



M.I.E.T. ENGINEERING COLLEGE
(Autonomous)
Tiruchirappalli-620007

Curriculum & Syllabus
(Regulations 2024)



M.E. Structural Engineering



M.I.E.T. ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai)
Accredited by NBA (CIVIL, CSE, ECE, EEE & MECH)

Accredited with 'A+' grade by NAAC
(An ISO 9001:2015 Certified Institution)

(Recognized by UGC under section 2(f) & 12(B) of UGC Act, 1956)
TRICHY - PUDUKKOTTAI MAIN ROAD, TRICHY - 620 007



DEPARTMENT OF CIVIL ENGINEERING



CURRICULUM AND SYLLABUS

M.E. STRUCTURAL ENGINEERING (Regulations 2024)

Vision

A knowledge hub in Civil Engineering sciences, contributing to the progress of humanity through innovative thinking, domain expertise and high ethical values.

Mission

- To provide quality education through industry based value-added trainings and develop skilled Civil Engineers.
- To nurture competent professionals trained in designing and implementing Civil Engineering systems and to perform professionally and ethically.
- To provide a conducive environment that fosters aptitude for research, higher education, entrepreneurship skills, leadership quality, and lifelong learning.

Programme Outcomes (POs)

1. An ability to independently carry out research/investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor's program.
4. Acquire in-depth knowledge of the Structural Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge in structural design.
5. Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.
6. Conceptualize and solve Structural Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors.

Program Educational Objectives (PEOs)

1. Gain knowledge and skills in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations.
2. Become consultants in Structural Engineering and solve complex real-life issues related to the analysis, design and maintenance of structures under various environmental conditions.
3. Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or Research organizations or Academia.

PEO/PO Mapping

Program Educational Objectives	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	2	2	3	3	3	3
PEO2	3	2	3	3	3	3
PEO3	3	2	3	3	3	3

1-Low, 2 -Medium, 3- High

INSTITUTIONS
Since 1984

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI FOR SEMESTERS I TO IV

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MP1101	Advanced Mathematical Methods	FC	3	0	0	3	3
2.	24ST1101	Theory of Elasticity and Plasticity	PCC	3	1	0	4	4
3.	24ST1102	Structural Dynamics	PCC	3	1	0	4	4
4.	24RE1101	Research Methodology and IPR	RMC	2	0	0	2	2
5.	24ST13XX	Professional Elective I	PEC	3	0	0	3	3
6.	24ST13XX	Professional Elective II	PEC	3	0	0	3	3
7.	24ST1201	Advanced Structural Laboratory	PCC	0	0	4	4	2
8.	24ST1701	Technical Seminar	EEC	0	0	2	2	1
Total							22	

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST2101	Finite Element Analysis in Structural Engineering	PCC	3	1	0	4	4
2.	24ST2102	Advanced Steel Structures	PCC	3	1	0	4	4
3.	24ST2103	Advanced Design of Concrete Structures	PCC	3	1	0	4	4
4.	24ST23XX	Professional Elective III	PEC	3	0	0	3	3

5.	24ST23XX	Professional Elective IV	PEC	3	0	0	3	3
6.	24ST2201	Structural Design Studio	PCC	0	0	4	4	2
7.	24ST2202	Computational Laboratory	PCC	0	0	4	4	2
Total								22

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST3101	Stability of Structures	PCC	3	1	0	4	4
2.	24RE3102	Research article review and Scientific Report Writing	RMC	2	0	0	2	2
3.	24ST33XX	Professional Elective V	PEC	3	0	0	3	3
4.	24OEXXXX	Open Elective – I	OEC	3	0	0	3	3
5.	24ST3601	Practical Training	EEC	0	0	2	2	1
6.	24ST3501	Project Work Phase- I	EEC	0	0	12	12	6
Total								19

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST4501	Project Work Phase-II	EEC	0	0	24	24	12
Total								12

FOUNDATION COURSE (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24MP1101	Advanced Mathematical Methods	FC	3	0	0	3	3

PROFESSIONAL CORE COURSES (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST1101	Theory of Elasticity and Plasticity	PCC	3	1	0	4	4
2.	24ST1102	Structural Dynamics	PCC	3	1	0	4	4
3.	24ST1201	Advanced Structural Laboratory	PCC	0	0	4	4	2
4.	24ST2101	Finite Element Analysis in Structural Engineering	PCC	3	1	0	4	4
5.	24ST2102	Advanced Steel Structures	PCC	3	1	0	4	4
6.	24ST2103	Advanced Design of Concrete Structures	PCC	3	1	0	4	4
7.	24ST2201	Structural Design Studio	PCC	0	0	4	4	2
8.	24ST2202	Computational Laboratory	PCC	0	0	4	4	2
9.	24ST3101	Stability of Structures	PCC	3	1	0	4	4
Total								30

RESEARCH METHODOLOGY COURSES (RMC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24RE1101	Research Methodology and IPR	RMC	2	0	0	2	2
2.	24RE3102	Research article review and Scientific Report Writing	RMC	2	0	0	2	2
Total								4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST1701	Technical Seminar	EEC	0	0	2	2	1
2.	24ST3601	Practical Training	EEC	0	0	2	2	1
3.	24ST3501	Project Work Phase- I	EEC	0	0	12	12	6
4.	24ST4501	Project Work Phase-II	EEC	0	0	24	24	12
Total								20

**PROFESSIONAL ELECTIVES COURSES (PEC)
SEMESTER I, PROFESSIONAL ELECTIVE I**

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST1301	Advanced Concrete Technology	PEC	3	0	0	3	3
2.	24ST1302	Experimental Techniques in Structural Engineering	PEC	3	0	0	3	3
3.	24ST1303	Disaster management	PEC	3	0	0	3	3
4.	24ST1304	Mechanics of fiber reinforced polymer concrete	PEC	3	0	0	3	3

SEMESTER I, PROFESSIONAL ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST1305	Prefabricated Structures	PEC	3	0	0	3	3
2.	24ST1306	Advanced Prestressed Concrete	PEC	3	0	0	3	3
3.	24ST1307	Masonry Structures Design	PEC	3	0	0	3	3
4.	24ST1308	Composite Structures	PEC	3	0	0	3	3

SEMESTER II, PROFESSIONAL ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST2301	Maintenance, Repair and Rehabilitation of Structures	PEC	3	0	0	3	3
2.	24ST2302	Structural Safety and Reliability	PEC	3	0	0	3	3
3.	24ST2303	Corrosion Prevention and Control in RC structures	PEC	3	0	0	3	3
4.	24ST2304	Structural Health Monitoring	PEC	3	0	0	3	3

SEMESTER II, PROFESSIONAL ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST2305	Design of Bridge	PEC	3	0	0	3	3
2.	24ST2306	Advanced Industrial Structures	PEC	3	0	0	3	3
3.	24ST2307	Tall Structures	PEC	3	0	0	3	3
4.	24ST2308	Design of Steel-Concrete Composite Structures	PEC	3	0	0	3	3

SEMESTER III, PROFESSIONAL ELECTIVE V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24ST3301	Advanced Foundation Design	PEC	3	0	0	3	3
2.	24ST3302	Earth retaining Structures	PEC	3	0	0	3	3
3.	24ST3303	Design of offshore Structures	PEC	3	0	0	3	3
4.	24ST3304	Soil Structure Interaction	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES (OEC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS			TOTAL CONTACT PERIODS PER WEEK	CREDITS
				L	T	P		
1.	24OEMF01	Green Supply Chain Management	OEC	3	0	0	3	3
2.	24OEMF02	Renewable Energy Technologies	OEC	3	0	0	3	3
3.	24OEMF03	Medical Robotics	OEC	3	0	0	3	3
4.	24OEMF04	Textile Reinforced Composites	OEC	3	0	0	3	3
5.	24OEMF05	Nano Composite Materials	OEC	3	0	0	3	3
6.	24OEMF06	New Product Design and Development	OEC	3	0	0	3	3
7.	24OEV L01	VLSI Architecture for Image Processing	OEC	3	0	0	3	3
8.	24OEV L02	Data Acquisition	OEC	3	0	0	3	3
9.	24OEV L03	Advanced VLSI Design	OEC	3	0	0	3	3
10.	24OEV L04	Embedded System Design	OEC	3	0	0	3	3
11.	24OEV L05	System on Chip	OEC	3	0	0	3	3
12.	24OEV L06	Wireless Sensor Networks	OEC	3	0	0	3	3
13.	24OEPE01	Electric Vehicle Technology	OEC	3	0	0	3	3
14.	24OEPE02	Renewable Energy Systems	OEC	3	0	0	3	3
15.	24OEPE03	Power Semiconductor Devices	OEC	3	0	0	3	3
16.	24OEPE04	Energy Storage Technologies	OEC	3	0	0	3	3
17.	24OEPE05	Control System Design	OEC	3	0	0	3	3
18.	24OEPE06	Energy Management and Auditing	OEC	3	0	0	3	3
19.	24OECS01	Speech Signal Processing	OEC	3	0	0	3	3
20.	24OECS02	Digital Forensics	OEC	3	0	0	3	3

21.	24OECS03	IT & Agricultural System	OEC	3	0	0	3	3
22.	24OECS04	Machine Learning	OEC	3	0	0	3	3
23.	24OECS05	IoT for Smart Systems	OEC	3	0	0	3	3
24.	24OECS06	Software Testing and Automation	OEC	3	0	0	3	3

Summary

S.No.	Subject Area	Credits Total				
		I	II	III	IV	
1.	Foundation Course (FC)	3	-	-	-	3
2.	Professional Core Courses (PCC)	10	16	4	-	30
3.	Professional Electives Courses (PEC)	6	6	3	-	15
4.	Research Methodology and Ipr Course (RMC)	2	-	2	-	4
5.	Open Elective Courses (OEC)	-	-	3	-	3
6.	Employability Enhancement Courses (EEC)	1	-	7	12	20
	Total Credit	22	22	19	12	75

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75

COURSE OBJECTIVES

- To develop the ability to apply the principles of matrix theory in solving linear algebraic equations and optimization problems.
- To enhance skills in utilizing Laplace and Fourier transform techniques for analyzing and solving partial differential equations.
- To cultivate the ability to employ calculus of variations in addressing complex functional optimization problems in engineering and physics.

UNIT I MATRIX THEORY**9**

The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Singular value decomposition - Pseudo inverses - Least square approximation.

UNIT II LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS**9**

Laplace transform - Definitions – Properties – Transform error function – Bessel's function – Dirac delta function – unit step functions – Convolution theorem – Inverse Laplace transform - Complex inversion formula – Solutions to partial differential equations - Heat equation – Wave equation.

UNIT III FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS**9**

Fourier transform - Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations - Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT IV CALCULUS OF VARIATIONS**9**

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT V TENSOR ANALYSIS**9**

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient - Divergence and curl.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Apply the principles of elasticity to analyze and solve problems involving stress and strain in various materials, using fundamental equations and theories.
- CO2: Develop the ability to determine the relationships between applied forces and resulting deformations in elastic bodies, incorporating boundary conditions and material properties into calculations.
- CO3: Utilize advanced techniques, such as the finite element method, to model complex structures and predict their behavior under various loading conditions.
- CO4: Evaluate the impact of different loading scenarios on elastic materials, including tensile, compressive, and shear forces, and analyze their effects on structural integrity.
- CO5: Integrate the principles of elasticity with practical applications in engineering, enabling the design and assessment of materials and structures for safety and performance.

TEXT BOOKS

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolc, L.D., "Calculus of Variations", Dover Publications Inc., New York, 2007.
3. Mathews, J. H., and Howell, R.W., "Complex Analysis for Mathematics and Engineering", 6th Edition, Jones and Bartlett Publishers, 2011.

REFERENCE BOOKS

1. Richard Bronson, matrix operation, Schaum's outline series, Second Edition, McGrawHill, New Delhi, 2011.
2. Sankara Rao, K., "Introduction to Partial Differential Equations", 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.
4. Ramaniah. G. "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.
5. Naveen Kumar, "An Elementary Course on Variational Problems in Calculus ", Narosa Publishing House, 2005.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	3	2	2	2
CO2	-	-	3	2	2	2
CO3	-	-	3	2	2	2
CO4	-	-	3	2	2	2
CO5	-	-	3	2	2	2
AVG	-	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1101 THEORY OF ELASTICITY AND PLASTICITY

L T P C

3 1 0 4

COURSE OBJECTIVES

- To develop the ability to use the principles of theory of elasticity.
- To enable students to solve problems on semi-infinite and finite beams.
- To introduce theoretical fundamentals of the theory of plasticity.

UNIT I ANALYSIS OF STRESS AND STRAIN

9+3

Basic concepts of deformation of deformable bodies, notations for stress and strain in two and three dimensions. Stress transformation laws - differential equations of equilibrium in two and three dimensions in Cartesian coordinates, generalized Hooke's law - lame's constants.

UNIT II TWO DIMENSIONAL PROBLEMS

9+3

Plane stress and plane strain problems – examples- Two dimensional problems in rectangular coordinates - bending of a cantilever loaded at free end - Two dimensional problems in polar coordinates for curved beam, thick cylinders and plate with holes.

UNIT III STRAIN ENERGY METHODS

9+3

Total strain energy- complementary energy - Principle of virtual work and total potential energy- Theorem of minimum complementary energy- Griffith's theory of rupture - Castigliano's theorem - Principle of least work.

UNIT IV BEAMS ON ELASTIC FOUNDATIONS

9+3

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible –Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT V PLASTICITY

9+3

Introduction - physical assumptions, yield criteria of metals, graphical representation of yield criteria, Flow rule (plastic stress - strain relation)- Application to simple problems in tension – compression - Solution of elasto-plastic problems.

TOTAL:60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Derive and write the fundamental equations of elasticity describing the linear behavior of elements and develop constitutive models based on material behavior.

CO2:Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems.

CO3:Solve torsion problems in circular and non-circular cross-sections.

CO4:Analyze beams resting on elastic foundations.

CO5:Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties.

TEXT BOOKS

1. Arthur P Boresi, Ken P.Chong, “Elasticity in Engineering Mechanics”, John Wiley & Sons, 2000.
2. Kachanov L M, “Fundamentals of the Theory of Plasticity”, Dover Publications, 2013.
3. Timoshenko and Goodier, “Theory of Elasticity”, 3rd Edition, McGraw Hill, 2010.

REFERENCE BOOKS

1. Stuart Antman, “Nonlinear Problems of Elasticity”, Springer Publication, 2nd Edition, 2005.
2. Sadhusingh, “Theory of Elasticity”, Khanna Publishers, New Delhi 2012.
3. Ansel.C.Ugural and Saul.K.Fenster, “Advanced Strength and Applied Elasticity,” Fourth Edition, Prentice Hall Professional Technical Reference, New Jersey, 2003.
4. Chakrabarty. J, “Theory of Plasticity”, Third Edition, Elsevier Butterworth – Heinmann UK, 2007.
5. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	3	2
CO2	3	-	3	2	3	2
CO3	3	-	3	2	3	2
CO4	3	-	3	2	3	2
CO5	3	-	3	2	3	2
AVG	3	-	3	2	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1102 STRUCTURAL DYNAMICS

L T P C

3 1 0 4

COURSE OBJECTIVES

- To help students understand the fundamentals of dynamic analysis in structural systems.
- To enable students to apply vibration analysis techniques for assessing structural responses to dynamic loads.
- To equip students with the skills to evaluate structural property matrices and natural vibrations in multi-storeyed frames.

UNIT I INTRODUCTION TO DYNAMIC ANALYSIS

9+3

Introduction to Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion - Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

UNIT II VIBRATION ANALYSIS

9+3

Fourier series expression for loading - (blast or earthquake) - Duhamel's integral - Numerical methods - Expression for generalized system properties - vibration analysis - Rayleigh's method - Rayleigh-Ritz method.

UNIT III STRUCTURAL PROPERTY MATRICES

9+3

Evaluation of structural property matrices - Natural vibration - Solution of the Eigen value problem - Iteration due to Holzer and Stodola.

UNIT IV MULTI STOREYED FRAMES

9+3

Idealization of multi-storeyed frames - analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system.

UNIT V VIBRATION ANALYSIS USING FINITE ELEMENT

9+3

Differential equation of motion - Beam flexure including shear deformation and rotatory inertia
- Vibration analysis using finite element method for beams and frames.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Analysis of system/structures with a single degree of freedom.
- CO2: Dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration.
- CO3: Derive a mathematical model of a continuous system and do a dynamic analysis under free and forced vibration.
- CO4: Analysis of earthquake response.
- CO5: Evaluate the vibration analysis using finite element method.

TEXT BOOKS

1. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, Fifth Edition, 2006.
2. Roy R.Craig, Jr Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.
3. A. K. Chopra "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.

REFERENCE BOOKS

1. Madhujit Mukhopadhyay," Structural Dynamics: Vibrations and Systems", Ane's Student Edition, 2017.
2. Srinivasan Chandrasekaran, Dynamic Analysis and Design of Ocean Structures, Springer, 2015.
3. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2020.
4. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2014.
5. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2013.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	3	2
CO2	3	-	2	2	3	2
CO3	3	-	2	2	3	2
CO4	3	-	2	2	3	2
CO5	3	-	2	2	3	2
AVG	3	-	2	2	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24RE1101 RESEARCH METHODOLOGY AND IPR

L T P C

2 0 0 2

COURSE OBJECTIVES

- To give an overview of the research methodology and explain the technique of defining a research problem.
- To explain the functions of the literature review in research.
- To explain the art of interpretation and the art of writing research reports.

