

Unit 4 Static Analysis of Shells **[6Hrs]**

Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells.

Unit 5 Shells of Revolution **[6Hrs]**

Shells of Revolution with Bending Resistance - Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels

Unit 6 Thermal Stresses in Plate/ Shell **[5Hrs]**

Thermal Stresses in Plates/ Shell, causes and effects.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

TEXT BOOKS:

1. Design and Construction of Concrete Shells, Ramaswamy G.S.

REFERENCE BOOKS:

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
3. Thin Elastic Shells, Kraus H., John Wiley and Sons.
4. Theory of Plates, Chandrashekhara K., Universities Press.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2CC2T - SEISMIC DESIGN OF MULTISTORIED BUILDINGS

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25 marks

Course Outcomes: - At the end of the course, students will be able to,

1. Evaluate the seismic response of the structures.
2. Design the reinforced concrete buildings for earthquake resistance.
3. Analyse, design and detail the multistoried buildings subjected to seismic loads.

SECTION-I

Unit 1 Characteristics of Earthquakes **[5Hrs]**

Characteristics of Earthquakes: Earthquake terminology, Indian Earthquakes, Measurement of Earthquakes, Magnitude, Intensity, Frequency-magnitude relationship, Liquefaction.

Unit 2 Earthquake response of systems **[8Hrs]**

Earthquake response of systems: Response spectrum theory, Strong ground motion, Concept of earthquake response spectrum Response Spectrum–elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design.

Unit 3 Earthquake design philosophy **[10Hrs]**

Effect of irregularities and architectural planning, center of mass and center of rigidity, philosophy of earthquake resistant design, maximum considered earthquake, design based earthquake, concept of stiffness, flexibility and ductility.

SECTION-II

Unit 4 Structural Concept [7Hrs]

Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations for multistoried buildings

Unit 5 Design of Reinforced concrete buildings for earthquake resistance [10Hrs]

Load combinations, Lateral load analysis, Provisions of IS-1893 for buildings, Base Shear, Application to Multistorey buildings. Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions of IS- 13920.

Unit 6 Seismic response control concepts [5Hrs]

Seismic response control concepts – Passive control, Base isolation, Tuned Mass Dampers, Vibration absorbers.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., South Asian Publishers, New Delhi,2002.
2. Earthquake Design Practice for Buildings -- David Key, Thomas Telford Pub.
3. Dynamics of Structures:- Theory and Application to Earthquake Engineering by K. Chopra, Prentice- hall Publication.
4. Earthquake Resistant Design for Engineers and Architects – D. J. Dowrick, John Wiley and Sons.
5. Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. & Karve, S. R. Structures Publications, Pune, 2013.
6. High Rise Building Structures, Wolfgang Schueller, Wiley1971.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EB1T - ELECTIVE- II

DESIGN OF PRESTRESSED CONCRETE STRUCTURES

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25 marks

Course Outcomes: - At the end of the course, students will be able to

1. Describe different prestressing techniques.
2. Analyze and design statically determinate PSC beams.
3. Design the Anchor Blocks.
4. Design composite structural elements and prestressed concrete pipes.

SECTION-I

Unit 1 Introduction to prestressed concrete **(6)**

Types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.

Unit 2 Statically determinate PSC beams **(9)**

Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

Unit 3 Design of Anchor Blocks **(5)**

Design of Anchor Blocks using Magnel's Method, Guyon's Method and IS Code Method

SECTION-II

Unit 4 Statically indeterminate structures **(9)**

Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

Unit 5 Composite construction **(9)**

Precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations

Unit 6 Prestressed concrete pipes **(5)**

Analysis and design of prestressed concrete pipes.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

TEXT BOOKS:

1. Design of Concrete Bridges, Jagadish & Jayaram, Tata McGrawHill.

REFERENCE BOOKS:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House,1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3. Concrete Bridge Practice: Analysis, Design and Economics, .Dr. V. K. Raina, Shroff Publishers & Distributors Pvt. Ltd.
4. Reinforced Concrete Structures, Vol. II, Dr. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications.
5. IS: 1343- Code of Practice for Prestressed Concrete

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EB2T - ELECTIVE-II

STRUCTURAL AUDITS

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, students will be able to,

1. Strength evaluation of existing structures.
2. Evaluate the damaged structures and implement different retrofitting techniques.
3. Maintain the concrete structures in the working and safe condition.
4. Be able to take the decision of dismantling the structure, if it is deteriorated beyond the repairing.

SECTION-I

Unit 1 Introduction to Structural Audit **[3Hrs]**

Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed.

Unit 2 Structural Health **[10Hrs]**

Structural Health, factors affecting health of structures, effect of leakage, age, creep, corrosion, fatigue on life of structure. Structural health monitoring. Various measures, regular maintenance, structural safety in alteration. Quality control & assurance of materials of structure, durability of concrete, Factors affecting durability of concrete, Corrosion in structures, Testing and prevention of corrosion.

Unit 3 Structural Audit **[10Hrs]**

Structural Audit, Assessment of health of structure, study of structural drawings, nature of distress, visual observations, Collapse and investigation, limitations on investigator, tools for investigation, Various NDT Methods for assessing strength of distressed materials, investigation management, review of assimilated information, interviews and statements, evaluation and reporting.