UNIT I RESEARCH DESIGN

6

Overview of the research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys, Research problem formulation, Research gap identification, Formulation of materials and methods.

UNIT II DATA COLLECTION AND SOURCES

6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying, Advanced tools and techniques

UNIT III DATA ANALYSIS AND REPORTING

6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentations, Computer aided Research – Simulation – Case study

UNIT IV INTELLECTUAL PROPERTY RIGHTS

6

Intellectual Property – Concept of IPR, Evolution and development of the concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS

6

Patents – Objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the research problem formulation.

CO2: Design experiments for different statistical concepts.

CO3: Demonstrate research ethics.

CO4: Formulate research proposals and reports.

CO5: Explore that IPR protection provides an incentive to inventors for further research work and investment in R & D.

TEXT BOOKS

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 2018.
2. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2012.

REFERENCE BOOKS

1. Ellapu Venkatesh Palagati Anusha, Savuturu Sujith Kumar, Syed Mastan Basha fundamentals of Research Methodology and Intellectual Property Rights, Fedshine Publication, 2023.
2. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.
5. Robert P. Merges, Peter S. Menell and Mark A. Lemley, “Intellectual Property in New Technological Age”, Aspen Publishers, 2016.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	2
CO2	3	2	2	2	2	2
CO3	3	2	2	2	2	2
CO4	3	2	2	2	2	2
CO5	3	2	2	2	2	2
AVG	3	2	2	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1201 ADVANCED STRUCTURAL LABORATORY

L T P C

0 0 4 2

COURSE OBJECTIVES

- To provide hands-on experience in testing reinforced concrete beams and columns for strength and deflection behavior.
- To equip students to perform dynamic and static tests on steel beams and frames, evaluating damping coefficients, drift, stiffness, and energy dissipation.
- To enhance skills in assessing in-situ concrete strength and quality using rebound hammers and ultrasonic pulse velocity testers.

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behavior.
2. Testing of simply supported steel beam for strength and deflection behavior.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
 - a. To determine the damping coefficients from free vibrations.
 - b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
 - a. Drift of the frame.
 - b. Stiffness of the frame.
 - c. Energy dissipation capacity of the frame.
6. Determination of in-situ strength and quality of concrete using
 - a. Rebound hammer
 - b. Ultrasonic Pulse Velocity Tester.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Fabricate, cast, and test reinforced concrete beams and columns, analyzing their strength and deflection behavior under different loading conditions.
- CO2: Conduct dynamic and static tests on steel beams and frames, interpreting results related to damping coefficients, mode shapes, drift, and stiffness.
- CO3: Evaluate the energy dissipation capacity of steel frames through static cyclic testing and assess the implications for structural design.
- CO4: Determine the in-situ strength and quality of concrete using non-destructive testing methods, including rebound hammers and ultrasonic pulse velocity testers.
- CO5: Effectively communicate testing procedures, results, and analyses in written reports and oral presentations.

REFERENCE BOOK

1. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill Inc. New York, 1991.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	2
CO2	3	3	2	2	3	2
CO3	3	3	2	2	3	2
CO4	3	3	2	2	3	2
CO5	3	3	2	2	3	2
AVG	3	3	2	2	3	2

1-Low, 2-Medium, 3-High, "-" – No correlation

24ST1701 TECHNICAL SEMINAR

LTPC
0 0 2 1

COURSE OBJECTIVES

- To work on a specific technical topic in Structural Engineering.
- To acquire the skills of oral presentation.
- To acquire technical writing abilities for seminars and conferences.

SYLLABUS:

A group of 2 students have to choose a problem and carry out scientific systematic investigation experimentally/ theoretically in suggesting a viable solution. At the end of the semester, each group of students have to submit a report for evaluation. Depth of

understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL:30 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Identify the latest developments in the field of Structural Engineering.

CO2:Acquire technical writing abilities for seminars, conferences and journal publications.

CO3:Use modern tools to present the technical details.

CO4:Conduct brainstorming sessions on technical concepts.

CO5:Gain insight on upcoming trends in Structural Engineering.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	2
CO2	3	3	2	2	3	2
CO3	3	3	2	2	3	2
CO4	3	3	2	2	3	2
CO5	3	3	2	2	3	2
AVG	3	3	2	2	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2101 FINITE ELEMENT ANALYSIS IN STRUCTUTRAL ENGINEERING

**LT P C
3 1 0 4**

COURSE OBJECTIVES

- To make the students understand the basics of the Finite Element Technique.
- To cover the analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.
- To understand the assembly process and imposition of boundary conditions in FEM analysis.

UNIT I CONCEPTS OF FINITE ELEMENT METHOD

9+3

General description of the finite element method – Overview of matrix techniques- basic equations from solid mechanics - Variation formulation – approximate methods – Rayleigh Ritz, Weighted residual (Galerkin) and finite difference methods.

UNIT II PLANE STRESS AND PLANE STRAIN

9+3

The concept of an element - derivation of Elemental Equations – assembly -Imposition of boundary Conditions - solution of the equations – Basic functions and shape functions – one dimensional element - Two dimensional problems in plane stress and plain strain.

UNIT III AXISYMMETRIC STRESS ANALYSIS AND 3D-STRESS ANALYSIS

9+3

Ax symmetric problems - Triangular and quadrilateral Elements – natural coordinates - Isoperimetric formulation - numerical Integration - Plate bending and shell elements - brick elements - Higher Order Elements.

UNIT IV MESHING AND SOLUTION PROBLEMS

9+3

Pre and post processor interpretations –‘p’ and ‘h’ methods of refinement – ill conditioned elements - Discretization errors – patch test - auto and adaptive mesh generation techniques - error evaluation - Finite element programming and FEA Software – ANSYS.

UNIT V NONLINEAR AND VIBRATION PROBLEMS

9+3

Material and geometric non-linearity - Consistent system matrices – dynamic condensation - Eigen value extraction - modal methods – Integration methods - application to thermal analysis.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1:Formulate a finite element problem using basic mathematical principles.
- CO2:Understand the fundamental concepts of plane stress and plane strain.
- CO3:Analyze a frame using truss element.
- CO4:Formulate and analyze the two- dimensional and three-dimensional solid finite element problems.
- CO5:Analyze shells, thick and thin plates and explain the dynamic analysis using FEM.

TEXT BOOKS

1. Seshu, P., TEXT BOOKS of Finite Element Analysis, Prentice-Hall of India Pvt.Ltd., New Delhi, 2007.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw-Hill International Editions (Engineering Mechanics Series), 1993.
3. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Fourth Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Logan D. L, A First Course in the Finite Element Method, Thomson- Engineering, 3rd edition, 2010.
2. David V. Hutton Fundamentals of Finite Element Analysis, Tata McGrawHill Edition, 2005.
3. Cook Robert. D., Plesha, Michael. E & Witt, Robert J. Concepts and Applications of Finite Element Analysis, Wiley Students Edition, 2004.

4. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 2020.
5. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Seventh Edition, McGraw – Hill, 2013.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	2	2
CO2	3	-	2	3	2	2
CO3	3	-	2	3	2	2
CO4	3	-	2	3	2	2
CO5	3	-	2	3	2	2
AVG	3	-	2	3	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2102 ADVANCED STEEL STRUCTURES

LT PC
3 1 2 4

COURSE OBJECTIVES

- To familiarize students with design philosophies, codes, and stability criteria for steel structures.
- To enable students to design various types of connections, including welded and bolted connections.
- To equip students with the knowledge to analyze and design industrial buildings.

UNIT I GENERAL

9+3

Design Philosophies and Design Codes (IS, EC, AISC) – Stability Criteria –Beam- Columns and Frames (Sway and Non-Sway) – Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder.

UNIT II DESIGN OF CONNECTIONS

9+3

Types of connections – Welded and Bolted – Design of simple base, Gusseted base and Moment Resisting Base – Flexible Connections - Seated Connections – Unstiffened and Stiffened Seated Connections – Moment Resistant Connections– Clip angle Connections – Split beam Connections.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS

9+3

Structural Configurations - Functional and Serviceability Requirements- Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non-sway frames –Gantry Girders –Earthquake resistant design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES

9+3

Introduction, Shape factor - Moment redistribution - Beam, Sway, Joint and Gable mechanisms - Combined mechanisms - Analysis of portal frames, Effect of axial force and shear force on plastic moment capacity, Connection Requirements - Moment resisting connections - Design of Straight Corner Connections - Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES

9+3

Introduction to Direct Strength Method - Behavior of Compression Elements - Effective width for load and deflection determination - Behavior of Unstiffened and Stiffened Elements - Design of webs of beams - Flexural members - Lateral buckling of beams - Shear Lag - Flange Curling - Design of Compression Members - Wall Studs.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Design steel members such as purlins, gable wind girders subjected to combined forces.
- CO2: Design different types of steel connections such as welded and bolted flexible and moment resisting connections.
- CO3: Analyze and design industrial structures such as trusses and portal frames subjected to wind and seismic forces.
- CO4: Explore the effect of axial force and shear force on steel structures and analyze continuous beams and frames using plastic theory.
- CO5: Evaluate the behavior and design of compression and flexural Cold-formed Steel members.

TEXT BOOKS

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1997.
2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
3. Subramanian. N, Design of Steel Structures, Oxford University Press, 2016.

REFERENCE BOOKS

1. Teaching Resources for "Structural Steel Design". Vol. 2 of 3, Institute of Steel Development and Growth (INSDAG), 2000.
2. Wie Wen Yu, Design of Cold-Formed Steel Structures, McGraw Hill Book Company, 2019.
3. S.K. Duggal, Limit State Design of Steel Structures, McGraw Hill Book Company, 2017.
4. Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt.Ltd., New Delhi, 2010.
5. Punmia B.C., Comprehensive Design of Steel Structures, Lakshmi Publications, New Delhi, 2000.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2103 ADVANCED DESIGN OF CONCRETE STRUCTURES

L T P C

3 1 0 4

COURSE OBJECTIVES

- To make the students familiar with the behavior of RCC beams.
- To gain knowledge on design principle of columns.
- To design special structural members with detailing.

UNIT I DESIGN OF BEAMS

9+3

Overall review on behavior of RC beams in flexure and shear - behavior and design of RCC beams under combined Shear, Torsion and Bending -Serviceability limit states - computation of deflections and crack width as per codal provisions.

UNIT II DESIGN OF SLENDER COLUMNS

9+3

Behavior of slender RCC Columns - Failure modes - Calculation of design moments for braced and unbraced columns - Design of slender columns.

UNIT III DESIGN OF SPECIAL RC ELEMENTS

9+3

Design of RC walls – ordinary and Shear walls - Strut and tie method of analysis for Corbels and Deep beams.

UNIT IV DESIGN OF FLAT SLABS AND PLATES

9+3

Yield line theory and Hiller berg method of design of slabs - Design of flat slabs and flat plates according to BIS method - Shear in flat slabs and flat plates -Design of Grid floors.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES

9+3

Inelastic behavior of concrete beams - Moment-rotation curves – Moment redistribution concept of Ductility – Detailing for ductility – design of beams, Columns for ductility - design of cast-in-situ joints in frames.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the structural behavior of flexural members and columns.
- CO2: Design the compression members and construct interaction diagrams.
- CO3: Design the special elements like corbels, deep beams and grid floors.
- CO4: Design flat slab and spandrel beam.
- CO5: Predict the moment curvature behavior and design and detail concrete elements based on ductility.

TEXT BOOKS

1. Varghese, P.C. Advanced Reinforced Concrete Design, Prentice Hall of India, 2005.
2. Gambhir.M.L, Design of Reinforced Concrete Structures, Prentice Hall of India, 2012.
3. Subramanian. N, Design of Reinforced Concrete Structures, Oxford University Press, 2013.

REFERENCE BOOKS

1. Sinha.S.N., Reinforced Concrete Design, Tata-McGraw-Hill, 1996.
2. Purushothaman, P, Reinforced Concrete Structural Elements: Behaviour Analysis and Design, Tata McGraw-Hill, 1986.
3. Park. R., & Paulay. T, Reinforced Concrete Structures, John Wiley & Sons, 2009.
4. Arthur H.Nilson, Design of Concrete Structures, Tata McGraw-Hill, 2003.
5. Bureau of Indian Standards. (2000). IS 456:2000 - Plain and reinforced concrete – Code of practice (4th ed.). New Delhi: Bureau of Indian Standards.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To enable students to design structures using modern software tools such as ETABS, STAAD, and STRAP, ensuring compliance with relevant standards and codes.
- To equip students with skills in analyzing and detailing structural components, culminating in the creation of comprehensive drawings and reports that reflect their design process.
- To foster independent learning and problem-solving abilities by requiring students to complete a detailed project that includes both a written report and a presentation of their design work.

EXPERIMENTS/ EXERCISES

To design a structure using modern software tools available like ETABS, STAAD, STRAP, etc. and present it in the form of a complete detailed drawing. Students have to work individually with standard codes, computational tools and software packages for analyzing, designing and detailing a structure. A detailed report on the work done shall be submitted by individual students in the form of a report and presentation.

TOTAL: 60 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

- CO1: Explore the requirements of a structure and model it accordingly using computer software.
- CO2: Analyze the structure for various loads and load combinations according to the relevant IS codes.
- CO3: Design and detail structures using computer software/tools and check the correctness using manual approximate methods.
- CO4: Prepare the complete structural drawings using computer software.
- CO5: Prepare a detailed report on the work done.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
AVG	3	3	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To enable students to solve mathematical equations and conduct finite element analysis using computational methods and software tools.
- To equip students with practical skills in applying finite element software like ABAQUS and ANSYS to model, analyze, and interpret Engineering problems.
- To foster a deep understanding of numerical methods and their application in solving complex Engineering problems through hands-on experience with advanced computational tools.

EXPERIMENTS/ EXERCISES

1. Dynamic analysis of frame using mathematical computational software
2. Finite Element Analysis of 2D truss.
3. Finite Element Analysis of 3D space trusses.
4. Modeling and Finite Element Analysis of RC beams.
5. Modeling and Finite Element Analysis of slabs.
6. Finite Element Analysis of thin plates.
7. Finite Element Analysis of thick plates .
8. Stability analysis using FEM.

TOTAL: 60 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

CO1:Acquire knowledge to handle Finite Element software.

CO2:Do Dynamic analysis of frames.

CO3:Analyze thin and thick plates.

CO4:Carryout Stability Analysis.

CO5:Use finite element softwares such as ABAQUS / ANSYS for FE modeling.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
AVG	3	3	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To introduce students to the fundamental concepts of stability analysis, including energy methods.
- To enable students to analyze the buckling behavior of beam, columns and frames.
- To equip students with the knowledge of torsional and lateral buckling.

UNIT I BUCKLING OF COLUMNS**9+3**

States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES**9+3**

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT III TORSIONAL AND LATERAL BUCKLING**9+3**

Torsional buckling – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES**9+3**

Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.

UNIT V INELASTIC BUCKLING**9+3**

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behavior of plates.

TOTAL: 60 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

- CO1: Explain the phenomenon of buckling of columns and calculate the buckling load on column by various approaches.
- CO2: Estimate the buckling load of beams, columns and frames.
- CO3: Explore the concepts of torsional and lateral buckling of thin-walled members.
- CO4: Explain the phenomenon of buckling of plates.
- CO5: Analyze the inelastic buckling of columns and plates.

TEXT BOOKS

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd. New Delhi.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
3. Gambhir.M.L, "Stability Analysis and Design of Structures", springer, New York, 2013.

REFERENCE BOOKS

1. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
2. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", Dover Publication, 2012.
3. Iyenger, N. G. R., Structural Stability of Columns and Plates, Affiliated East West Press Pvt. Ltd., 1990.
4. Bleich F., Buckling Strength of Metal Structures, McGraw Hill 1991.
5. Alexandar Chajes, Principles of Structural Stability Theory, Prentice Hall, New Jersey, 1980.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	3	3	2
CO2	2	-	3	3	3	2
CO3	2	-	3	3	3	2
CO4	2	-	3	3	3	2
CO5	2	-	3	3	3	2
AVG	2	-	3	3	3	2

1-Low, 2-Medium, 3-High, "-" – No correlation

24RE3102 RESEARCH ARTICLE REVIEW AND SCIENTIFIC REPORT WRITING

L T P C
2 0 0 2

COURSE OBJECTIVES

- To improve writing skills and level of readability.
- To learn the structure of project report.
- To understand the comprehensive research process, including hypotheses, methodologies, and findings.

UNIT I WRITING SKILL **6**

Writing Skills – Essential Grammar and Vocabulary – Passive Voice, Reported Speech, Concord, Signpost words, Cohesive Devices – Paragraph writing - Technical Writing vs. General Writing.

UNIT II PROJECT REPORT **6**

Project Report – Definition, Structure, Types of Reports, Purpose – Intended Audience – Plagiarism– Report Writing in STEM fields – Experiment – Statistical Analysis.

UNIT III STRUCTURE OF PROJECT REPORT **6**

Structure of the Project Report: Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question -Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV REPORT WRITING **6**

Literature Review, Research Design, Methods of Data Collection - Tools and Procedures - Data Analysis - Interpretation - Findings –Limitations -Recommendations – Conclusion – Bibliography.

UNIT V PROOF READNG **6**

Proof reading a report – Avoiding Typographical Errors – Bibliography in required Format – Font –Spacing – Checking Tables and Illustrations – Presenting a Report Orally – Techniques.

TOTAL:30 PERIODS

Stage-1	Collection of latest Research articles
Stage-2	Read the entire article and take a note in his/her own words.
Stage-3	Summarize the literature in his/her own words.
Stage-4	Classify and arrange the literatures with template
Stage 5	Preparation of review article
Stage 6	Plagiarism checked by the department and it must be less than 10%
Stage 7	Article must be communicated to the journal.

The students must do the above work individually by the guidance of faculty members and one coordinator is required to monitor the work progress. The evaluation will be done based on the following

- | | | |
|-------|------------------------------|-----|
| (i) | Review of work after stage 3 | 10% |
| (ii) | Review of work after stage 5 | 20% |
| (iii) | Review of work after stage 7 | 20% |
| (iv) | Final examination | 50% |

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Demonstrate improved writing skills by applying essential grammar, vocabulary, and cohesive devices in both technical and general writing contexts.
- CO2: Construct well-organized project reports that clearly outline the purpose, structure, and intended audience while adhering to ethical standards, including avoiding plagiarism.
- CO3: Implement the essential components of a project report, including the title, abstract, introduction, methodology, and theoretical framework, to effectively communicate their research findings.
- CO4: Interpret data through appropriate research designs and statistical methods, leading to well-supported conclusions and recommendations.
- CO5: Acquire skills in proofreading and formatting reports to ensure clarity, correctness, and professionalism in presentation, including attention to detail in bibliographies and oral presentation techniques.

TEXT BOOKS

1. Gerson and Gerson - Technical Communication: Process and Product, 7th Edition, Prentice Hall (2012).
2. Virendra K. Pamecha - Guide to Project Reports, Project Appraisals and Project Finance (2012).
3. Daniel Riordan - Technical Report Writing Today (1998) Darla-Jean Weatherford Technical Writing for Engineering Professionals (2016) Penwell Publishers.

REFERENCE BOOKS

1. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.
5. C.R.Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2001.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	2
CO2	3	2	2	2	2	2
CO3	3	2	2	2	2	2
CO4	3	2	2	2	2	2
CO5	3	2	2	2	2	2
AVG	3	2	2	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3601 PRACTICAL TRAINING (4 Weeks)

LT P C

0 0 2 1

COURSE OBJECTIVES

- To provide practical exposure to structural engineering principles through hands-on training in reputable companies.
- To enhance technical reporting skills by guiding students in the preparation of comprehensive training reports.
- To develop effective communication skills through viva-voce examinations, enabling students to articulate their experiences clearly.

SYLLABUS

The students individually undertake training in reputed engineering companies doing Structural Engineering during the summer vacation for a specified duration of four weeks. At the end of the training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Describe the Structural Engineering organization.
- CO2: Realize the various functions of construction activities.
- CO3: Gain an explanation of groups and group dynamics.
- CO4: Participate in real-life construction projects.
- CO5: Put to use the theoretical knowledge gained so far.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	2
CO2	3	2	2	2	2	2
CO3	3	2	2	2	2	2
CO4	3	2	2	2	2	2
CO5	3	2	2	2	2	2
AVG	3	2	2	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3501 PROJECT WORK PHASE I

L T P C

0 0 12 6

COURSE OBJECTIVES

- To identify a specific problem for the current need of the society and collect information related to the same through a detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examinations.

SYLLABUS

The student individually works on a specific topic approved by the faculty member who is familiar with this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains a clear definition of the identified problem, detailed literature review related to the area of work and a methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL:180 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1:Apply the knowledge gained from theoretical and practical courses in solving problems.
- CO2:Recognize the importance of literature review.
- CO3:Develop a clear outline and methodology for the project.
- CO4:Identify the potential research gap and list parameters to work.
- CO5:Report and present the findings of the work conducted.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
AVG	3	3	3	3	3	3

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST4501 PROJECT WORK PHASE II

L T P C
0 0 24 12

COURSE OBJECTIVES

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.
- To prepare a project report in the specific format mentioned.

SYLLABUS

The student should continue the phase I work on the selected topic as per the formulated methodology / Undergo internship. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report and the viva-voce examination by a panel of examiners including one external examiner.

Since 1984

TOTAL:360 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Discover potential research areas in the field of Structural Engineering.
- CO2: Apply the knowledge gained from theoretical and practical courses to be creative, well-planned, organized and coordinated.
- CO3: Represent data acquired in graphical and reader-friendly formats.
- CO4: Derive detailed conclusions from work carried out.
- CO5: Report and present the findings of the work conducted.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
AVG	3	3	3	3	3	3

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1301 ADVANCED CONCRETE TECHNOLOGY

L T P C

3 0 0 3

COURSE OBJECTIVES

- To provide students with a comprehensive understanding of concrete-making materials.
- To equip students with the principles and methods of concrete mix design, including IS Method, ACI Method, and DOE Methods.
- To familiarize students with various concreting methods and techniques, including manufacturing, transportation, curing, and special concrete types.

UNIT I CONCRETE MAKING MATERIALS

9

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified grading, Testing of aggregates - Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements - Water - Chemical admixtures, Mineral admixture.

UNIT II MIX DESIGN

9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Mix design for special concretes- changes in Mix design for special materials.

UNIT III CONCRETING METHODS

9

Process of manufacturing of concrete, methods of transportation, placing and curing, cracking, plastic shrinkage, Extreme weather concreting, special concreting methods, Vacuum dewatering – Underwater Concrete.

UNIT IV SPECIAL CONCRETES

9

Light weight concrete Fly ash concrete, Fiber reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self-Compacting Concrete, Geo Polymer Concrete, Waste material-based concrete – Ready mixed concrete.

UNIT V TESTS ON CONCRETE

9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage – Durability of concrete, Non-destructive Testing Techniques - microstructure of concrete.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Develop knowledge on various materials needed for concrete manufacturing.

CO2:Carryout Mix Designs for concrete by various methods.

CO3:Explain the methods of concreting.

CO4:Explore special concretes.

CO5:Explain various tests on fresh and hardened concrete.

TEXT BOOKS

1. Gupta.B.L., Amit Gupta, “Concrete Technology, Jain Book Agency, 2017.
2. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2019.
3. P. Kumar Metha and Paulo J. M. Monteiro., Concrete: Microstructure, Properties and Materials, Mc Graw Hill, Fourth Edition, 2014.

REFERENCE BOOKS

1. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
2. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
3. Job Thomas., Concrete Technology, Cengage learning India Private Ltd, New Delhi, 2015.
4. A. R. Santhakumar, Concrete Technology” Oxford University Press, 2006.
5. P. C. Aitcin, High Performance Concrete, E & FN SPON, 1998.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	2	2	2
CO2	2	-	3	2	2	2
CO3	2	-	3	2	2	2
CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To introduce students to various experimental stress analysis methods.
- To equip students with the knowledge and skills to measure structural vibrations and wind flow.
- To familiarize students with non-destructive testing methods for assessing structural integrity.

UNIT I FORCES AND STRAIN MEASUREMENT 9

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses, Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – vibrating wire sensors– Fibre optic sensors.

UNIT II MEASUREMENT OF VIBRATION AND WIND FLOW 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements, Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – wind tunnels – Flow meters – Venturimeter – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND CONTROL 9

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

UNIT IV NON-DESTRUCTIVE TESTING METHODS 9

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR , Ground penetrating radar (GPR).

UNIT V MODEL ANALYSIS 9

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems – Usage of influence lines in model studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Gain knowledge on measurement of strain.
- CO2: Explain the measurement of vibrations and wind blow.
- CO3: Diagnose distress in structures.
- CO4: Analyze the structure by non-destructive testing methods.
- CO5: Explore various laws used in model analysis.

TEXT BOOKS

1. Dalley .J. W and Riley. W. F, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991.
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Ravisankar.K. and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.

REFERENCE BOOKS

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
2. Srinivasan, A. V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2000.
3. Yoseph Bar Cohen, Smart Structures and Materials, The International Society for Optical Engineering, 2003.
4. Brian Culshaw, Smart Structures and Materials , Artech House, Boston, 1996.
5. M. V. Gandhi and B. S. Thompson, Smart Materials and Structures, Chapman and Hall, 1992.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
AVG	3	3	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To understand the key concepts in disaster risk reduction and humanitarian response.
- To illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

UNIT I INTRODUCTION**9**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS**9**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem, Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA**9**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT**9**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT**9**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation, Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

CO1: Summarize basics of disaster.

CO2: Explain key concepts in disaster risk reduction and humanitarian response.

CO3: Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Explore standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5:Develop the strengths and weaknesses of disaster management approaches.

TEXT BOOKS

1. Goel S. L., “Disaster Administration and Management text and Case Studies”, Deep& Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company, 2007.
3. Sahni, Pardeep Et Al., “Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi, 2001.

REFERENCE BOOKS

1. Natural Hazards and Disaster Management: Vulnerability and Mitigation" by R B Singh, 2006.
2. "Disaster Mitigation: Experiences and Reflections" by Alka Dhameja and Pardeep Dhameja, 2001.
3. Disaster Management and Mitigation" by Prof R B Singh,2000.
4. "Disaster Mitigation and Management: Post-Tsunami Perspectives" by Jegadish P Gandhi, 2005.
5. "Disasters: Strengthening Community Mitigation and Preparedness" by Khanna B K, 2011.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	2	2	2
CO2	2	-	3	2	2	2
CO3	2	-	3	2	2	2
CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1304 MECHANICS OF FIBER REINFORCED POLYMER CONCRETE

L T P C
3 0 0 3

COURSE OBJECTIVES

- To provide students with an understanding of composite materials.
- To equip students with the knowledge of stress-strain relations specific to orthotropic and anisotropic materials.
- To familiarize students with the analysis of laminated composites, including governing equations, static and dynamic analysis.

UNIT I INTRODUCTION **9**

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites.

UNIT II STRESS STRAIN RELATIONS **9**

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III ANALYSIS OF LAMINATED COMPOSITES **9**

Governing equations for anisotropic and orthotropic plates, Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses.

UNIT IV FAILURE AND FRACTURE OF COMPOSITES **9**

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V APPLICATIONS AND DESIGN **9**

Meal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the various types of composites and their constituents.
- CO2: Derive the constitutive relationship and determine the stresses and strains in a composite material.
- CO3: Analyze a laminated plate.
- CO4: Explain the various failure criteria and fracture mechanics of composites.
- CO5: Design simple composite elements.

TEXT BOOKS

1. Agarwal. B.D. Broutman. L.J. and Chandrashekar. K. "Analysis and Performance of Fiber Composites", Fourth Edition, John-Wiley and Sons, 2017.
2. Daniel. I.M, and Ishai. O, "Engineering Mechanics of Composite Materials", Second Edition, Oxford University Press, 2005.
3. David Broek, Elementary Engineering Fracture Mechanics, Sijthoff and Noordhaff, Alphen Aan Den Rijn, The Netherlands, 2001.

REFERENCE BOOKS

1. Hyer M.W., and White S.R., “Stress Analysis of Fiber-Reinforced Composite Materials”, Detach Publications Inc., 2009.
2. Jones R.M., “Mechanics of Composite Materials”, Taylor and Francis Group 1999.
3. Analysis of Concrete Structure by Fracture Mechanics, Ed L. Elfgren and S.P. Shah, Proc of Rilem Workshop, Chapman and Hall, London, 2001.
4. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India, 2009.
5. K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	2	2	2
CO2	2	-	3	2	2	2
CO3	2	-	3	2	2	2
CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1305 PREFABRICATED STRUCTURES

LT P C
3 0 0 3

COURSE OBJECTIVES

- To introduce students to the design principles and requirements for prefabricated structures.
- To equip students with the knowledge of reinforced concrete applications in prefabricated structures.
- To familiarize students with the analysis and design of floors, stairs, roofs, and walls in prefabricated.

UNIT I DESIGN PRINCIPLES

9

General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II REINFORCED CONCRETE

9

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

UNIT III FLOORS, STAIRS AND ROOFS

9

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behavior and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV WALLS

9

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behavior and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS

9

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper prefabricated shells, Erection and jointing, joint design, hand book based design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Explain the design principles involved in prefabrication.

CO2: Detail the different types of connection.

CO3: Design for stripping forces during manufacture.

CO4: Determine the forces in shear walls.

CO5: Identify the different roof trusses used in industrial buildings.

TEXT BOOKS

1. Koncz.T., "Manual of Precast Concrete Construction", Vol.I II and III & IV Bauverlag, GMBH, 1971.
2. Laszlo Mokka, "Prefabricated Concrete for Industrial and Public Structures", Akademiai Kiado, Budapest, 2007.
3. Hass, A. M. Precast Concrete Design and Applications, Applied Science Publishers, 1983.

REFERENCE BOOKS

1. Lewicki.B, "Building with Large Prefabricates", Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
2. "Structural Design Manual", Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.

3. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
4. Structural Design Manual - Precast concrete connection details”, Society for studies in the use of Precast concrete, Netherland Betor Verlag, 2009.
5. "Construction and Design of Prestressed Concrete Structures" by H. J. B. P. N. Wang, 2008.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1306 ADVANCED PRESTRESSED CONCRETE

**L T P C
3 0 0 3**

COURSE OBJECTIVES

- To develop an understanding of the philosophy of design of prestressed concrete.
- To be able to design indeterminate prestressed concrete structure.
- To design the prestressed concrete bridge and composite sections.

UNIT I INTRODUCTION

9

Concepts of Prestressing – Materials and methods of prestressing – Design philosophy- Analysis methods, Time-dependent deformation of concrete and losses of prestress.

UNIT II DESIGN FOR FLEXURE, SHEAR AND TORSION

9

Behavior of flexural members, determination of ultimate flexural strength using various Codal provisions - Design for Flexure, Shear, torsion and bond of pre-stressed concrete elements – Transfer of prestress – Box girders - Camber, deflection and crack control.

UNIT III DESIGN OF CONTINUOUS AND COMPOSITE BEAMS

9

Statically indeterminate structures - Analysis and design of continuous beams and frames– Choice of cable profile - Methods of achieving continuity – concept of linear transformations, concordant cable profile and gap cables – Composite sections of prestressed concrete beam and cast in situ RC slab - Design of composite sections - Partial prestressing - Limit State design of partially prestressed concrete beams.

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS

9

Pre-stressed concrete compression and tension members – application in the design of prestressed pipes and prestressed concrete cylindrical water tanks – Design of compression members with and without flexure – its application in the design of piles, flag masts and similar structures – Two-way pre-stressed concrete floor systems – Connections for pre-stressed concrete elements.

UNIT V DESIGN OF PRESTRESSED CONCRETE BRIDGES

9

Review of IRC and IRS loadings. Effect of concentrated loads on deck slabs, load distribution methods for concrete bridges. Analysis and Design of superstructures - Design of pre-stressed concrete bridges incorporating long-term effects like creep, shrinkage, relaxation, and temperature effects, Dynamic response of bridge decks.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Identify the various methods of prestressing and estimate the loss.

CO2:Design the beams for flexure, shear, bond and torsion.

CO3:Design the continuous beams and composite beams.

CO4:Design the water tank, piles and masts.

CO5:Analyze and design the prestressed concrete bridge.

TEXT BOOKS

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 6th Edition, 2018.
3. Lin.T.Y.and Burns.H “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, 3rd Edition, 2010.

REFERENCE BOOKS

1. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2014.
2. Sinha.N.C. and. Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co.,1998.
3. Johnson Victor, D., Essentials of Bridge Engineering, Oxford and IBH Publishing Co New Delhi 2019.
4. Antonnie. E. Naaman, Prestressed Concrete Analysis and Design, Technopress, 3rd Edition, 2012.
5. Edward. G .Nawy, Prestressed Concrete, Prentice Hall, 5th Edition, 2010.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST1307 MASONRY STRUCTURES DESIGN

L T P C

3 0 0 3

COURSE OBJECTIVES

- To design and detail masonry structures according to relevant codes and standards.
- To analyze the behavior of masonry under lateral loads and seismic conditions.
- To retrofit and strengthen existing masonry structures for improved performance.

UNIT I INTRODUCTION

9

Introduction – Masonry construction – National and International perspective – Historical development, Modern masonry, Material Properties – Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT II DESIGN OF COMPRESSION MEMBER

9

Principles of masonry design, Masonry standards: IS 1905 and others - Masonry in Compression – Prism strength, Eccentric loading -Kern distance. Structural Wall, Columns and Plasters, Retaining Wall, Pier and Foundation – Prestressed masonry

UNIT III DESIGN OF MASONRY UNDR LATERAL LOADS

9

Masonry under Lateral loads – In-plane and out-of-plane loads, Ductility of Reinforced Masonry Members Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms. Behavior of Masonry – Shear and flexure – Combined bending and axial loads – Reinforced and unreinforced masonry – Infill masonry

UNIT IV EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES

9

Structural design of Masonry – Consideration of seismic loads –concepts of confined masonry – Cyclic loading and ductility of shear walls for seismic design -Code provisions- Working and Ultimate strength design – In-plane and out-of-plane design criteria for load-bearing and infills, connecting elements and ties. Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra – use of Software.