SECTION-II

Unit 4 Retrofitting of Structures [10Hrs]

Retrofitting of Structures, parameters for assessment for restoration strategies, selection of construction chemicals during restoration, Specification for important items of work in restoration, Structural detailing for restoration and various techniques of retrofitting.

Unit 5 Safety during construction [15Hrs]

Safety during construction, formwork and staging, Modular formwork, Structural aspects for formwork in buildings & bridges. Fire safety. Demolition of Structure, study of structural system and structural drawings, outline of various demolition methods and their evaluation, partial and controlled demolition, role of safety measures, temporary support structures in demolition. Recycling of demolished materials

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. R N. Raikar: 'Durable Structures', R & D Centre, (SDCPL), Raikar Bhavan, Sector 17, Vashi, Navi Mumbai.
2. R.N. Raikar: 'Learning from Failures', R & D Centre, (SDCPL),Raikar Bhavan, Sector 17, Vashi, Navi Mumbai.
3. R.N. Raikar: 'Diagnosis and treatment of structures in Distress', R & D Centre, (SDCPL), Raikar Bhavan, Sector 17, Vashi, Navi Mumbai.
4. Jayakumar, J. Shah: 'A Book – A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures)', Third updated photo-copyset.
5. Austin. C. K : 'Formwork to Concrete', Chapman and Hall
6. Mr. Umesh Dhargalkar 'Structural Audit', Mumbai.
7. Jayakumar J. Shah: 'An Article – House Keeping of RCC Buildings', Published in April 2001 issue of the Housing Times, Vikas Premises, Fort Mumbai 400001.
8. Jayakumar J. Shah: 'An Article – Repairs & Rehabilitation of RCC Buildings (Structures) – Materials and Techniques', Published in March 2002 issue of New Building Materials and Construction World, New Delhi.
9. Jayakumar J. Shah: 'An Article – Repairs, Rehabilitation of Structurally Distressed

RCC Members of Buildings', published in July 2000 issue of Construction World, ASAP Media, Mumbai.

10. J. J. Shah: 'Point of View – Repair, Rehabilitation and Waterproofing of structures-Some View', Published in April 1998 issue of The Indian Concrete Journal, Mumbai.
11. Mani, K and Srinivasan, P.: 'An Article :Corrosion Damage and its Evaluation by Testing' in Advanced Testing and Evaluation of Structures and Components, Allied Publishres, Chennai, 2002 pp 14.01 –14.33.
12. Popovics, S and Popovics, J.S: 'An Article: A Critique of the Ultrasonic Pulse Velocity Method for Testing Concrete' in Non-destructive Testing of Concrete Elements and Structures', ASCE, New York, 1992, pp94-103.
13. Thandavamoorthy T.S. et al: 'Health Assessment of Concrete Structures by Ultrasonic pulse Velocity Technique an experimental Investigation in Building Materials', RRL Bhopal, February 26-27, 2004, pp.284-89.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EB3T -ELECTIVE- II

CONCRETE COMPOSITES

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, students will be able to,

1. Produce and test Fabre reinforced concrete
2. Design and cast ferro-cement products
3. Produce Silica fume Concrete
4. Design and cast Polymer concrete

SECTION-I

Unit 1 Fiber Reinforced Concrete **[12Hrs]**

Introduction, properties of constituent materials, Mix proportion, mixing, casting methods, properties of freshly mixed concrete (Fiber reinforced concrete), workability tests, mechanical properties, Behavior of Fiber reinforced concrete under Compression, tensile, flexure, research findings, application of Fiber Reinforced Concrete**.**

Unit 2 Ferro cement **[10Hrs]**

Introduction, materials used, mechanical properties, construction techniques, design in direct tension, applications, merits as structural materials.

SECTION-II

Unit 3 Silica Fume Concrete **[11Hrs]**

Introduction, physical and chemical properties of silica Fume, reaction mechanism of silica fume, properties of silica fume concrete in fresh state, mechanical properties and durability of silica fume concrete

Unit 4 Polymer concrete **[11Hrs]**

Introduction, classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application**.**

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. Concrete Technology & Design by R. N. Swamy, Surrey University Press.
2. Special Structural Concrete by Rafat Siddique ,Galgotia pub. pvt. Ltd.
3. Fiber Reinforced Cement Composites by P. N. Balaguru, S. P. Shah, Mc-GrawGill
4. Fiber Cement and Fiber Concrete by John Wiley and sons.
5. Fracture Mechanics and Structural Concrete by Bhushan L. Karihal Longman Scientific and Technical John Wiley and sons.

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F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EB4T -ELECTIVE- II

DESIGN OF INDUSTRIAL STRUCTURES

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, students will be able to,

1. Design Steel Gantry Girders.
2. Design Steel Portal, Gable Frames.
3. Design Steel Bunkers and Silos.
4. Design Chimneys and Water Tanks

SECTION-I

Unit 1 Steel Gantry Girders **[8Hrs]**

Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure

Unit 2 Portal Frames **[8Hrs]**

Design of portal frame with hinge base, design of portal frame with fixed base- Gable Structures – Lightweight Structures

Unit 3 Steel Bunkers and Silos **[8Hrs]**

Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.