UNIT V RETROFITTING OF MASONRY

9

Seismic evaluation and Retrofit of Masonry – In-situ and non-destructive tests for masonry – properties – Repair and strengthening of techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore the properties of a masonry unit and the various components.
- CO2: Design a masonry structure for compression.
- CO3: Design a masonry structure for lateral loads.
- CO4: Design an earthquake-resistant masonry wall.
- CO5: Suggest retrofitting techniques for existing masonry walls.

TEXT BOOKS

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R, “Masonry Structures: Behaviour & Design”, Prentice Hall Hendry, 1994.
2. A.W. Hendry, B.P. Sinha and Davis, S. R, “Design of Masonry Structures”, E & FN Spon, UK, 2017.
3. Santha Kumar, A.R., “Concrete Technology”, Oxford University Press, New Delhi, 2007.

REFERENCE BOOKS

1. R.S. Schneider and W.L. Dickey, “Reinforced Masonry Design”, Prentice Hall, 3rd edition, 1994.
2. Paulay, T. and Priestley, M. J. N., “Seismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley, 1992.
3. A.W. Hendry, “Structural Masonry”, 2nd Edition, Palgrave MacMillan Press, 1998.
4. Yoshihiko Ohama, “Hand Book of Polymer Modified Concrete and Mortars”, Noyes Publications, U.K., 3rd Edition, 2013.
5. "Masonry Design and Construction" by A.P. MacGregor, 2009.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To understand the principles and design codes governing steel-concrete composite construction.
- To design composite structural elements, including beams, slabs, columns, and trusses.
- To analyze and design connections in composite structures, focusing on shear connectors and their interactions.

UNIT I INTRODUCTION**9**

Introduction to steel – concrete composite construction – Codes – Composite action – Serviceability and Construction issues in design.

UNIT II DESIGN OF COMPOSITE MEMBERS**9**

Design of composite beams, slabs, columns, beam – columns – Design of composite trusses.

UNIT III DESIGN OF CONNECTIONS**9**

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

UNIT IV COMPOSITE BOX GIRDER BRIDGES**9**

Introduction – Design concepts of box girder bridges and corrugated web girder bridges

UNIT V CASE STUDIES**9**

Case studies on steel – concrete composite construction in buildings – seismic behavior of composite structures.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

CO1: Explain concrete composite construction and its codal provision.

CO2: Design composite members.

CO3: Design connections in composite connections.

CO4: Explore the concept of design of composite box girder bridges.

CO5: Study and evaluate case studies on concrete composite construction in buildings.

TEXT BOOKS

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol. I, Fourth Edition, Blackwell Scientific Publications, 2018.
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Revised Edition, Pergamon press, Oxford, 2013.

- Owens. G.W and Knowles.P, “Steel Designers Manual”, Seventh Edition, Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 2011.

REFERENCE BOOKS

- Narayanan R, “Composite steel structures – Advances, design and construction”, Elsevier, Applied science, UK, 1987.
- Teaching resource for, “Structural Steel Design,” Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
- "Composite Structures: Design and Analysis" by S. P. Timoshenko, 2014.
- Principles of Composite Material Mechanics" by A. L. Jones, 2016.
- Composite materials handbook – Volume 1: Polymer matrix composites – Guidelines for characterization of structural materials (Rev. G). SAE International,2012.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2301 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

LT P C
3 0 0 3

COURSE OBJECTIVES

- To understand the principles of maintenance, repair, and rehabilitation of structures, focusing on the causes and effects of deterioration.
- To evaluate the strength and durability of concrete, including quality assurance and the impact of environmental factors and corrosion.
- To explore various repair materials and techniques, along with protection methods and structural health monitoring for effective maintenance of structures.

UNIT I MAINTENANCE AND REPAIR STRATEGIES

9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures- Service life behavior - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques.

UNIT II STRENGTH AND DURABILITY OF CONCRETE **9**

Quality assurance for concrete based on Strength, Durability and Microstructure of concrete – NDT techniques- Cracks- different types, causes – Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage.

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES **9**

Repair materials-Variou repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes- Polymer Concrete and Grouting materials- Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets.

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING **9**

Concrete protection methods – reinforcement protection methods- cathodic protection – Sacrificial anode - Corrosion protection techniques – Corrosion inhibitors, concrete coatings- Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring.

UNIT V REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES **9**

Variou methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks. Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition -Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the importance of maintenance assessment and repair strategies.
- CO2: Acquire knowledge of strength and durability properties and their effects due to climate and temperature.
- CO3: Gain knowledge of recent developments in repair.
- CO4: Explore the techniques for repair and protection methods.
- CO5: Explain the repair, rehabilitation and retrofitting of structures and demolition methods.

TEXT BOOKS

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butter worth Heinemann, Elsevier, New Delhi 2012.
2. Dov Kominetzky.M.S., - Design and Construction Failures, Galgotia Publications Pvt. Ltd., 2001.
3. Ravishankar.K., Krishnamoorthy. T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.

REFERENCE BOOKS

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD, Govt of India, New Delhi – 2002.
3. BS EN 1504 - Products and systems for the protection and repair of concrete structures -Definitions, requirements, quality control and evaluation of conformity.
4. "Structural Maintenance and Repair" by J. W. Bullock, 2006.
5. " Li, K.. Durability design of concrete structures: Phenomena, modeling, and practice. John Wiley & Sons Singapore Pte. Ltd, 2016.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	3	2	2	2
CO2	2	-	3	2	2	2
CO3	2	-	3	2	2	2
CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2302 STRUCTURAL SAFETY AND RELIABILITY

L T P C

3 0 0 3

COURSE OBJECTIVES

- To impart adequate knowledge on safety aspects involved in construction industry.
- To impart knowledge on the quantitative estimates of the reliability of structures under different limit state conditions.
- To implement reliability-based design methodologies.

UNIT I INTRODUCTION TO STRUCTURAL SAFETY

9

Structural safety - role of safety officers, responsibilities of general employees, safety committee, safety monitoring. Concepts of Safety Factors, Safety, Reliability and Risk Analysis.

UNIT II PROBABILITY CONCEPTS

9

Fundamentals of Set Theory and Probability; Probability Distribution, Regression Analysis, Hypothesis Testing. Stochastic Process and Its Moments; Probability Distributions. Probability of failure. Fatal accident rate. Societal risk. Anatomy of failure. Management of safety.

UNIT III STRUCTURAL RELIABILITY THEORY AND METHODS 9

R-S problem in structural design and assessment - Probability of Failure and the Reliability Index. Convolution Integral, Standardized Method for Normal Variables, First Order Reliability Method, Monte Carlo Simulation. Second order Reliability Method.

UNIT IV RELIABILITY ANALYSIS 9

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).

UNIT V RELIABILITY BASED DESIGN 9

Specification of Characteristic Load/Resistance Values, Design Values, Partial Factors, Target Reliability, Methods of Code Calibration - Use of ISO 2394 method and its significance.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Describe the safety practices to be followed during various construction operations
- CO2: Explain the quantifying uncertainties using theories of probability.
- CO3: Illustrate the theory of methods of structural reliability based on the concept of reliability indices.
- CO4: Perform the reliability-based limit state design for simple structural elements and recognize the sensitivity of the outcome to the uncertainty in different variables.
- CO5: Explore the reasons leading to different values of partial safety factors for load and resistance variables in design and assessment standards.

TEXT BOOKS

1. Tim Howarth, Paul Watson, "Construction Safety Management" Wiley-Blackwell, 2008.
2. Choi S K, Grandhi R V and Canfield R A., "Reliability Based Structural Design", Springer Verlag, London, UK, 2007.
3. "Structural Reliability Analysis and Prediction" by R. E. Melchers and R. D. Beck, 2018.

REFERENCE BOOKS

1. Haldar, A., and Mahadevan, S., "Probability, Reliability and Statistical Methods in Engineering Design", John Wiley and Sons, New York, 2000.
2. Ranganathan, R., "Structural Reliability Analysis and Design", Jaico Publishing House, Mumbai, 2006.
3. Melchers, R. E.. Structural reliability analysis and design (2nd ed.), 1999.
4. Der Kiureghian, A.. Structural and system reliability. Springer, 2022..
5. Modarres, M. Risk analysis in engineering: Techniques, tools, and trends. CRC Press, 2006.

Mapping of COs and POs

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CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2303 CORROSION PREVENTION AND CONTROL IN RC STRUCTURES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge on mechanism of corrosion of steel in concrete, major causes, influencing parameters and consequences in reinforced and pre-stressed concrete structures.
- To understand the techniques and methods for condition assessment, corrosion prevention, and corrosion control in reinforced concrete (RC) structures.
- To understand types of corrosion and its mechanism, non-destructive and destructive testing techniques for corrosion assessment in distressed concrete elements through hands on training.

UNIT I MECHANISM OF CORROSION OF STEEL IN RC STRUCTURES 9

Corrosion mechanism – black rust - pits - stray current, causes of corrosion – carbonation - chloride attack – microbial induced corrosion in concrete – influencing parameters - corrosion damage in reinforced concrete and pre-stressed concrete - stress corrosion cracking - hydrogen embrittlement, cost of corrosion - worldwide scenario.

UNIT II CORROSION PREVENTION IN RC STRUCTURES 9

Control of carbonation - control of chlorides - high performance concrete - corrosion inhibitors – anodic, cathodic and mixed inhibitors - protective coatings to steel rebars: fusion bonded epoxy coating, galvanization, cement polymer composite coating and anticorrosive polymer cementitious coatings - stainless steel reinforcement - sealers and membranes - cathodic protection.

UNIT III CONDITION EVALUATION 9

Preliminary survey - visual inspection and detailed survey – delaminating survey - cover – half-cell potential measurements - carbonation depth measurement - chloride determination.

UNIT IV CORROSION RATE MEASUREMENT 9

Resistivity measurement, corrosion rate measurement – linear polarization resistance techniques - impedance studies - microcell techniques - potential-time behavior studies - accelerated corrosion studies.

UNIT V CORROSION CONTROL IN RC STRUCTURES 9

Physical and chemical rehabilitation techniques – coatings - sealers and membranes - corrosion inhibitors - electrochemical repair techniques: basic principles, chloride removal and real kalization - cathodic protection.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore corrosion mechanism under different contexts, its causes and consequences.
- CO2: Suggest techniques and methods for corrosion prevention in RC structures.
- CO3: Conduct corrosion audit in distressed RC elements.
- CO4: Explain the scientific principles, and submit a professional report.
- CO5: Recommend techniques / methods for corrosion control in distressed RC structures.

TEXT BOOKS

1. Baeckmann, W. von, W. Schwenk, and W. Prinz, Handbook of cathodic corrosion protection: Theory and practice of electrochemical protection processes, 3rd ed. Gulf Publishing Company, 1997.
2. John P. Broomfield, Corrosion of Steel in Concrete: Understanding, Investigation and Repair, second edition, CRC Press, 2006.
3. ACI (American Concrete Institute) 222R-01: Protection of metals in concrete against corrosion. American Concrete Institute, Farmington Hills, MI, USA, 2010.

REFERENCE BOOKS

1. ASTM G109-07: Standard test method for determining effects of chemical admixtures on corrosion of embedded steel reinforcement in concrete exposed to chlorides. ASTM International, West Conshohocken, PA, USA, 2013.
2. Chess, P. M. and J. P. Broomfield, Cathodic Protection of Steel in Concrete and Masonry, 2nd Edition. London: CRC Press, 2014.
3. ASTM A 775/A775 M-19, "Standard specification for epoxy-coated steel reinforcing bars", American Society for Testing and Materials, 2019.
4. ASTM C 876, Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete, American Society for Testing and Materials, 2015.
5. IS 13620, "Fusion bonded epoxy-coated reinforcing bars-Specification", Bureau of Indian Standards, New Delhi, 2020.

Mapping of COs and POs

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CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2304 STRUCTURAL HEALTH MONITORING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the principles and methods of Structural Health Monitoring.
- To explore various sensors and instrumentation used in SHM.
- To apply advanced data processing techniques for damage detection and analysis.

UNIT I INTRODUCTION TO STRUCTURAL HEALTH MONITORING 9

Need for SHM, Structural Health Monitoring versus Non-Destructive Evaluation, Methods of SHM Local & Global Techniques for SHM, Short & Long-Term Monitoring, Active & Passive Monitoring, Remote Structural Health Monitoring- Advantages of SHM - Challenges in SHM.

UNIT II SENSORS AND INSTRUMENTATION FOR SHM 9

Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fiber Optic Sensors, Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors, Data Acquisition – Data Transmission - Data Processing – Storage of processed data -Knowledgeable information processing.

UNIT III STATIC AND DYNAMIC MEASUREMENT TECHNIQUES FOR SHM 9

Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement -Vibration based testing- Ambient Excitation methods, Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.

UNIT IV DAMAGE DETECTION 9

Damage Diagnostic methods based on vibrational response- Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and

transmission, Wave tuning/mode selectivity, Migration imaging, Phased array imaging, Focusing array/SAFT imaging.

UNIT V DATA PROCESSING AND CASE STUDIES

9

Advanced signal processing methods -Wavelet, Hilbert-Huang transform, Neural networks, Support Vector Machine Principal component analysis, Outlier analysis. Applications of SHM on bridges and buildings, case studies of SHM in Civil/ Structural engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore the need, advantages and challenges of SHM.
- CO2: Explore the different types of sensors and instrumentation techniques.
- CO3: Gain knowledge of the static and dynamic measurement techniques.
- CO4: Compare the various damage detection techniques.
- CO5: Know the various data processing methods through case studies.

TEXT BOOKS

1. Daniel Balageas, Peter Fritzen, Alfredo Guemes, Structural Health Monitoring, John Wiley & Sons, 2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components Methods with Applications, Wiley Publishers, 2007.
3. Hua-Peng Chen, Structural Health Monitoring of Large Civil Engineering Structures, Wiley Publishers, 2018.

REFERENCE BOOKS

1. Ansari, F Karbhari, Structural health monitoring of civil infrastructure systems, V.M, Woodhead Publishing, 2009.
2. J. P. Ou, H. Li and Z. D, “Duan Structural Health Monitoring and Intelligent Infrastructure”, Vol1, Taylor and Francis Group, London, UK, 2006.
3. Victor Giurgutiu, “Structural Health Monitoring with Wafer Active Sensors”, Academic Press Inc, 2007.
4. Ravishankar K. and Krishnamoorthy T. S., “Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures”, Allied Publishers, 2004.
5. “Hand book on Seismic Retrofit of Buildings”, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.

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CO4	2	-	3	2	2	2
CO5	2	-	3	2	2	2
AVG	2	-	3	2	2	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST2305 DESIGN OF BRIDGE

LTPC

3 0 0 3

COURSE OBJECTIVES

- To understand the principles of bridge design, including site selection, classification, and standard loading as per various codes.
- To analyze and design different types of bridge superstructures and substructures.
- To apply design principles for prestressed concrete bridges and steel bridges.

UNIT I INTRODUCTION

9

Introduction-Selection of Site and Initial Decision Process - Classification of Bridges- General Features of Design- Standard Loading for Bridge Design as per different codes - Road Bridges –Railway Bridges - Design Codes - Working Stress Method- Limit State Method of Design.

UNIT II SUPERSTRUCTURES

9

Selection of main bridge parameters, design methodologies -Choices of superstructure types orthotropic plate theory, load distribution techniques - Grillage analysis - Finite element analysis Different types of superstructures (RCC and PSC); Longitudinal Analysis of Bridge – Transverse Analysis of Bridge

UNIT III BRIDGE DESIGN PRINCIPLES

9

Analysis and Design of RCC solid slab culverts -Design of RCC Tee beam and slab bridges – Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges–Design principles only.

UNIT IV SUBSTRUCTURE, BEARINGS AND DECK JOINTS

9

Design of bridge bearings and substructure.

UNIT V PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES

9

Design principles of PSC bridges – PSC girders – Design principles of steel bridges - Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the different types of bridges and design philosophies.
- CO2: Design a RC solid slab culvert bridge.
- CO3: Design a RC Tee Beam and Slab bridge.
- CO4: Design the bridge bearings and substructure.
- CO5: Explain the design principles of PSC bridges, box girder bridges, truss bridges.

TEXT BOOKS

1. Jagadeesh. T.R. and Jayaram. M.A., “Design of Bridge Structures”, Second Edition, Prentice Hall of India Pvt. Ltd. 2009.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Sixth Edition, Oxford and IBH Publishing Co. New Delhi, 2019.
3. Ponnuswamy, S., “Bridge Engineering”, Third Edition, Tata McGraw Hill, 2017.

REFERENCE BOOKS

1. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Design of Highway Bridges, Richard M. Barker & Jay A. Puckett, John Wiley & Sons, Inc., 2021.
3. Chen, W.-F., & Duan, L. (Eds.). Bridge engineering handbook, 2nd ed., 2014.
4. Richard M. Barker & Jay A. Puckett, “Design of Highway Bridges”, John Wiley & Sons Inc., 2021.
5. N. Krishna Raju, “Design of Bridges”, Fifth Edition, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, 2018.

Mapping of COs and POs

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CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

COURSE OBJECTIVES

- To understand the planning and functional requirements for industrial structures.
- To analyze and design various types of industrial buildings.
- To design foundations for critical structures such as towers, chimneys, and cooling towers.

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS**9**

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.

UNIT II INDUSTRIAL BUILDINGS**9**

Steel and RCC -Sway and non-sway frames–Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase- Earthquake resistant design of steel buildings.

UNIT III POWER PLANT STRUCTURES**9**

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures.

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS**9**

Analysis and design of transmission line towers - Sag and Tension calculations, Testing of towers – Design of self-supporting chimney, Design of Chimney bases.

UNIT V FOUNDATION**9**

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

- CO1:Develop the concept of planning & functional requirements of industrial standards.
- CO2:Analyze and design Steel Gantry girders & Crane girders and RCC design of corbels, nibs and staircase.
- CO3:Analyze & design cooling towers, bunkers, silos and pipe supporting structures.
- CO4:Analyze and design Steel transmission line towers and chimneys.
- CO5:Design foundations for cooling tower, chimneys and turbo generator.

TEXT BOOKS

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers, 2004.
2. Manohar S.N, "Tall Chimneys - Design and Construction", Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., "Transmission Line Structures", Tata McGraw Hill, 1992.

REFERENCE BOOKS

1. Srinivasulu P and Vaidyanathan.C, "Handbook of Machine Foundations", Tata McGraw Hill, 1976.
2. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: Design Manual", Birkhauser Publishers, 2004.
3. Swami Saran, "Analysis & Design of Substructures - Limit state Design", Second Edition, 2018.
4. N. Subramaniyan, "Design of Steel Structures", 2018.
5. N. Krishna Raju, "Advanced Reinforced Concrete Design", 3rd Edition, 2016.

Mapping of COs and POs

COs	POs					
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CO1	3	-	3	3	3	2
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CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, "-" – No correlation

24ST2307 TALL STRUCTURES

LT P C

3 0 0 3

COURSE OBJECTIVES

- To introduce design philosophy, loading, different types of frames, types of shear walls.
- To make students understand approximate analysis, accurate analysis and reduction techniques.
- To familiarize students with design of structural elements, buckling analysis, p delta analysis.

UNIT I LOADING AND DESIGN PRINCIPLES 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced frames, In-filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 9

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three-dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT IV STRUCTURAL ELEMENTS 9

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT V STABILITY OF TALL BUILDINGS 9

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

Since 1984

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the design philosophy, loading, different types of frames, types of shear walls.
- CO2: Explore different lateral load resisting systems.
- CO3: Explain the approximate analysis, accurate analysis and reduction techniques.
- CO4: Design structural elements in tall buildings.
- CO5: Explain translational – torsional instability.

TEXT BOOKS

1. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alex coull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.
3. Smith B. S. and Coull A., “Tall Building Structures - Analysis and Design”, John Wiley, 1991.

REFERENCE BOOKS

1. Gupta.Y.P.,(Editor), "Proceedings of National Seminar on High Rise Structures" - Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
2. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.
3. Taranath B. S., "Structural Analysis and Design of Tall Buildings", CRC Press, 2011. Sons, Inc., 2011.
4. Holmes, "Wind Loading of Structures", Third Edition, Spon Press, London, 2017.
5. Schuller W. G., "High rise building structures", John Wiley, 1977.

Mapping of COs and POs

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CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3		3	3	3	2

1-Low, 2-Medium, 3-High, "-" – No correlation

24ST2308 DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To develop an understanding of the behaviour of Steel Composite structures.
- To design concrete composite elements and structures.
- To design the Joints of steel and concrete composite structures.

UNIT I INTRODUCTION

9

Types of composite constructions - General behaviour of composite beams, slabs, columns and walls - Material properties of concrete and steel under static and fatigue loads - Codes and standards - Serviceability concepts - Fire resistance requirements and design procedure - Construction techniques.

UNIT II SHEAR CONNECTORS

9

Methods of shear connection - Properties of shear connectors - Types - Transfer of shear connector forces in concrete elements - Post-cracking dowel strength - Longitudinal force - Embedment force - Partial interaction and full interaction - Design of shear connectors.

UNIT III DESIGN OF COMPOSITE BEAMS AND SLABS

9

Moment of inertia of composite beams - Design of composite beams - Design of composite profiled slabs and decks - Design of composite beams with composite slabs - Serviceability requirements - behaviour of box girder bridges.

UNIT IV DESIGN OF COMPOSITE COLUMNS

9

Behaviour under pure axial, eccentric axial loads and moments - Short column and long columns - Axial load-moment interaction curves - Design of encased columns - Design of concrete-filled steel columns - Composite trusses.

UNIT V DESIGN OF JOINTS

9

Joint configurations - Design of beam-to-beam joints - Design of beam-to-column joints - Column bases - Design of beam and column splices - Design of simple joints and moment-resisting joints.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain properties and behaviour of steel-concrete composites.
- CO2: Design shear connectors.
- CO3: Design composite beams and slab for strength and serviceability.
- CO4: Design encased and concrete-filled composite columns for axial loads and moments.
- CO5: Design connections in composite structures.

TEXT BOOKS

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol. I, Fourth Edition, Blackwell Scientific Publications, 2018.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Revised Edition, Pergamon press, Oxford, 2013.
3. Davison B. and Owens G. W., "Steel Designers Manual", Seventh Edition, Steel Concrete Institute (UK), Wiley Black, 2016.

REFERENCE BOOKS

1. Owens. G.W and Knowles. P," Steel Designers Manual", Seventh Edition, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 2011.
2. Narayanan R, "Composite steel structures – Advances, design and construction", Elsevier, Applied science, UK, 1987.
3. Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
4. Ghosh, A. "Composite Steel and Concrete Structures", CRC Press, 2020.
5. Bhowmick, A., and Saha, P. "Design of Composite Structures", Springer, 2016.

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CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3301 ADVANCED FOUNDATION DESIGN

LT P C

3 0 0 3

COURSE OBJECTIVES

- To design various types of foundations.
- To design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions.
- To design machine foundations and special foundations.

UNIT I SHALLOW FOUNDATIONS

9

soil investigation – Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates – structural design of isolated, strip, rectangular and trapezoidal and combined footings – strap – raft foundation.

UNIT II PILE FOUNDATIONS

9

Types of Pile foundations and their applications – Load Carrying capacity – pile load test – Settlements – Group action – pile cap – structural design of piles and pile caps – undreamed pile foundation.

UNIT III WELL FOUNDATION

9

Types of well foundations – grip length – load carrying capacity – construction of wells – failure and remedies – structural design of well foundation – lateral stability.

UNIT IV MACHINE FOUNDATIONS

9

Types – General requirements and design criteria – General analysis of machine foundations-soil system – Stiffness and damping parameters – Tests for design parameters – design of foundation for reciprocating engines, impact type machines and rotary type machines.

UNIT V SPECIAL FOUNDATIONS

9

General requirements and design criteria – Foundations for towers, Chimneys and Silos – design of anchors

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1:Design shallow and deep foundations for various types of structures.
- CO2:Design piles and pile caps.
- CO3:Design well foundation for bridge piers and related structures.
- CO4:Gain knowledge on design and construction of machine foundation.
- CO5:Design foundations for bridges, towers and chimneys.

TEXT BOOKS

1. Tomlinson, M.J. and Boorman. R., Foundation Design and Construction, ELBS Longman, Seventh Edition, 2001.
2. Nayak, N.V., Foundation Design manual for Practicing Engineers, Dhanpat Rai and Sons, 2018.
3. Brain J. Bell and M.J. Smith, Reinforced Concrete Foundations, George Godwin Ltd., 1981.

REFERENCEBOOKS

1. Braja M. Das, Principles of Foundations Engineering, Eighth Edition, Thomson Asia (P) Ltd., 2017.
2. Bowels J.E., Foundation Analysis and Design, Fifth Edition, McGraw-Hill International Book Co., 2017.
3. P. C. Varghese, "Foundation Engineering", Prentice-Hall of India, New Delhi, 2005.
4. Swamy Saran, Analysis and Design of Substructures, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
5. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3		3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3302 EARTH RETAINING STRUCTURES

LT P C

3 0 0 3

COURSE OBJECTIVES

- To design retaining walls, anchored bulkheads, braced cuts, coffer dams and earth dams.
- To analyze and design rigid, flexible earth retaining structures.
- To design the anchored bulkheads and stability analysis of structures.

UNIT I LATERAL PRESSURE

9

Basic concepts, Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures: Culmann's, Rebhan's, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quake, wave effect, stratification, type of backfill, wall friction and adhesion.

UNIT II ANCHORED BULKHEADS

9

Classification of anchored bulkheads, free and fixed earth support methods. Rowe's theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods and dead man Braced cuts and Cofferdams: Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams: uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils.

UNIT III EARTH DAMS- STABILITY ANALYSIS

9

Classification, seepage control in embankments and foundations, seepage analysis, stability analysis: upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishop's method.

UNIT IV EARTH DAMS -PROTECTION & CONSTRUCTION

9

Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.

UNIT V RETAINING WALLS

9

Different types of Retaining Walls, Proportioning the retaining walls, determining the Lateral earth pressure on Retaining walls, Perform the Stability checks: overturning, sliding, bearing capacity, and settlement, Design the Cantilever and counterfort retaining walls, Provision of joints in retaining wall construction, the drainage of walls from backfill. Special types of retaining walls – Gabion walls.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1:Explore lateral earth pressure theories and pressure theories.

CO2:Design anchored bulkheads by different methods.

CO3:Explain pressure envelopes and design of various components in braced cuts and cofferdams.

CO4:Explore stability of earth dams and its protection and construction.

CO5:Design of retaining walls.

TEXT BOOKS

1. W.C. Huntington, Earth pressure on retaining walls, Literary Licensing, 2013.
2. J.E. Bowles, Foundation Analysis and Design, McGraw Hill, 2001.
3. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.

REFERENCE BOOKS

1. C.J.F.P. Jones, Earth Reinforcements and Soil structures, Thomas Telford Ltd, 1996.
2. S. Prakash, G. Ranjan & S. Swaran, Analysis & Design of Foundations & Retaining Structures, Sarita Prakashan, 1979.
3. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, Galgotia Book source, 2000.
4. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
5. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, Prentice Hall, 2002.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	2
CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3303 DESIGN OF OFFSHORE STRUCTURES

L T P C
3 0 0 3

COURSE OBJECTIVES

- To impart knowledge about the concept of Wave Theories, Forces, Offshore Foundation, Analysis and Design of Jacket Towers, Pipes and Cables.
- To understand the demand for coastal and offshore structures.
- To be familiar with the problems associated with the material behavior in marine environment and various protection methods.

UNIT I INTRODUCTION TO OFFSHORE ENVIRONMENT

7

Ocean winds - Waves - Wave parameters - Introduction to Airy's wave theory and its applications - Brief introduction about ocean currents - Tides, ice-sea interactions - Need for offshore structures - Introduction to environmental loads - Wind, wave, current and ice loads - Introduction to API and DNV code provisions.

UNIT II TYPES AND COMPONENTS OF OFFSHORE STRUCTURES

6

Types of offshore structures - Functional and structural requirements of an offshore platform - Components of a fixed jacket steel platform, steel jack-up platform, concrete gravity platform, semisubmersible platform and ship structures.

UNIT III LOADS ON OFFSHORE STRUCTURES

8

Wind Loads; Wave and Current Loads; Calculation based on Maximum base, Shear and Overturning Moments; Design Wave heights and Spectral, Definition; Hydrodynamic Coefficients and Marine growth; Fatigue Load, Definition and Joint Probability distribution; Seismic Loads.

UNIT IV ANALYSIS AND DESIGN OF JACKET PLATFORMS

12

Design considerations - Codes and provisions - Typical preliminary design - Minimum embedment length of piles (of columns) - Top deck analysis for imposed loads - Analysis and design of deck framing members - Truss structures in the top deck - Reassessing sufficiency of

vertical column below the top deck - Tubular members in jacket structure - Miscellaneous considerations for jacket platform.

UNIT V ANALYSIS AND DESIGN OF CONCRETE GRAVITY PLATFORMS 12

Introduction and design environmental conditions - Analysis and design aspects of gravity platform - Salient features to be considered in analysis and design - Bearing capacities of gravity platform foundation - Requirements in design - Drained and undrained bearing capacity of foundation soil - Sliding resistance of foundation soil - Analysis and design of gravity platform subjected to wind and wave loads - Assumptions made in simplified analysis - Additional considerations for dynamic behavior of platform components.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Develop the concept of wave theories.
- CO2: Apply the knowledge of wave forces and offshore structures.
- CO3: Explain the modeling for offshore structure and its foundation.
- CO4: Analyze offshore structures by means of static and dynamic methods.
- CO5: Design of jacket towers, mooring cables and pipelines.

TEXT BOOKS

1. Graff W. J., "Introduction to Offshore Structures", Gulf Publ. Co., 1981.
2. Dawson T. H., "Offshore Structural Engineering", Prentice Hall, 1983.
3. B. C. Gerwick Jr., "Construction of Marine and Offshore Structures", CRC Press, Florida, 2000.

REFERENCE BOOKS

1. Reddy D. V. and Arockiasamy M., "Offshore Structures" Vol. 1 & 2, Kreiger Publ. Co., 1991.
2. Morgan N., "Marine Technology Reference Book", Butterworths, 1990.
3. McClelland B. and Reifel M. D., "Planning and Design of fixed Offshore Platforms", Van Nostrand, 1986.
4. "PI RP 2A - Planning, Designing and Constructing Fixed Offshore Platforms", API, 2000.
5. Clauss G., Lehmann E. and Ostergaard C., "Offshore Structures", Vol. 1 & 2, Springer-Verlag, 1992.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
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CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
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AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, “-” – No correlation

24ST3304 SOIL STRUCTURE INTERACTION

LTPC
3 0 0 3

COURSE OBJECTIVES

- To make students understand soil foundation interaction and its importance.
- To study the concept of soil-structure – interaction in the analysis and design of structures.
- To expose students to beams and plates on elastic foundation.

UNIT I INTRODUCTION

9

Nature and complexities of Soil-Structure Interaction (SSI) problems - Critical study on conventional foundation design - Effect on structural analysis with SSI.

UNIT II TECHNIQUES OF ANALYSIS

9

Advanced techniques of analysis - Finite element method - Finite differences - Relaxation and interaction for SSI for different types of structures and for various soil conditions.

UNIT III APPLICATION OF SSI

9

Theory of sub grade reaction - Beams, footings, bulkheads - Shallow foundation - Deep foundation -Grouping of piles and its effects - Effect of soil layer on SSI analysis.

UNIT IV STRUCTURAL ANALYSIS WITH SSI

9

Analysis of different types of framed structures founded in stratified natural deposits – Determination of stiffness and damping parameters of soil.

UNIT V PRACTICAL APPLICATION

9

Modeling, analysis and design of building - Real time problem analysis - Case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the concept of soil structure interaction.
- CO2: Do a static analysis of infinite and finite beams resting on elastic foundation.
- CO3: Analyze finite thin and thick plates.
- CO4: Do a static and dynamic analysis of soil structure interaction problems.
- CO5: Analyze ground foundation and structure interaction problems.

TEXT BOOKS

1. John P. Wolf, "Soil-Structure Interaction", Prentice Hall, 1987.
2. Bowels J. E., "Analytical and Computer methods in Foundation", McGraw Hill Book Co., New York, 1974.
3. Desai C. S. and Christian J. T., "Numerical Methods in Geotechnical Engineering", McGraw Hill, Book Co., New York, 1977.

REFERENCE BOOKS

1. "Soil Structure Interaction, The Real Behavior of Structures", Institution of Structural Engineers, 1989.
2. A. P. S. Selvadurai, "Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg. Vol - 17", Elsevier Scientific Publishing Co., 1979.
3. Prakash S. and Sharma H. D., "Pile Foundations in Engineering Practice", John Wiley & Sons, New York, 1990.
4. J. W. Bull, Soil-Structure Interaction: Numerical Analysis and Modelling, CRC Press, 1st Edition, 1994.
5. Chandrakant S. Desai, Musharraf Zaman, Advanced Geotechnical Engineering: Soil Structure Interaction using Computer and Material Models, CRC Press, 2013.

Mapping of COs and POs

COs	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
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CO2	3	-	3	3	3	2
CO3	3	-	3	3	3	2
CO4	3	-	3	3	3	2
CO5	3	-	3	3	3	2
AVG	3	-	3	3	3	2

1-Low, 2-Medium, 3-High, "-" – No correlation

COURSE OBJECTIVES:

- To introduce the concept and significance of Green Supply Chain Management.
- To equip learners with the knowledge of environmental management practices.
- To develop analytical and strategic skills.

UNIT I INTRODUCTION**9**

Concept and importance of Green Supply Chain Management - Evolution of GSCM: Traditional Supply Chains vs. Green Supply Chains. Environmental Impact, Key Drivers and Challenges in GSCM. Green Procurement and Eco-friendly Sourcing - Life Cycle Assessment (LCA) and its role in GSCM.

UNIT II ENVIRONMENTAL MANAGEMENT IN SUPPLY CHAIN**9**

Environmental Policies and Regulations Impacting Supply Chains - Green Manufacturing. Role of Technology and Innovation in Reducing Environmental Footprints - Eco-labeling and Certifications in Supply Chains - Reverse Logistics and Recycling - Waste Management and Circular Economy Principles - Carbon Footprint Calculation and Reduction Strategies in SCM.