SECTION-II

Unit 4 Chimneys **[6Hrs]**

Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation

Unit 5 Water Tanks **[8Hrs]**

Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts

Unit 6 Design of pressed steel water tank **[6Hrs]**

Design of stays – Joints –Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers,1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2009.
3. Design of Steel Structures, Subramaniyam.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EB5T -ELECTIVE- II

DESIGN OF TALL BUILDINGS

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hours per Week, 3 Credits	**ESE:** 60 marks (Duration: 3 Hours)
Tutorial: 1 hour per Week, 1 Credit	**ISE:** 40 marks
	ICA: 25marks

Course Outcomes: - At the end of the course, students will be able to,

1. To impart knowledge latest concepts, techniques and design of wind- and seismic-resistant buildings.
2 To introduce the fundamental concepts relevant to different approach of high rise building design method.
3 To enable the students to understand the factors that causes the economy and optimization of the structural design and construction of Tall building.

SECTION-I

Unit 1 Structural Systems and concepts. Loading: Gravity, wind and seismic loading **[8 Hrs]**

Unit 2 Matrix and Approximate methods, Interaction of frames, shear-wall frames, Twist of frames **[8Hrs]**

Unit 3 Analysis of coupled shear walls. Tubular Buildings **[6Hrs]**

SECTION-II

Unit 4 Sequential loading, creep and shrinkage effects on tall buildings **[6Hrs]**

Unit 5 Overall buckling analysis of frames, wall-frames, second order effects of gravity loading, P-Delta analysis **[8Hrs]**

Unit 6 Analysis and Design: Modeling for approximate analysis, accurate analysis, subsystem interaction **[6Hrs]**

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. High Rise Building Structures by Schuellar, W
2. Structural Analysis & Design of tall Buildings B.S. Taranath
3. Handbook of Concrete Structures M. Fintal.
4. Tall Building Structures: Analysis & Design B. Stafford Smith & A. Coule
5. Advances in Tall Buildings, CBS Publishers and Distributors Delhi, 1986.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EC1T -ELECTIVE- III

THEORY OF STRUCTURAL STABILITY

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course Outcomes: - At the end of the course, students will be able to,

1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analyzing discrete and continuous systems

SECTION-I

Unit 1 Introduction **[6Hrs]**

Concept of stability, Static, dynamic and energy criterion of stability. Flexibility and stiffness criteria, Snap-through & post buckling behavior.

Unit 2 Stability of columns **[8Hrs]**

Critical load for standard boundary conditions, elastically restrained perfect Columns, effect of transverse shear in buckling, columns with geometric imperfections, eccentrically loaded columns. Orthogonality of buckling modes. Large deformation theory for columns

Unit 3 Stability of continuous Beams and Frames **[8Hrs]**

Moment distribution and stiffness methods for stability analysis of continuous beam & frames

SECTION-II

Unit 4 Lateral Buckling of Beam **[6Hrs]**

Differential equations for lateral bucking, lateral buckling of beams in pure bending, lateral buckling of beams subjected to concentrated and uniformly distributed forces

Unit 5 In-elastic stability of Columns **[8Hrs]**

In-elastic buckling, double modulus theory, tangent modulus theory, Shanleys theory of in-elastic buckling, eccentrically loaded in-elastic columns

Unit 6 Dynamic Stability of Structure **[8Hrs]**

Discrete systems, Lagrange-Hamilton formulation for continuous systems, Stability of continuous system, general method for conservative and non-conservative systems

INTERNAL CONTINUOUS ASSESSMENT (ICA)

A set of tutorials/ problems based on above topics of syllabus.

REFERENCE BOOKS:

1. Concrete Technology & Design by R.N.Swamy, Surrey University Press.
2. Special Structural Concrete by Rafat Siddique ,Galgotia pub Pvt. Ltd.
3. Fiber Reinforced Cement Composites by P.N. Balaguru, S.P. Shah, Mc-Grawhill
4. Fiber Cement and Fiber Concrete by John Wiley and sons.
5. FractureMechanicsandStructuralConcretebyBhushanL.KarihalLongmanScientific and Technical John Wiley and sons.

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F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EC2T -ELECTIVE- III

DESIGN OF R. C. C. BRIDGES

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25marks

Course outcome: At the end of the course, students will be able to,

1. Select the suitable type of bridges according to the site condition.
2. Categorize IRC loads, distribution of these loads among longitudinal beams of abridge.
3. Design Solid deck slab and T beam bridge superstructure
4. Analyze and verify the adequacy of piers and abutments.
5. Identify and design the suitable type of bearing for the given condition

SECTION I

Unit 1 Introduction to Bridge Engineering **[5Hrs]**

General Basic bridge forms-beam, arch, suspension ,various types of bridges, selection of type of bridge and economic span length, super structure philosophy, geometric alignment, drainage, road kerb, wall foundation, pile foundation, open well foundation

Unit 2 Loading on bridges **[5Hrs]**

Dead load, vertical live load, IRC loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces, deformation and horizontal forces.

Unit 3 Analysis and Design **[12Hrs]**

Analysis and Design of R. C. deck slab, beam and slab (For IRC class AA and IRC class A loading), T beam, Pigeaud's theory, Courbon's theory, Introduction to Hendry-Jaeger And Morice- Little Method, Analysis and Design of box culvert.