UNIT III GREEN LOGISTICS AND TRANSPORTATION MANAGEMENT**9**

Sustainable Transportation Practices and Eco-friendly Logistics - Green Packaging: Materials, Design, and Processes - Optimizing Distribution and Transportation Networks for Sustainability - Carbon Emissions in Logistics - Energy Efficiency in Transportation - Role of ICT in Greening Transportation Networks - Urban Logistics and Green Infrastructure.

UNIT IV SUSTAINABLE SUPPLY CHAIN DESIGN AND STRATEGY**9**

Sustainable Supply Chain Network Design - Supplier Selection and Collaboration for Sustainability. Risk Management - Sustainable Product Design and Eco-innovation. Green Supply Chain Metrics and Performance Indicators - Integration of Environmental and Social Considerations into SCM Strategy - Case Studies.

UNIT V GREEN SUPPLY CHAIN ANALYTICS AND PERFORMANCE MANAGEMENT**9**

Data Analytics for Green Supply Chain Management - Tools and Techniques for Evaluating Sustainability in SCM - Environmental and Economic Performance Evaluation in GSCM - Benchmarking and Best Practices in Green SCM - Use of Green Certifications and Standards for Supply Chain Performance - Reporting and Communicating Sustainability in the Supply Chain - Challenges in Monitoring and Managing Green Supply Chains.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

On successful completion of this course, the students will be able to

- CO1: Explain the key drivers, challenges, and environmental policies.

- CO2: Apply green procurement strategies and life cycle assessment.
 CO3: Implement sustainable practices in logistics and transportation.
 CO4: Design and manage sustainable supply chain networks.
 CO5: Analyze and monitor green supply chain performance.

TEXT BOOKS

1. Wang, Hsiao-Fan & Gupta, Surendra M. Green Supply Chain Management: Product Life Cycle Approach, McGraw-Hill Professional, 2011.
2. Sarkis, Joseph & Dou, Yijie, Green Supply Chain Management: A Concise Introduction, Routledge, 2017.
3. Khan, Mehmood; Hussain, Matloub; Ajmal, Mian M. Green Supply Chain Management for Sustainable Business Practice, IGI Global, 2017.

REFERENCE BOOKS

1. Johnsen, Thomas E.; Howard, Mickey; Miemczyk, Joe, Purchasing and Supply Chain Management: A Sustainability Perspective, Routledge, 2018.
2. Bouchery, Yann; Corbett, Charles J.; Fransoo, Jan C.; Tan, Sustainable Supply Chains: A Research-Based Textbook on Operations and Strategy Springer, 2017.
3. Khan, Syed Abdul Rehman (Ed.), Green Practices and Strategies in Supply Chain Management, Intech Open, 2019.
4. Esty, Daniel C.; Winston, Andrew S. Yale University Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage, Press, 2006.
5. Sarkis, Joseph (Ed.), Handbook of Green Supply Chain Management, CRC Press, 2012.

24OEMF02 RENEWABLE ENERGY TECHNOLOGIES

L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals and classification of renewable energy sources, their environmental impact, and the current scenario in India.
- To analyze the working principles and characteristics of solar photovoltaic and wind energy systems, including system design and performance factors.
- To explore various alternative renewable energy technologies such as biomass, ocean, hydrogen, fuel cells, and geothermal systems.

UNIT I INTRODUCTION

9

Classification of energy sources – Co2 Emission - Features of Renewable energy – Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

9

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III PHOTOVOLTAIC SYSTEM DESIGN

9

Block diagram of solar photo voltaic system : Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

9

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES

9

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources.

TEXT BOOKS

1. S.N.Bhadra, D. Kasta, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.

REFERENCE BOOKS

1. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
2. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
3. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
4. Fang Lin Luo Hong Ye, "Renewable Energy systems", Taylor & Francis Group,2013
5. Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

24OEMF03 MEDICAL ROBOTICS

L T P C

3 0 0 3

COURSE OBJECTIVES

- Identify and describe different types of medical robots and their potential applications.
- Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image guided interventions.

UNIT I INTRODUCTION

9

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics – Stateof art of robotics in the field of healthcare-DICOM.

UNIT II LOCALIZATION AND TRACKING

9

Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems.

UNIT III DESIGN OF MEDICAL ROBOTS

9

Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.

UNIT IV SURGICAL ROBOTICS

9

Minimally invasive surgery and robotic integration - surgical robotic sub systems – synergistic control - Control Modes - Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies.

UNIT V ROBOTS I REHABILITATION AND MEDICAL CARE

9

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots – Robots in Physiotherapy - case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Identify various medical robots and their potential applications.

CO2: Recognize the position tracking and hybrid systems.

CO3: Apply Robotics and its concepts in Medical field.

CO4: Simulate a MIS procedure and be aware of the state of art in surgical and oncology robotics.

CO5: Design a medical robotic system given the specific requirements for Rehabilitation and medical care.

TEXT BOOKS

1. Achim Ernst Floris Schweikard, "Medical Robotics", Springer, 2016.
2. Paula Gomes, "Medical robotics Minimally invasive surgery", Woodhead, 2013.
3. Russell H. Taylor, Paolo Dario, Gabor Fichtinger, "Medical Robotics", Springer, 2022.

REFERENCE BOOKS

1. Jaydev P Desai, Rajni V Patel, Antoine Ferreira; Sunil Kumar Agrawal, "The
2. Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt. Ltd, 2019.
3. Jocelyne Troccaz , "Medical Robotics", John Wiley & Sons Incorporated, 2013.
4. Vanja Bonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.
5. Farid Gharagozloo "Robotic Surgery", Springer, 2022.

24OEMF04 TEXTILE REINFORCED COMPOSITES

L T P C

3 0 0 3

COURSE OBJECTIVES:

- Describe the role and properties of reinforcements in composite materials.
- Explain the difference between thermoset and thermoplastic matrices in composites.
- List and briefly explain two mechanical tests used for evaluating composite materials.

UNIT I REINFORCEMENTS

9

Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites.

UNIT II MATRICES

9

Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices.

UNIT III COMPOSITE MANUFACTURING

9

Classification; methods of composites manufacturing for both thermoplastics and hermosets Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding,

pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements.



UNIT IV TESTING 9

Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS 9

Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical Lamination theory, failure theories and prediction of inter laminar stresses using at ware.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the different types of textile reinforcements.
- CO2: Explain the different types of matrices.
- CO3: Explore the manufacturing of composites.
- CO4: Evaluation of the properties of thermoset and thermoplastic composite.
- CO5: Explore the mechanics of composites failure.

TEXT BOOKS

1. Bor Z.Jang, "Advanced Polymer composites", ASM International, USA, 1994.
2. Carlsson L.A. and Pipes R.B., "Experimental Characterization of advanced composite Materials", Second Edition, CRC Press, New Jersey, 1996.
3. K. K. Chawla, "Composite Materials: Science and Engineering", Springer, 2012.

REFERENCE BOOKS

1. George Lubin and Stanley T. Peters, "Handbook of Composites", Springer Publications, 1998.
2. Mel. M. Schwartz, "Composite Materials", Vol. 1 & 2, Prentice Hall PTR, New Jersey, 1997.
3. Richard M. Christensen, "Mechanics of composite materials", Dover Publications, 2005.
4. Sanjay K. Mazumdar, "Composites Manufacturing: Materials, Product, and Process Engineering", CRC Press, 2001.
5. Autar K. Kaw, "Mechanics of Composite Materials", CRC Press, 2005.

24OEMF05 NANO COMPOSITE MATERIALS

L T P C

3 0 0 3

COURSE OBJECTIVES

- To explore the difficulties, fabrication technologies and properties of nano composite materials.
- To gain knowledge on Nano materials.
- To get familiarize in synthesis of nano materials.

UNIT I CERAMIC-BASED NANOCOMPOSITES **9**

Composites – nomenclature, properties; classification of ceramic nanocomposites; challenges with bulk nanoceramics/Nano ceramic composites; problems associated with synthesis of nano size powders – chemical /physical methods of synthesis of nano scaled ceramic powders, challenges posed by the typical properties of nano scaled powders, Challenges faced during processing/ sintering; various processing techniques, spark plasma sintering; properties of nanoceramics – hardness, tensile; super plasticity – superplastic forming applications; superhard nanocomposites – properties, bottle neck, industrial applications.

UNIT II METAL-BASED NANOCOMPOSITES **9**

Processing of metal-matrix nanocomposites – liquid metallurgy processing techniques, thermal spray techniques, cold spray, powder metallurgy (PM) techniques, difficulties, applications of metal matrix nanocomposites – Cu–Ni alloy nanocomposites, magnesium metal–matrix nanocomposites- implants, titanium nanocomposites; fractal-based glass-metal nanocomposites, its designing and fractal dimension analysis; core–shell structured nanocomposites; bio-medical imaging, environmental remediation applications, semiconductor core–shell nanomaterials, heterojunction photo catalyst.

UNIT III POLYMER-BASED NANOCOMPOSITES **9**

Block copolymer nanocomposites – features, advantage over homopolymer composites; fundamentals of block copolymer; nanoparticle co-assembly; particle–polymer enthalpic interactions; particle surface chemistry – grafting suitable polymeric ligands, entropic interactions, mechanism of nanoparticle incorporation; applications of block copolymers nanocomposites – Textile fabric, bulk heterojunction (BHJ) organic photovoltaic (solar cell) devices, drug delivery; polymer and carbon nanotube–based composites, their mechanical properties, and industrial possibilities.

UNIT IV BIOMEDICAL NANOCOMPOSITES **9**

Natural nanocomposite systems – spider silk, bones, shells; ceramic nanocomposites – biomedical applications; toughening mechanisms; alumina and zirconia ceramics, alumina–zirconia nanocomposites; tooth nanocomposites and dental implants; organic–inorganic nanocomposite formation through self-assembly; biomimetic synthesis of nanocomposites material.

UNIT V NANOCOMPOSITE TECHNOLOGY **9**

Nanocomposite membrane structures – preparation and applications; nanotechnology in textiles and cosmetics; nano-fillers embedded polypropylene fibers – soil repellency, lotus effect; nano finishing in textiles (UV resistant, anti-bacterial, hydrophilic, self-cleaning, flame-retardant finishes); sun-screen dispersions for UV protection using titanium oxide – colour cosmetics; nanotechnology in food technology – nanopackaging for enhanced shelf life, smart/intelligent packaging.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the fabrication technologies, properties and drawbacks of ceramic nanocomposites.
- CO2: Explain the fabrication technologies, properties and drawbacks of metal matrix nanocomposites.
- CO3: Explain the fabrication technologies, properties and drawbacks of block copolymer Nano composites.
- CO4: Comprehend biomimicry and evaluate them in load bearing arena for bone tissue engineering.
- CO5: Design nanocomposite materials for engineering applications.

TEXT BOOKS

1. Twardowski T.E., "Introduction to nanocomposite materials: properties, processing, characterization", DES Tech Publications, USA, 2007.
2. Ajayan P.M., Schadler L.S. and Braun P.V., "Nanocomposites science and technology", 2006.
3. Tsuji, Nobuo, "Nano Structured Metals and Alloys: Processing, Microstructure, Mechanical Properties and Applications", Woodhead Publishing, 2011.

REFERENCE BOOKS

1. Sadasivuni K.K., Ponnamma D., Rajan M., Ahmed B. and Al-Maadeed M.A.S.A., "Polymer nanocomposites in biomedical engineering", Springer Nature, Switzerland, 2019.
2. Basu B. and Balani K., "Advanced structural ceramics", John Wiley & Sons, 2011.
3. Brown P. and Stevens K., "Nanofibers and nanotechnology in textiles", Woodhead publication, London, 2006.
4. Rakesh K. Gupta, "Polymer and Composite Nanotechnology: Synthesis and Applications", DEStech Publications, 2012.
5. Sabu Thomas, Shaijumon Manayil Jacob, Deepalekshmi Ponnamma, "Nanocomposite Materials: Synthesis, Properties and Applications", Wiley-VCH, 2020.

24OEMF06 NEW PRODUCT DESIGN AND DEVELOPMENT

**L T P C
3 0 0 3**

COURSE OBJECTIVE

- The course aims at providing the basic concepts of product design, product features.
- Architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To gain knowledge for business opportunity.

UNIT I INTRODUCTION

9

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION

9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE

9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN

9

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the strategic significance of product development and the integration of customer, designer, supplier, and process planner in IPPD.
- CO2: Apply structured methods to generate, explore, and evaluate innovative product concepts effectively.
- CO3: Analyze product architecture and its impact on design, manufacturability, variety, and system-level interactions.

CO4: Evaluate the role of industrial design in product development, integrating tools and customer needs to enhance usability and performance.

CO5: Demonstrate principles of design for manufacturing, cost estimation, prototyping, and economic analysis to ensure efficient product development.

TEXT BOOK

1. Kari T. Ulrich and Steven D. Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.
2. Kevin Otto, Kristin Wood, "Product Design: Techniques in Reverse Engineering and New Product Development", Pearson Education, 2001.
3. Anil Mital, Anoop Desai, Anand Subramanian, Aashi Mital, "Product Development: A Structured Approach to Design and Manufacture", Elsevier, 2008.

REFERENCE BOOKS

1. Kenneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Stuart Pugh, "Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New York, NY.
4. Michael Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", Wiley, 2015.
5. Don Norman, "The Design of Everyday Things", Basic Books, 2013.

240EVL01 VLSI ARCHITECTURE FOR IMAGE PROCESSING

L T P C
3 0 0 3

COURSE OBJECTIVES

- The students will be able to acquire knowledge on image and video processing algorithms.
- The students will be able to acquire knowledge on design of VLSI architectures.
- To enhance the knowledge on the concepts of image processing.

UNIT I IMAGE PROCESSING ALGORITHMS AND ARCHITECTURES 9

Image Processing Tasks - Low Level Image Processing Operations - Intermediate Level Operations Image Processor Architecture: Requirements and Classification - Uni and Multi Processors - MIMD Systems - SIMD Systems - Pipelines - Design Aspects of Real Time Low Level Image Processors - Design Method for Special Architectures.

UNIT II 3D IMAGE PROCESSING 9

Overview of 3D Image - Types and Characteristics of 3D Image Processing - Examples of 3D Image Processing, Continuous and Digitized Images, Models of Image Operations, Algorithm of Image Operations - Smoothing Filter - Difference Filter - Differential Features of a Curved Surface - Region Growing.

UNIT III 3D BINARY IMAGE PROCESSING 9

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with powerof-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV PIPELINED, 2D AND 3D IMAGE PROCESSING ARCHITECTURES 9

Architecture of a Cellular Logic Processing Element - Second Decomposition in Data Path and Control - Real Time Pipeline for Low Level Image Processing - Design Aspects of Image Processing Architectures - Implementation of Low Level 2D and 3D and Intermediate Level Algorithms

UNIT V VLSI SYSTEMS FOR IMAGE PROCESSING 9

Concurrent Systems for Image Analysis- VLSI Wavefront Arrays for Image Processing-Curve Detection in VLSI-Design of VLSI Based Multicomputer Architecture for Dynamic Scene Analysis VLSI-Based Image Resampling for Electronic Publishing.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Analyze Various Architectures to Realize Image Processing Algorithms and Explain The 3D Image Processing Algorithms.
- CO2: Explore Various Processing Techniques of Image and Design Different Architectures for Image Processing.
- CO3: Analyze various pipelined hardware architecture for 2D and 3D Image processing.
- CO4: Realize binary image processing algorithm in VLSI systems.
- CO5: Implement filter techniques in 2D and 3D image.

TEXT BOOKS

1. Pieter Jonker, "Morphological Image Processing: Architecture and VLSI Design", Springer, First Edition, 1992.
2. Junichiro Toriwaki · Hiroyuki Yoshida, "Fundamentals of Three-Dimensional Digital Image Processing", Springer 2009.
3. King-Sun Fu, "VLSI for Pattern Recognition and Image Processing", Springer-Verlag, 1984.

REFERENCE BOOKS

1. U. Meyer – Baese, “Digital Signal Processing with Field Programmable Gate Arrays”, Springer, 2nd Edition, 2004.
2. J.G. Proakis and D.G. Manolakis, Digital Signal Processing, Third Edition, Prentice Hall,2007.
3. Jose E. France, YannisTsvividls, Design of Analog Digital VLSI Circuits for Telecommunications and Signal Processing’ Prentice Hall, 1994.

4. Mohammed Ismail, Terri, Fiez, Analog VLSI Signal and Information Processing, McGraw Hill, 1994.
5. Kung. S.Y., H.J. While house T.Kailath, VLSI and Modern signal processing, Prentice Hall, 1985.

240EVL02 DATA ACQUISITION

L T P C

3 0 0 3

COURSE OBJECTIVES

- To teach Learn to develop Hadoop applications for storing processing and analyzing data stored in Hadoop cluster.
- To Understand the complexity and volume of Big Data and their challenges.
- To comprehend the necessity for pre-processing Big Data and their issues.

UNIT I INTRODUCTION TO BIG DATA ACQUISITION

9

Big data framework – fundamental concepts of Big Data Management and analytics – Current challenges and trends in Big Data Acquisition. Anatomy of File Write and Read, Name Node, Secondary Name Node, and Data Node - Hadoop Configuration – Pig Configuration – Hive Configuration - HBase Configuration.