SECTION II

Unit 4 Design of sub structure **[8Hrs]**

Piers and Abutments- type, shape and their suitability, Design of sub-structure – abutments, piers, approach slab.

Unit 5 Bearings and Expansion Joint **[8Hrs]**

Bearing and expansion joints – forces on bearings – Types of bearing, design of reinforced elastomeric bearings, expansion joints.

Unit 6 Construction techniques **[5Hrs]**

Construction of sub structure- piles, caissons. Construction of reinforced earth retaining wall, super structure – erection methods.

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Problems/ tutorials based on above topics.

TEXT BOOKS:

1. "Essentials of Bridge Engineering"- D Johnson Victor, Oxford & IBH Publishing Co New Delhi

REFERENCE BOOKS:

1. "Design of Bridges"- N Krishna Raju, Oxford & IBH Publishing Co New Delhi
2. "Principles and Practice of Bridge Engineering"- S P Bindra Dhanpat Rai & Sons New Delhi
3. IRC 6 – 1966 "Standard Specifications And Code Of Practice For Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi
4. IRC21–1966"StandardSpecifications and Code of Practice For Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
5. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi
6. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi
7. Raina V.K., "Concrete Bridge Practice"- Tata McGrawHill
8. Bakht B & Jaeggar, "Bridge Analysis Simplified"- McGrawHill

9. Ponnuswamy. S, “Bridge Engineering”- Tata McGrawHill.
10. Derrick Beckett, “An Introduction to Structural Design of Concrete Bridges”- Surrey University Press

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EC3T -ELECTIVE- III

ADVANCED STEEL DESIGN

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25 marks

Course outcome: At the end of the course, students will be able to,

1. Design steel structures/ components by different design processes.
2. Use the design provisions for hot-rolled and cold-formed steel structures.
3. Design Steel Beams with Web Openings.
4. Perform plastic analysis and design of portal frames and Beams.

SECTION-I

Unit 1 Laterally Unrestrained Beams **[8Hrs]**

Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Mono- symmetric and non- uniform beams–Design Examples. Concepts of Shear Center, Warping, Uniform and Non-Uniform torsion

Unit 2 Tubular Structures **[6Hrs]**

Design of tubular Trusses and scaffoldings using circular hollow, rectangular hollow sections as per code, detailing of joints.

Unit 3 Cold–formed light gauges steel sections **[8Hrs]**

Special design considerations for compression elements, design of compression elements, stiffened compression elements, multi-stiffened elements, design of light gauge beams, behavior under repetitive loads and temperature effects. IS 801& 811 code provisions-numerical examples

SECTION-II

Unit 4 Plastic analysis **[8Hrs]**

Plastic bending of beams, plastic hinge, upper and lower bond theorems, Uniqueness theorem, Yield criteria, analysis and design of fixed and continuous beams. Plastic analysis and design of portal frames, collapse mechanisms, plastic moment distribution method, Introduction to Limits States in Steel Design

Unit 5 Steel Beams with Web Openings **[8Hrs]**

Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results)

Unit 6 Concrete –Steel composite sections **[6Hrs]**

Elastic behavior of composite beams, shear connectors, Behavior at ultimate load. Design of composite beams. Design of encased steel columns

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Problems/ tutorials based on above topics.

TEXT BOOKS:

1. Design of steel structures-Vol. II Ramchandra, Standard book, house, Delhi.

REFERENCE BOOKS:

1. Dynamics of Structures–Theory & Application to Earthquake Engineering, A.K. Chopra, Prentice Hall Publications
2. Design of steel structures, A.S. Arya, J.L. Ajamani, Nem chand and brothers.
3. Limit state design of steel structures, S K Duggal, Tata McGraw Hill Education
4. IS: 800 - 1984, Code of Practice for General Construction in Steel, BIS, New Delhi.
5. IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members in general building construction, BIS, New Delhi.
6. IS: 802 (Part I and II)-1978, Code of practice for use of structural steel in overhead

transmission line towers, BIS, New Delhi.

7. IS: 806-1988, Code of practice for use of steel tubes in general building construction, BIS, New Delhi.
8. IS: 811-1987, Specification for cold formed light gauge structural steel sections, BIS, New Delhi.
9. IS: 875 (Part 1, 2 and 3) – 1987, Code of practice for design loads for buildings and structures, BIS, New Delhi.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2EC4T -ELECTIVE- III

SOIL STRUCTURE INTERACTION

Teaching Scheme:
Lectures: 3 hours per Week, 3 Credits
Tutorial: 1 hour per Week, 1 Credit

Examination Scheme:
ESE: 60 marks (Duration: 3 Hours)
ISE: 40 marks
ICA: 25 marks

Course outcome: At the end of the course, students will be able to,

1. Evaluate soil structure interaction for different types of structure under various conditions of loading.
2. Prepare a comprehensive numerical tool for interaction problem based on theory of subgrade reaction such as beam, footing raft etc.
3. Analyze the soil-structure interaction of framed structures
4. Evaluate action of group of piles considering soil structure interaction

SECTION-I

Unit 1 Soil-Foundation Interaction **[7Hrs]**

Introduction to soil - Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface, behaviour, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behavior

Unit 2 Beam On Elastic Foundation - Soil Models **[7Hrs]**

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

Unit 3 Soil-foundation-structure interaction models **[8Hrs]**

Idealization of soil by linear and non-linear modified Winkler model, Elastic continuum model (isotropic and anisotropic), Two parameter elastic models- Heteny model, Pasternak model, Reissner model.

SECTION-II

Unit 4 Soil Structure Interaction in Framed Structures [5Hrs]

Structures with isolated foundation, spring analog approach, determinations of spring parameters, structures with continuous beams and rafts as foundation, finite element modelling, sub-structure technique of analysis, concept of relative stiffness, Interactive behavior of some framed structure.

Unit 5 Soil pile interaction [10Hrs]

Laterally loaded single piles-Concept of coefficient of horizontal subgrade reaction, finite difference and finite element solution, soil-structure interaction of framed structures with pile foundation, Interaction of other structures with soil foundation system, Tanks with annular ring foundations, chimneys, silos, cooling towers, underground subways and tunnels.

Unit 6 Introduction to dynamic soil structure interaction as well as non- linear soil/concrete behavior. **[5Hrs]**

INTERNAL CONTINUOUS ASSESSMENT (ICA)

Assignment based on above topics

REFERENCE BOOKS:

1. John, P. Wolf, 'Dynamic Soil-Structure-Interaction'.
2. John, P. Wolf,' Soil-Structure-Interaction in Time Domain'.
3. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford,1998.
3. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geotechnic s (6th Edition), Prentice Hall,2002.
4. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier,1979.
5. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley,1980.
6. Scott, R.F. Foundation Analysis, Prentice Hall,1981.
7. Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, Dehit, 1988.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2CC6L -ADVANCED CONCRETE TECHNOLOGY LAB

Lab Scheme:	**Examination Scheme:**
Practical:2 hours per Week, 2 Credits	**ICA**: 50 marks

Course Outcomes: - At the end of the course, student will be able to,

1. Design high grade concrete and study the parameters affecting its performance.
2. Conduct Non Destructive Tests on existing concrete structures.
3. Apply engineering principles to understand behavior of structural elements

DETAILS OF LAB WORK

1. Study of parameters of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Non-Destructive testing of existing concrete members. Behavior of Beams under flexure, Shear

REFERENCE BOOKS:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

Walchand Institute of Technology, Solapur

F. Y. M. Tech Civil (Structural Engineering) – Semester-II

23SEP2MP7L - MINI PROJECT

Lab Scheme:	**Examination Assessment Scheme:**
Practical: 2 hours per week, 2 Credits	**ICA**: 50 marks

Course Outcomes: At the end of the course, the students will be able to,

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.

Mini Project shall consist of detailed analysis, design along with working drawings of any one structure.

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.

The student shall submit report on the subject chosen and make a presentation at the end of Semester-I. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the Advisor.

Walchand Institute of Technology, Solapur

S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3CC1L - LAB. PRACTICE

Lab Scheme	**Examination Assessment Scheme:**
Practical : 2 hours per week, 2Credits	**ICA**: 50 marks

Course Outcome: At the end of the course, the students will be able to,

1. Acquire hands on experience on the various experimental set up.
2. Measure the various technical parameters by instrument and by mathematical relationship.
3. Acquire hands on experience on application software.

Syllabus Contents:

Lab practice shall be related to the dissertation as decided by the faculty advisor for developing/ acquiring necessary skills required for completion of M. Tech Project. The lab practice shall be amongst one of the following, as decided by faculty advisor:

(i) Proficiency in use of application software for solving problems.

(ii) Requisite field work if any.

(iii) Lab. work

(iv) Industrial exposure/ Training as deemed fit.

The student shall submit a report to the faculty advisor regarding completion of Lab Practice. As an internal continuous assessment (ICA) the faculty advisor shall monitor the progress and certify completion of student's work. Accordingly after assessment, ICA marks shall be submitted.

Walchand Institute of Technology, Solapur

S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3OA1T - OPEN ELECTIVE COURSE: - BUSINESS ANALYTICS

Teaching Scheme:
Lectures: 3 hours per week

Examination Assessment Scheme:
ESE: 60 marks
ISE: 40 marks

Course Outcome: At the end of the course, the students will be able to,

1. Understand the concepts and methods of business analytics
2. Identify and describe complex business problems in terms of analytical models.
3. Apply appropriate analytical methods to find solutions to business problems.