UNIT II DATA COLLECTION AND TRANSMISSION

9

Big data collection – Strategies – Types of Data Sources – Structured Vs Unstructured data – ELT vs ETL – storage infrastructure requirements – Collection methods – Log files – sensors – Methods for acquiring network data (Libcap-based and zero-copy packet capture technology) – Specialized network monitoring softwares (Wireshark, Smartsniff and Winnetcap) – Mobile equipments, Transmission methods, Issues.

UNIT III PIG FEATURES

9

Introduction - Pig features - Pig Architecture - Pig Execution modes, Pig Grunt shell and Shell commands. Pig Latin Basics: Data model, Data Types, Operators - Pig Latin Commands - Load & Store, Filtering, Sorting, Splitting - Built-In Functions, User define functions. Pig Execution Modes: Batch Mode – Embedded Mode – Pig Execution in Batch Mode –Use cases - Map Reduce programs with Pig – Pig Vs SQL.

UNIT IV HIVE FEATURES

9

Introduction - Hive Features - Hive architecture -Hive Meta store - Hive data types - Hive Tables - Table types - Creating database, Altering database, Create table, alter table, Drop table, Built-In Functions - Built-In Operators, User defined functions(UDFs), View, Pig Vs Hive.

UNIT V HBASE FEATURES

9

HBasics, Features of HBase, Concepts, Clients, Example, Hbase Versus RDBMS, Limitations of HBase Big Data Privacy And Applications: Data Masking – Privately identified Information (PII) – Privacy preservation in Big Data – Popular Big Data Techniques and tools – Applications- Social Media Analytics – Fraud Detection.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to:

CO1: study the various sources of Big Data.

CO2: Collect and store Big Data from various sources.

CO3: Write Pig Scripts- Extract, Transform and Load the data on HDFS.

CO4: Write Hive Scripts- Extract, Transform, Load and Analyse the data present in HDFS.

CO5: Write scripts to extract data from structured and un-structured data for analytics.

TEXT BOOKS

1. Raj. Pethuru “ Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global..
2. M. Pelgrom, “Analog-to-Digital Conversion”, Springer, 2010.
3. Rudy Van De Plassche, “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters” Kluwer Academic Publishers, Boston, 2003.

REFERENCE BOOKS

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, John Wiley & Sons, 2014.
2. Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
3. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
4. Min Chen. Shiwen Mao, Yin Zhang. Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.
5. Michael Minelli, Michele Chambers Ambiga Dhiraj, “Big Data, Big Analytics : Emerging Business Intelligence and Analytic Trends”, John Wiley & Sons, 2013.

24OEV L03 ADVANCED VLSI DESIGN

L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand MOS transistor fabrication processes.
- To have an exposure to the design rules to be followed for drawing the layout of circuits.
- To have a knowledge of the testing processes of CMOS circuits.

UNIT I INTRODUCTION

9

Brief Introduction to IC technology MOS, PMOS, NMOS, CMOS & BiCMOS Technologies.

UNIT II VLSI CIRCUIT DESIGN PROCESSES

9

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Lambda(λ)-based design rules for wires, contacts and Transistors, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III GATE LEVEL DESIGN

9

Logic gates and other complex gates, Switch logic, Alternate gate circuits. Sheet Resistance R_s and its concepts to MOS, Area Capacitances calculations, Inverter Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out.

UNIT IV SUBSYSTEM DESIGN

9

Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Counters. Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices, parameters influencing low power design.

UNIT V CMOS TESTING

9

CMOS Testing, Need for Testing, Test Principles, Design Strategies for Test, Chip Level and Board Level Test Techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Use various VLSI design MOS transistor fabrication methodologies.
- CO2: Explain the basic circuit concepts.
- CO3: Develop algorithms for partitioning and placement.
- CO4: Design of building blocks using different approaches.
- CO5: Design and testing processes of CMOS circuits.

TEXT BOOKS

1. Sabih H. Gerez, "Algorithms for VLSI Design Automation", Second Edition, Wiley-India, 2017.
2. Naveed a. Sherwani, "Algorithms for VLSI Physical Design Automation", 3rd Edition, Springer, 2017.
3. Essentials of VLSI Circuits and Systems, Kamran Eshraghian, Eshraghian Douglas, A. Pucknell, 2005, PHI..

REFERENCE BOOKS

1. Charles J. Alpert, Dinesh P. Mehta and Sachin S Sapatnekar, "Handbook of Algorithms for Physical Design Automation, CRC Press, 1st Edition,
2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

3. Ramachandran, “Digital VLSI systems design”, Springer, 2007.
4. M. Sarrafzadeh and C.K. Wong, An introduction to physical design, McGraw Hill, 1996.
5. J. Bhasker, Verilog VHDL synthesis: a practical primer, B S Publications, 1998.

24OEVL04 EMBEDDED SYSTEM DESIGN

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the design challenges in embedded systems.
- To understand the bus structures and protocols.
- To design a real time embedded system.

UNIT I EMBEDDED SYSTEM OVERVIEW

9

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Components, Optimizing Custom Single-Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR

9

Basic Architecture, Pipelining, Superscalar and VLIW Architectures, Programmer’s View, Development Environment, Application-Specific Instruction-Set Processors (ASIPS) Microcontrollers, Timers, Counters and Watchdog Timer, UART, LCD Controllers and Analog-to- Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES

9

Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus - based I/O, Arbitration, Serial Protocols, I2C, CAN and USB, Parallel Protocols – PCI and ARM bus, Wireless Protocols – IRDA, Bluetooth, IEEE 802.11.

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS

9

Basic State Machine Model, Finite-State Machine with Data path Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, RTOS – System design using RTOS.

UNIT V SYSTEM DESIGN

9

Burglar alarm system-Design goals -Development strategy-Software development-Relevance to more complex designs- Need for emulation -Digital echo unit-Creating echo and reverb-Design requirements-Designing the codecs -The overall system design

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Use different protocols.
- CO2: Apply state machine techniques and design process models.
- CO3: Apply knowledge of embedded software development tools and RTOS.
- CO4: Apply networking principles in embedded devices.
- CO5: Design suitable embedded systems for real world applications.

TEXT BOOKS

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, the Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.
2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.
3. Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.

REFERENCES BOOKS

1. Frank Vahid and Tony Gwargie, “Embedded System Design”, John Wiley & Sons, 2009.
2. Steve Heath, “Embedded System Design”, Elsevier, Second Edition, 2004.
3. Bruce Powel Douglas, “Real Time UML, Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 2004, Pearson Education.
4. Daniel W. Lewis, “Fundamentals of Embedded Software where C and Assembly Meet”, Pearson Education, 2004.
5. Bruce Powel Douglas, “Real Time UML; Second Edition: Developing Efficient Objects for Embedded Systems”, 3rd Edition 1999, Pearson Education.

2240EVL05 SYSTEM ON CHIP

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce architecture and design concepts underlying system on chips.
- Students can gain knowledge of designing SoCs.
- To impart knowledge about the hardware-software design of a modest complexity chip all the way from specifications, modeling, synthesis and physical design.

UNIT I SYSTEM ARCHITECTURE: OVERVIEW

9

Components of the system – Processor architectures – Memory and addressing – system level inter connection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II PROCESSOR SELECTION FOR SOC

9

Overview – soft processors, processor core selection. Basic concepts – instruction set, branches, interrupts and exceptions. Basic elements in instruction handling – Minimizing pipeline delays – reducing the cost of branches – Robust processors – Vector processors, VLIW processors, Superscalar processors.

UNIT II MEMORY DESIGN

9

SoC external memory, SoC internal memory, Scratch pads and cache memory – cache organization and write policies – strategies for line replacement at miss time – split I- and Dcaches – multilevel caches – SoC memory systems – board based memory systems – simpleprocessor/memory interaction.

UNIT IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION

9

Bus architectures – SoC standard buses – AMBA, CoreConnect – Processor customization approaches – Reconfigurable technologies – mapping designs onto reconfigurable devices - FPGA based design – Architecture of FPGA, FPGA interconnect technology, FPGA memory, Floor plan and routing.

UNIT V FPGA BASED EMBEDDED PROCESSOR

9

Hardware software task partitioning – FPGA fabric Immersed Processors – Soft Processors and Hard Processors – Tool flow for Hardware/Software Co-design – Interfacing Processor with memory and peripherals – Types of On-chip interfaces – Wishbone interface, Avalon Switch Matrix, OPB Bus Interface, Creating a Customized Microcontroller - FPGA-based Signal Interfacing and Conditioning.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to :

- CO1: Explain all important components of a System-on-Chip and an embedded system.
- CO2: Digital hardware and embedded software.
- CO3: Outline the major design flows for digital hardware and embedded software.
- CO4: Discuss the major architectures and trade-offs concerning performance.
- CO5: Consumption of single chip and embedded systems.

TEXT BOOKS

1. ChrysostoMOSnicopoulos, Vijaykrishnan Narayanan, Chita R.Das” System-On - Chip“ Architectures Holistic Design Exploration”, Springer.
2. Wayne Wolf, —Modern VLSI Design – System – on – Chip Design, Prentice Hall, 3rd Edition, 2008.
3. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008.

REFERENCES BOOKS

1. F Wayne Wolf, “Modern VLSI Design – System – on – Chip Design”, Prentice Hall, 3rd Edition, 2008.
2. Wayne Wolf , “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008.
3. Konstantinos Tatas and Kostas Siozios "Designing 2D and 3D Network-On-Chip, Architectures" 2013.
4. Palesi, Maurizio, Daneshtalab, Masoud “Routing Algorithms in System-On-Chip” 2014.
5. Fayezegebali, Haythamelmiligi, Hqhahedwatheq El-Kharashi “On-Chips Theory and Practice CRC Press.

240EVL06 WIRELESS SENSOR NETWORKS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To enable the student to understand the role of sensors and the networking of sensed data for different applications.
- To expose the students to the sensor node essentials and the architectural details.
- To enable the student to understand the challenges in synchronization and localization of sensor nodes.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS

9

Challenges for wireless sensor networks-characteristics requirements-required mechanisms, difference between mobile ad-hoc and sensor networks, applications of sensor networks- case study, enabling technologies for wireless sensor networks.

UNIT II ARCHITECTURES

9

Single-node architecture - hardware components, energy consumption of sensor nodes, operating systems and execution environments, network architecture - sensor network scenarios, optimization goals and figures of merit, gateway concepts. Physical layer and transceiver design considerations.

UNIT III MAC AND ROUTING

9

MAC protocols for wireless sensor networks, IEEE 802.15.4, Zigbee, low duty cycle protocols and wakeup concepts - s-MAC , the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols- energy- efficient routing, geographic routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT

9

Topology control, clustering, time synchronization, localization and positioning, sensor tasking and control.

UNIT V DATA MANAGEMENT AND SECURITY

9

Data management in WSN, storage and indexing in sensor networks, query processing in sensor, data aggregation, directed diffusion, tiny aggregation, greedy aggregation, security in

WSN, security protocols for sensor networks, secure charging and rewarding scheme, secure event and event boundary detection.

TOTAL:45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Design and implement simple wireless network concepts.
- CO2: Design, analyze and implement different network architectures.
- CO3: Implement MAC layer and routing protocols.
- CO4: Deal with timing and control issues in wireless sensor networks.
- CO5: Analyze and design secured wireless sensor networks.

TEXT BOOKS

1. C. Siva Ram Murthy and B. S. Manoj, —Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004.
2. Feng Zhao, Leonidas Guibas, —Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004.
3. Charles E. Perkins, —Ad Hoc Networking, Addison Wesley, 2000.

REFERENCES BOOKS

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Erdal Çayirci , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks-S Technology, Protocols, and Applications”, John Wiley, 2007.
4. Yingshu Li, My T. Thai, Weili Wu, “Wireless Sensor Networks and Applications”, Springer, 2008.
5. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, —Wireless sensor networks: a survey, computer networks, Elsevier, 2002, 394 - 422.

24OEPE01 ELECTRIC VEHICLE TECHNOLOGY

L T P C

3 0 0 3

COURSE OBJECTIVES

- To explain the architecture and social importance of Electric Vehicles.
- To develop the knowledge about batteries used in Electric Vehicles.
- To design the motor and converters for Electric Vehicles.

UNIT I NEED FOR ELECTRIC VEHICLES

9

History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges.

UNIT II ELECTRIC VEHICLE ARCHITECTURE

9

Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III ENERGY STORAGE

9

Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electro chemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel.

UNIT IV ELECTRIC DRIVES AND CONTROL

9

Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor -drives and control , AC and Switch reluctance motor drives and control – Drive system efficiency –Inverters – DC and AC motor speed controllers.

UNIT V DESIGN OF ELECTRIC VEHICLES

9

Materials and types of production, Chassis skate board design, motor sizing, power pack sizing, component matching, Ideal gear box – Gear ratio, torque–speed characteristics, Dynamic equation of vehicle motion, Maximum tractive effort – Power train tractive effort Acceleration performance, rated vehicle velocity – maximum gradability, Brake performance, Electronic control system, safety and challenges in electric vehicles. Case study of Nissan leaf, Toyota Prius, tesla model 3, and Renault Zoe cars.

Since 1984

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explain the basic of electric vehicle history and components.
- CO2: Explore the properties of batteries.
- CO3: Enumerate the electrical machine properties and classifications.
- CO4: Explain the properties of electric vehicle drives systems.
- CO5: Design the motor sizing of hybrid electric vehicles.

TEXT BOOKS

1. A.K. Babu, Khanna Publishing House, Electric & Hybrid Vehicles New Delhi, 2018.
2. Iqbal Hussain, Electric & Hybrid Vehicles – Design Fundamentals , Second Edition, CRC Press, 2011.
3. Electric Vehicle Battery Systems – Sandeep Dhameja, Newnes, 2000.

REFERENCE BOOKS

1. Deshpande.M. V. PHI Learning Pvt. Ltd., 2010, Design and Testing of Electrical Machines.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric And Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained - Wiley, 2003.
4. Ehsani, M, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory And Design”, CRC Press, 2005.
5. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals – Mehrdad Ehsani, Yimin Gao, Ali Emadi, CRC Press, 2010.

24OEPE02 RENEWABLE ENERGY SYSTEMS

L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand the different types of renewable energy technologies.
- To explain Standalone operation, grid connected operation of renewable energy systems.
- To design the structure of PV system.

UNIT I INTRODUCTION TO RENEWABLE ENERGY SYSTEMS

9

Classification of energy sources – Co₂ Emission - Features of Renewable energy – Renewable energy scenario in India -Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capita Consumption - CO₂ Emission - importance of renewable energy sources, Potentials – Achievements– Applications.

UNIT II SOLAR PHOTOVOLTAICS

9

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- angle of sunrays on solar collector-Estimating Solar Radiation Empirically - Equivalent circuit of PV Cell- Photovoltaic cell characteristics: P-V and I-V curve of cell-Impact of Temperature and Insolation on I-V characteristics-Shading Impacts on I-V characteristics-Bypass diode -Blocking diode.

UNIT III DESIGN OF PV SYSTEM

9

Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

9

Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz's limit-Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical axis wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve of wind turbine - Configurations of wind energy conversion systems: Type

A, Type B, Type C and Type D Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES

9

Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

CO1: Demonstrate the need for renewable energy sources.

CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.

CO3: Design a stand-alone and Grid connected PV system.

CO4: Analyze the different configurations of the wind energy conversion systems.

CO5: Realize the basic of various available renewable energy sources.

TEXT BOOKS

1. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
2. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition, 2009.
3. Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group, 2013.

REFERENCE BOOKS

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
2. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
3. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012.

24OEPE03 POWER SEMICONDUCTOR DEVICES

LT P C

3 0 0 3

COURSE OBJECTIVES

- To understand the function of Power switching devices.
- To analyze characteristics of current controlled and voltage-controlled devices.
- To design the protection circuits.

UNIT I INTRODUCTION

9

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Power diodes – Types, forward and reverse characteristics, switching characteristics – rating. Features and Brief History of Silicon

Carbide-Promise and Demonstration of SiC Power Devices- Physical Properties of Silicon Carbide devices–Unipolar and Bipolar Diodes- GaN Technology Overview.

UNIT II CURRENT CONTROLLED DEVICES 9

BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Construction, working, static and transient characteristics, types, series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor- Basics of GTO, SiC based Bipolar devices- Applications- Building a GaN Transistor – GaN Transistor Electrical Characteristics.

UNIT III VOLTAGE CONTROLLED DEVICES 9

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs –and IGCT. New semiconductor materials for devices – Intelligent power modules - study of modules like APTGT100TL170G, MSCSM70TAM05TPAG. Integrated gate commutated thyristor (IGCT) –SiC based unipolar devices-applications.

UNIT IV DEVICE SELECTION, DRIVING AND PROTECTING CIRCUITS 9

Device selection strategy – On-state and switching losses – EMI due to switching. Necessity of isolation, pulse transformer, optocoupler – Gate drive integrated circuit: Study of Driver IC – IRS2110/2113. SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers.

UNIT V THERMAL PROTECTION 9

Heat transfer – conduction, convection and radiation; Cooling – liquid liquid cooling, vapour – phase cooling; Guidance for heat sink selection – Thermal resistance and impedance – Electrical analogy of thermal components, heat sink types and design – Mounting types-switching loss calculation for power device.