SECTION-I

Unit 1 Introduction **[4Hrs]**

What Is Business Analytics? Business Analytics Process, Relation of BA process and Organization decision making process What is Data Mining? Data Mining and Related Terms, Big Data, Data Science, Terminology and Notation in Data mining

Unit 2 Overview of the Data Mining Process **[5Hrs]**

Core Ideas in Data Mining, Classification, Prediction, Association Rules and Recommendation Systems, Predictive Analytics, Data Reduction and Dimension Reduction, Data Exploration and Visualization, Supervised and Unsupervised Learning, Steps in Data Mining, Organization of Data sets

Unit 3 Data Visualization **[5Hrs]**

Uses of Data Visualization, Basic Charts: Bar Charts, Line Graphs, and Scatter Plots, Distribution Plots: Box plots and Histograms, Heat maps: Visualizing Correlations and Missing Values Multidimensional Visualization: Adding Variables: Color, Size, Shape, Multiple Panels, and Animation Manipulations: Rescaling, Aggregation and Hierarchies, Zooming, Filtering, Reference: Trend Lines and Labels, Scaling up to Large Datasets

Unit 4 Dimension Reduction **[4Hrs]**

Introduction, Curse of Dimensionality, Data Summaries, Summary Introduction, Curse of Dimensionality, Data Summaries, Summary. Statistics, Aggregation and Pivot Tables, Correlation Analysis, Reducing the Number of Categories in Categorical Variables, Converting a Categorical Variable to a Numerical Variable, Principal Components Analysis

SECTION-II

Unit 5 Performance Evaluation **[5Hrs]**

Evaluating Predictive Performance, Naive Benchmark: The Average, Prediction Accuracy Measures Comparing Training and Validation Performance, Lift Chart, Judging Classifier Performance, Benchmark: The Naive Rule, Class Separation, The Confusion (Classification) Matrix, Using the Validation Data, Accuracy Measures.

Unit 6 Multiple Linear Regression **[4Hrs]**

Explanatory vs. Predictive Modeling, Estimating the Regression Equation and Prediction, Variable Selection in Linear Regression, Reducing the Number of Predictors

Unit 7 Classification & Regression Trees **[5Hrs]**

Introduction, Classification Trees, Recursive Partitioning, Measures of Impurity, Tree Structure, Classifying a New Record, Evaluating the Performance of a Classification Tree, Navie Bayes Classifier Regression Trees

Unit 8 Clustering **[4Hrs]**

Introduction, Feature selection for clustering: Filter models and Wrapper models, k-Means algorithm

IN SEMESTER EVALUATION (ISE)

ISE shall be based upon minimum 6 assignments based on curriculum and consisting of literature survey, case study, data compilation and analysis etc.

REFERENCE BOOKS:

1. Data Mining for Business Analytics - Concepts, Techniques, And Applications In R, Galit Shmueli Peter C. Bruce InbalYahav Nitin R. Patel Kenneth C. Lichtendahl, Jr., Wiley Publication
2. https://edu.kpfu.ru/pluginfile.php/274079/mod_resource/content/2/DatMiningBusAnalytics.pdf
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services (2015)
4. Business Analytics – Principles, Concepts and Applications, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson Education Limited
5. Data Mining : The Textbook, Charu C. Agrawal, Springer Publications

Walchand Institute of Technology, Solapur

S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3OA2T - OPEN ELECTIVE COURSE: - OPERATION RESEARCH

Teaching Scheme:	**Examination Assessment Scheme:**
Lectures: 3 hours per week, Credits: 3	**ESE**: 60 marks **ISE**: 40 marks

Course outcome:-At the end of this course the students shall be able to,

1. Formulate the real life managerial problems in an appropriate mathematical model
2. Provide the optimum solution to the real life problems within the constraints.
3. Use network techniques in project management
4. To evaluate alternative courses of actions in actual decision making under conditions of uncertainty using Simulation techniques.

SECTION-I

Unit 1 OR Models, **[5Hrs]**

OR Models, model formulation, Linear Programming models, Graphical solution, Simplex techniques, Two Phase method

Unit 2 Duality theory **[5Hrs]**

Duality theory - Properties of Primal and Dual Optimal Solutions, Duality Simplex method , Shadow Price- Sensitivity analysis

Unit 3 Simulation Techniques **[5Hrs]**

Simulation Techniques - Need of Simulation techniques, Monto- Carlo Simulation, random number concept, applications of Simulation technique. Queuing Model M/M/1:/FIFO

Unit 4 Queuing Models **[3Hrs]**

Queuing Models - Introduction, Structure of queuing system, Terminology (Kendal‘s Notations) and Applications

SECTION-II

Unit 5 Inventory control **[5Hrs]**

Inventory control - Inventory costs, Economic order quantity, deterministic models with or without shortages - probabilistic models - Price break model, Selective Inventory management techniques

Unit 6 Replacement analysis **[5Hrs]**

Replacement analysis - Replacement models - Replacement policy for items considering change in money value with time - Individual replacement policy - Group replacement policy

Unit 7 Network flow models **[3Hrs]**

Network flow models - Minimal Spanning Tree problems -Shortest route problems - Dijiktra's algorithm - Maximal Flow problem

Unit 8 PERT and CPM Networks **[5Hrs]**

PERT and CPM Networks - floats and applications - Network crashing - Cost optimization - Resource allocation and scheduling

IN SEMESTER EVALUATION (ISE)

ISE shall be based upon minimum 5 assignments and at least one case study.

REFERENCE BOOKS:

1. Operations Research by Hillier and Lieberman TMGH
2. Hamdy Taha, “Operations Research – An Introduction”, 7th edition PHI(2003)
3. S. D. Sharma, “Operation Research”, Kedarnath and Rannalt Pub.
4. Hira and Gupta, “Operation Research”, S. Chand and Co.
5. N. D. Vohra, “Quantitative Techniques in Management”, TMGH
6. Shrinath L.S.: PERT & CPM –Affiliate East West Press
7. Anand Sharma " Quantitative Techniques for decision making" Himalaya Publishing House
8. Billy E. Gillet - " Introduction to Operations Research" TMGH
9. R. Panneerselvan " Operations Research" PHI

Walchand Institute of Technology, Solapur

S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3OA3T - OPEN ELECTIVE COURSE: COST MANAGEMENT OF ENGINEERING PROJECTS

Teaching Scheme:	**Examination Assessment Scheme:**
Lectures: 3 hours per week, Credits: 3	**ESE**: 60 marks
	ISE: 40 marks

Course outcomes:- At the end of this course the students shall be able to,

1. Analyze various elements of the cost associated with the engineering project
2. Measure and assess the performance of engineering projects
3. Control the cost of project
4. carry out value analysis in an engineering project

SECTION-I

Unit 1 Cost **[8Hrs]**

Cost Elements - Pricing , Materials ,Labor , Engineering , Equipment, Parts, and Tools; Economic Costs ; **Cost Analysis:** Direct Cost, indirect Cost, Overhead, allowance, Contingency

Unit 2 Cost Estimating **[7Hrs]**

Estimating Models; Parametric estimating- moduler estimating, parametric model , Analogous estimating- ratio estimating, The Three-quarters rule, The Square root rule, Two-Thirds rule, Range estimating

Unit 3 Progress & Cost Control **[7Hrs]**

Progress Measurement and Earned Values; Earned Value for Variable Budgets; Tracking Cost and Schedule Performance

SECTION-II

Unit 4 Cost Management **[8Hrs]**

Causes of Change, Feed Forward Techniques, Impact of schedule on cost, Lifecycle costs, Impact of project risk, integrated cost management programme.

Unit 5 Value Management **[7Hrs]**

Concept of Value, Dimensions and Measures of Value, Overview of Value Management, Definition' Scope, Key Principles of VM , Key Attributes of VM ,Value Management Terms , Need for Value Management in Projects , The Value Management Approach ,Cross-functional Framework ' Use of Functions, Structured Decision Process, the VM Process, Benefits of Value Management, Other VM requirements. Relationship between Project Value and Risk, Value Management as an Aid to Risk Assessment

Unit 6 Value Analysis **[8Hrs]**

Earned Value Management for assessing project performance, Earned Value Management, Earned Value Management Model, Fundamentals of Earned Value, EVM Terminology, Relevancy of Earned Value Management, Conducting an Earned Value Analysis, Performing an Earned Value Assessment, Managing a Portfolio of Projects with Earned Value Management, Important Issues in the Effective Use of Earned Value Management. Integrating Cost and Value in Projects

IN SEMESTER EVALUATION (ISE)

ISE shall be based upon minimum 5 assignments and at least one case study.

REFERENCE BOOKS:

1. Project Estimating and Cost Management By Parivs F. Rad PhD, PMP
2. Project Cost Management guide from PMBOK 5thedition
3. Project Scheduling and Cost Control: Planning, Monitoring and Controlling the Baseline by James Taylor
4. Systems Life Cycle Costing: Economic Analysis, Estimation, and Management, John V. Farr, Draft Textbook, Version1.0.
5. COST AND VALUE MANAGEMENT IN PROJECTS Ray R. Venkataraman and Jeffrey K. Pinto John Wiley & Sons, Inc, Hoboken, New Jersey

6. American Association of Cost Engineers, “SKILLS AND KNOWLEDGE OF COST ENGINEERING”,1996
7. Cost Management of Capital Projects (Cost Engineering) by Kurt Heinze – International Edition, August 28,1996

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S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3OA4T - OPEN ELECTIVE COURSE: - NON CONVENTIONAL ENERGY

Teaching Scheme	**Examination Assessment Scheme:**
Lectures: 3 hours per week, Credits: 3	**ESE**: 60 marks **ISE**: 40 marks

Course Outcomes:- At the end of this course the students shall be able to,

1. Explore the various non conventional energy sources.
2. Identify energy demand and relate with available energy resources.
3. Analyze harnessing of various non conventional energy sources.

SECTION-I

Unit 1 Energy Resources **[5Hrs]**

Energy, economy and social development, Indian scenario, conventional energy sources-electric, nuclear, hydroelectric, environmental aspects, renewable energy sources, comparison between conventional and non conventional energy sources.

Unit 2 Energy Conservation and Efficiency **[5Hrs]**

Energy efficiency, conservation, energy audit, cogeneration, schemes to promote conservation and efficiency, new technologies, energy conservation opportunities, distributed energy systems.

Unit 3 Energy Storage **[3Hrs]**

Introduction, necessity, specifications of energy storage devices, methods of energy storage.

Unit 4 Solar Thermal Energy **[5Hrs]**

Introduction to solar radiation and energy, solar thermal energy collectors, solar thermal systems- water heater, distillation, power plant, cookers, kilns, air conditioning, greenhouse, furnace, dryer, industrial heating.

SECTION-II

Unit 5 Solar Photovoltaic System **[5Hrs]**

Solar cell fundamentals, characteristics, design consideration, classification, module and arrays, maximizing the output and load matching, balance of system, applications.

Unit 6 Wind Energy **[5Hrs]**

Fundamentals, wind energy estimation, turbines: types, construction and characteristics, modes of power generation, wind energy conversion system, wind –diesel hybrid system, wind energy storage, environmental aspects, applications.

Unit 7 Biomass Energy **[4Hrs]**

Fundamentals, resources, conversion technologies, urban waste to energy conversion, gasification, ethanol, biogas.

Unit 8 Emerging Technologies **[4Hrs]**

Fuel cell, classification, comparisons, fuel for fuel cells, efficiency and VI characteristics, fuel cell power plant, hydrogen as energy carrier.

IN SEMESTER EVALUATION (ISE)

ISE shall be based upon minimum 6 assignments based on curriculum and consisting of literature survey, case study, data compilation and analysis etc.

REFERENCE BOOKS:

1. Non-Conventional Energy Resources, B H Khan, McGraw Hill Education, Third Edition
2. Renewable Energy Sauces and Emerging Technologies, D P Kothari, K C Singal, Rakesh Ranjan, PHI Learning Pvt. Ltd., Second Edition

Walchand Institute of Technology, Solapur

S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3DS3L -DISSERTATION PHASE- I

SYNOPSIS SUBMISSION SEMINAR

Teaching Scheme	**Examination Assessment Scheme:**
Credits: 2	**ICA**: 50 marks

The student is expected to carry out intensive literature survey for a period of about two months in the field of interest and to select a topic for his/her dissertation in consultation with the faculty advisor assigned. The student shall then submit a report and deliver a seminar on the problem chosen by him/her to the panel of three departmental PG recognized faculty members. It shall be expected that a student justifies the gravity and also the relevance of the problem through his/her seminar. This shall be for the approval of synopsis.

The assessment of Synopsis Submission Seminar shall be done by aforesaid panel of three departmental PG recognized faculty members.

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S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3DS4L -DISSERTATION PHASE- II

Teaching Scheme	**Examination Assessment Scheme:**
Credits: 4	**ESE**: 100 marks

Student shall submit a report to the faculty advisor, on the basis of work carried out in accordance with instructions given by faculty advisor, throughout the semester. Dissertation Phase II evaluation consists of term-work evaluation (ISE) based on the efforts put in by the student to carry out his/her work & the results obtained thereof.

The faculty advisor shall complete the assessment of the report and accordingly allocate the marks to the student out of maximum 100 marks.

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S. Y. M. Tech Civil (Structural Engineering) – Semester-III

23SEP3DS5L -DISSERTATION PHASE- II:

PROGRESS SEMINAR

Teaching Scheme	**Examination Assessment Scheme:**
Credits: 4	**ESE**: 100 marks

Progress seminar shall be delivered capturing details of the work done by the student for dissertation. Student shall deliver seminar using modern presentation tools. A hard copy of report shall be submitted to the faculty advisor before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.

End Semester Evaluation (ESE) shall consist of presentation of progress seminar on the report submitted by the student, followed by demonstration before a panel of three departmental PG recognized faculty members.

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S. Y. M. Tech Civil (Structural Engineering) – Semester-IV

23SEP4DS1L -DISSERTATION PHASE- III

PROGRESS REPORT

Teaching Scheme	**Examination Assessment Scheme:**
Credits: 3	**ICA**: 100 marks

For all activities related to Phase III, student must interact regularly every week with the faculty advisor. The student who has cleared his/her Phase II evaluation, shall submit a report and present the status of work carried out on the dissertation after 8-10 weeks of Phase II ESE to three departmental PG recognized faculty members.

Progress seminar shall be delivered capturing details of the work done by student for dissertation. Student shall deliver seminar using modern presentation tools. A hard copy of report shall be submitted to the faculty advisor before delivering the seminar. A PDF copy of the report must be submitted to the faculty advisor along with other details if any.

The evaluation will be done by the aforesaid panel of three departmental PG recognized faculty members based on the requirements of completion of dissertation work for the dissertation Phase- III.

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S. Y. M. Tech Civil (Structural Engineering) – Semester-IV

23SEP4DS2L -DISSERTATION PHASE- IV: SUBMISSION OF REPORT

Teaching Scheme	**Examination Assessment Scheme:**
Credits: 4	**ICA**: 100 marks

After completing the dissertation work to the satisfaction of faculty advisor, the student shall submit the dissertation report in the prescribed format. The final approved dissertation shall be submitted in black bound hard copy along with soft copy on CD/DVD.

The evaluation of dissertation is to be carried out by the faculty advisor as ICA for 100 marks. This evaluation shall be on the basis of the requirements of completion of dissertation work. The faculty advisor shall submit mark list of term work marks, along with the submission of dissertation as mentioned in assessment scheme.

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S. Y. M. Tech Civil (Structural Engineering) – Semester-IV

23SEP4DS3L -DISSERTATION VIVA- VOCE

Teaching Scheme:	**Examination Assessment Scheme:**
Credits: 8	**ESE**: 200 marks

Dissertation Viva-Voce of the student shall be arranged by the Institute. This Viva-Voce shall be in front of the panel of examiners as appointed by the examination authority. The evaluation will be done by panel of examiners as appointed by examination authority.

Dr. M. G. Kalyanshetti
Chairman, BOS in Civil Engg.
W.I.T. (Autonomous), Solapur

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