TOTAL : 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Identify suitable device for the application and to learn the characteristics of voltage and current controlled power devices.
- CO2: Explore the significance of Silicon Carbide devices and Gallium Nitride devices
- CO3: Explain the principles and characteristics of Silicon devices, Silicon Carbide devices and Gallium Nitride devices.
- CO4: Design proper driving circuits and protection circuits.
- CO5: Construct a proper thermal protective devices for power semiconductor devices.

TEXT BOOKS

1. Biswanath Paul, “Power Electronics”, Universities Press 2019.
2. L. Umanand, “Power Electronics Essentials and Applications”, Wiley India Ltd., 2009.

- Muhammad H. Rashid , “Power Electronics Handbook”, Elsevier, 3rd ed., 2011.

REFERENCE BOOKS

- Rashid M.H., “Power Electronics Circuits, Devices and Applications “, Pearson, Fourth Edition, 2021.
- Ned Mohan, Undeland and Robins, “Power Electronics: Converters Applications. Design”, Media Enhanced Third Edition, Wiley, 2007.
- Tsunenobu Kimoto and James A. Cooper, “Fundamentals of Silicon Carbide Technology: Growth, Characterization, Devices, and Applications”, First Edition, 2014 John Wiley & Sons, Singapore Pte Ltd.
- Alex Lidow, Johan Strydom, Michael de Rooij, David Reusch, “GaN Transistors for efficient power conversion”, Second Edition, Wiley, 2015.

24OEPE04 ENERGY STORAGE TECHNOLOGIES

L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand the various types of energy storage Technologies.
- To develop the design of thermal storage system.
- To understand the thermodynamics of Fuel Cell.

UNIT I INTRODUCTION

9

Necessity of energy storage – types of energy storage –energy storage technologies – Applications.

UNIT II THERMAL STORAGE SYSTEM

9

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – Pressurized water storage system – Modelling of phase change storage system – Simple units, Packed bed storage units - Modelling using porous medium approach.

UNIT III ELECTRICAL ENERGY STORAGE

9

Fundamental concept of batteries – Measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues - Types of batteries: – Lead Acid, Nickel-Cadmium, Zinc-Manganese dioxide - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT IV FUEL CELL

9

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types: Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, Alkaline fuel cell -Detailed analysis – Advantages and disadvantages –Fuel Cell Thermodynamics.

UNIT V ALTERNATE ENERGY STORAGE TECHNOLOGIES

9

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore the concept of various storage technologies.
- CO2: Discuss the mechanical storage system.
- CO3: Analysis of Various Battery Energy Storage System.
- CO4: Analyze the operation of fuel cell.
- CO5: Compare various types of alternate storage technologies.

TEXT BOOKS

1. Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011).
2. Ralph Zito, Energy storage: A new approach, Wiley (2010).
3. Robert A. Huggins, Energy storage, Springer Science & Business Media (2010).

REFERENCE BOOKS

1. David Linden, Thomas B.Reddy, “Handbook of Batteries”, Third Edition, Tata McGraw Hill,2002.
2. James Larminie, Andrew Dicks, “Fuel cell Systems Explained”, Third Edition, Wiley, 2018.
3. Ru-Shi Liu, Lei Zhang and Xueliang Sun, “Electrochemical Technologies for Energy Storage and Conversion”, First Edition, Wiley, 2012.
4. P.Jayarama Reddy, “Principles of Energy Storage Systems”, BS Publications, Hyderabad, First Edition, 2022.
5. G.D.Rai, “Non-Conventional Energy Sources”, VI Edition Khanna Publishes, First Edition, 2017.

24OEPE05 CONTROL SYSTEM DESIGN

L T P C

3 0 0 3

COURSE OBJECTIVES

- To analyze the models of various linear systems.
- To design the compensators and controllers for SISO systems.
- To design state space forms to continuous and discrete systems

UNIT I ANALYSIS OF LINEAR SYSTEMS

9

Review of system models –Transfer function and state space form– Time and Frequency Response – stability- Discretization –Need for Discretization –Sample and Hold devices – Effect of sampling on transfer function and state models – Analysis – Test for controllability and Observability.

UNIT II DESIGN OF SISO SYSTEM **9**

Design Specifications –In continuous domain – Limitations – Controller Structure – Multiple degrees of freedom – PID controllers and Lag-lead compensators- Design – Discretization and direct discrete design - Design in continuous and discrete domain.

UNIT III STATE SPACE DESIGN **9**

Pole assignment design – State and Output Feedback – observers – Estimated State Feedback – Design Examples (Continuous and Discrete).

UNIT IV OPTIMAL CONTROL **9**

Introduction: Classical control and optimization, formulation of optimal control problem, Typical performance measures – Linear quadratic regulator problem – solution – Application examples.

UNIT V OPTIMAL FILTERING **9**

Filtering – Linear system and estimation – System noise smoothing and prediction – Kalman Filter –Recursive estimation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Analyze controllers for linear systems defined in transfer function and state space forms.
- CO2: Design controllers for linear systems defined in transfer function and state space forms.
- CO3: Apply state space forms to continuous and discrete systems.
- CO4: Apply optimal control to linear systems in continuous and discrete systems.
- CO5: Apply filtering concepts to linear systems in continuous and discrete systems.

TEXT BOOKS

1. M.Gopal, “Digital Control and State Variable Methods”, 4th edition, McGraw Hill India,2012.
2. K. Ogata, ‘Modern Control Engineering’, 5th Edition, Pearson, 2012.
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

REFERENCE BOOKS

1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Taylor and Francis Group, 2011.
3. AshishTewari, ‘Modern Control Design with Matlab and Simulink’, John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung, “Control Theory –Multivariable and Non-Linear

- Methods”, Taylor & Francis, 2002.
5. M. Chidambaram and R. Padma Sree, “Control of Unstable Single and Multi-Variable Systems”, Narosa Publishing, 2017.

24OEPE06 ENERGY MANAGEMENT AND AUDITING

LT P C
3 0 0 3

COURSE OBJECTIVES

- To study the concepts behind economic analysis and load management.
- To emphasize the energy management of various electrical equipment and metering.
- To illustrate the concept of energy management technologies.

UNIT I ENERGY SCENARIO

9

Basics of Energy and its various forms - Conventional and non-conventional sources – Energy policy - Energy conservation act 2001, Amedments (India) in 2010 - Need for energy management- Designing and starting an energy management program - Energy managers and energy auditors - Roles and responsibilities of energy managers - Energy labelling and energy standards.

UNIT II ENERGY COST AND LOAD MANAGEMENT

9

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- Cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT III ENERGY MANAGEMENT

9

Demand side management (DSM)– DSM planning – DSM techniques – Load management as a DSM strategy – Energy conservation – Tariff options for DSM.

UNIT IV ENERGY AUDITING

9

Definition – Energy audit methodology: audit preparation, execution and reporting – Financial analysis – Sensitivity analysis – Project financing options - Instruments for energy audit – Energy audit for generation, distribution and utilization systems – Economic analysis.

UNIT V ENERGY EFFICIENT TECHNOLOGIES

9

Energy saving opportunities in electric motors - Power factor improvement benefit and techniques-Shunt capacitor, Synchronous Condenser and Phase Advancer - Energy conservation in industrial drives, electric furnaces, ovens and boilers - Lighting techniques: Natural, CFL, LED lighting sources and fittings.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore the present energy scenario and role of energy managers.
- CO2: Comprehend the Economic Models for cost and load management.

CO3: Configure the Demand side energy management through its control.

CO4: Discuss the process of energy auditing.

CO5: Analyse the energy level of industrial electrical systems.

TEXT BOOKS

1. Anil Kumar, Om Prakash, Prashant Singh Chauhan “Energy Management: Conservation and Audits, CRC Press, 2020.
2. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, “Guide to Energy Management”, CRC press, Taylor & Francis group, Eighth Edition, 2016.
3. S.C. Bhatia and Sarvesh Devraj, “Energy Conservation”, Woodhead Publishing India Pvt. Ltd, 2016.

REFERENCE BOOKS

1. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, “Guide to Energy Management”, CRC press, Taylor & Francis group, Eighth Edition, 2016.
2. https://prsindia.org/files/bills_acts/bills_parliament/2010/The_Energy_Conservation_Amendment_Bill_2010.pdf
3. Eastop T.D and Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, 1990.
4. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
5. Amit K. Tyagi, “Handbook on Energy Audits and Management”, TERI, 2003.
<https://www.eeeguide.com/power-factor-improvement>.

24OECS01 SPEECH SIGNAL PROCESSING

L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of the speech processing.
- Gather knowledge about the phonetics and pronunciation processing.
- To understand the concepts of speech recognition.

UNIT I INTRODUCTION

9

Introduction - Knowledge in Speech and Language Processing - Ambiguity - Models and Algorithms - Language - Thought - Understanding - Regular Expression and Automata - Words & Transducers — N grams

UNIT II SPEECH MODELING

9

Word Classes and Part of Speech Tagging — Hidden Markov Model — Computing Likelihood: The Forward Algorithm – Training Hidden Markov Model – Maximum Entropy Model – Transformation - Based Tagging – Evaluation and Error Analysis – Issues in Part of Speech Tagging – Noisy Channel Model for Spelling

UNIT III SPEECH PRONUNCIATION AND SIGNAL PROCESSING **9**

Phonetics - Speech Sounds and Phonetic Transcription - Articulatory Phonetics – Phonological Categories and Pronunciation Variation - Acoustic Phonetics and Signals - Phonetic Resources - Articulatory and Gestural Phonology.

UNIT IV SPEECH IDENTIFICATION **9**

Speech Synthesis - Text Normalization - Phonetic Analysis - Prosodic Analysis – Diphone Wave Form Synthesis Unit Selection Waveform Synthesis – Evaluation.

UNIT V SPEECH RECOGNITION **9**

Automatic Speech Recognition - Architecture - Applying Hidden Markov Model - Feature Extraction: MFCC Vectors - Computing Acoustic Likelihoods - Search and Decoding - Embedded Training – Multi-pass Decoding: N-Best Lists and Lattices- a* (‘_stack’) Decoding - Context-Dependent Acoustic Models: Triphones - Discriminative Training - Speech Recognition by Humans.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Create new algorithms with speech processing.
- CO2: Derive new speech models.
- CO3: Perform various language phonetic analysis.
- CO4: Create a new speech identification system.
- CO5: Generate a new speech recognition system.

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin, — Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson Education, 2013.
2. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition 2/e Paperback – 1 January 2013 by Jurafsky / Martin (Author).
3. Thomas F. Quatieri, Discrete-Time Speech Signal Processing: Principles and Practice (Prentice-Hall Signal Processing Series) 2001.

REFERENCE BOOKS

1. Kai-Fu Lee, —Automatic Speech Recognition, The Springer International Series in Engineering and Computer Science, 1999.
2. Himanshu Chaurasiya, —Soft Computing Implementation of Automatic Speech Recognition, LAP Lambert Academic Publishing, 2010.
3. Claudio Becchetti, Klucio Prina Ricotti, —Speech Recognition: Theory and C++ implementation, Wiley publications 2008.
4. Ikrami Eldirawy, Wesam Ashour, —Visual Speech Recognition, Wiley publications, 2011.

5. Discrete-Time Speech Signal Processing: Principles And Practice Paperback – 1 January 2003 By Quatieri.

24OECS02 DIGITAL FORENSICS

L T P C
3 0 0 3

COURSE OBJECTIVES

- Understand the basics of wireless technologies and security.
- Learn the methods of investigation using digital forensic techniques.
- Identify and explain at least three current issues in the practice of digital forensic investigations.

UNIT I INTRODUCTION

9

Overview of wireless technologies and security: Personal Area Networks, Wireless Local Area Networks, Metropolitan Area Networks, Wide Area Networks. Wireless Threats, Vulnerabilities and Security: Wireless LANs, War Driving, Warchalking, War Flying, Common Wi-fi Security Recommendations, PDA Security, Cell Phones and Security, Wireless DoS attacks, GPS Jamming, Identity Theft.

UNIT II CONFIDENTIALITY, INTEGRITY, AVAILABILITY TRIAD IN MOBILE 9

Confidentiality, Integrity, Availability (CIA) TRIAD in Mobile Phones-Voice, SMS and Identification Data Interception in GSM: Introduction, Practical Setup and Tools, Implementation- Software and Hardware Mobile Phone Tricks: Net Monitor, GSM Network Service Codes, Mobile Phone Codes, Catalog Tricks and AT Command Set- SMS Security Issues

UNIT III MOBILE PHONE FORENSICS

9

Mobile Phone Forensics: Crime And Mobile Phones, Evidences, Forensic Procedures, Files Present in Sim Card, Device Data, External Memory Dump, Evidences in Memory Card, Operator Systems- Android Forensics: Procedures for Handling an Android Device, Imaging Android USB Mass Storage Devices, Logical and Physical Techniques.

UNIT IV DIGITAL FORENSICS

9

Digital Forensics: Introduction – Evidential Potential of Digital Devices: Closed vs. Open Systems, Evaluating Digital Evidence Potential- Device Handling: Seizure issues, Device Identification, Networked Devices and Contamination.

UNIT V DIGITAL FORENSICS EXAMINATION PRINCIPLES

9

Digital Forensics Examination Principles: Previewing, Imaging, Continuity, Hashing and Evidence Locations- Seven Element Security Model- Developmental Model of Digital Systems- Audit and Logs Evidence Interpretation: Data Content and Context.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Explore the basics of mobile and digital security.
- CO2: Explain mobile phone forensics and android forensics.
- CO3: Analyze issues in Digital forensics.
- CO4: Analyze the common data privacy techniques.
- CO5: Examine and analyze Digital forensics techniques.

TEXT BOOKS

1. Gregory Kipper, “Wireless Crime and Forensic Investigation”, Auerbach Publications, 2007.
2. Iosif I. And Roulidakis, “Mobile Phone Security and Forensics: A Practical Approach”, Springer publications, Second Edition, 2016.
3. Andrew Hoog, “Android Forensics: Investigation, Analysis and Mobile Security for Google Android”, Elsevier publications, 2011.

REFERENCE BOOKS

1. Digital Forensics, Andre Arnes, John Wiley and Sons U.S.A. 2017.
2. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics Paperback – Import, April 2012 by John Sammons (Author).
3. Cyber Forensics Paperback – 1 June 2018 by Deje (Author), Murugan (Author).
4. Hand book of Digital Forensics and Investigation Book, 2010.
5. Digital Forensics Dr. Jeetendra Pande, Dr. Ajay Prasad, Uttarakhand Open University, 2016.

24OECS03 IT AND AGRICULTURAL SYSTEM

L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the students to areas of agricultural systems in which IT and computers play a major role.
- To also expose the students to IT applications in precision farming, environmental control systems, agricultural systems management and weather prediction models.
- To enable students with the intense knowledge of sustainable production system without damaging environment.

UNIT I PRECISION FARMING	9
Precision Agriculture and Agricultural Management – Ground Based Sensors, Remote Sensing, GPS, GIS and Mapping Software, Yield Mapping Systems, Crop Production Modeling	
UNIT II ENVIRONMENT CONTROL SYSTEMS	9
Artificial Light Systems, Management of Crop Growth in Greenhouses, Simulation of CO ₂ Consumption in Greenhouses, On-Line Measurement of Plant Growth in the Greenhouse, Models of Plant Production and Expert Systems in Horticulture.	
UNIT III AGRICULTURAL SYSTEMS MANAGEMENT	9
Agricultural Systems - Managerial Overview, Reliability of Agricultural Systems, Simulation of Crop Growth and Field Operations, Optimizing the Use of Resources, Linear Programming, Project Scheduling, Artificial Intelligence and Decision Support Systems.	
UNIT IV WEATHER PREDICTION MODELS	9
Importance of climate variability and seasonal forecasting, Understanding and Predicting World's Climate System, Global Climatic Models and Their Potential for Seasonal Climate Forecasting, General Systems Approach to Applying Seasonal Climate Forecasts.	
UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS	9
Expert Systems, Decision Support Systems, Agricultural and Biological Databases, E-Commerce, E- Business Systems & Applications, Technology Enhanced Learning Systems and Solutions, E-Learning, Rural Development and Information Society.	
TOTAL: 45 PERIODS	

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Apply IT in remote sensing applications such as Drones etc.
- CO2: Explore the greenhouse can be automated and its advantages.
- CO3: Apply IT principles and concepts for management of field.
- CO4: Explore about weather models, their inputs and applications.
- CO5: Apply IT in e-governance in agriculture.

TEXT BOOKS

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997.
2. H.Krug, Liebig, H.P. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989.
3. Peart, R.M., and Shoup, W. D., "Agricultural Systems Management", Marcel Dekker, New York, 2004.

REFERENCE BOOKS

1. Hammer, G.L., Nicholls, N., and Mitchell, C., "Applications of Seasonal Climate", Springer, Germany, 2000.

2. Agricultural Systems, Agroecology and Rural Innovation for Development Book - Second Edition - 2017.
3. It In Agricultural System, Dr. C.R. Balamurugan, N. Ramadevi, Dr. S. Sathya.
4. An Introduction to Agricultural Systems Springer; 2nd ed. 1988. Softcover reprint of the original 2nd ed. 1988 edition (12 February 2012); 01149344934.
5. IT in Agricultural System by Pranjali S. Bahalkar (Author), Dr. Mithra Venkatesan (Author), Dr. Shubhangi Suryavanshi (Author).

24OECS04 MACHINE LEARNING

L T P C

3 0 0 3

COURSE OBJECTIVES

- Understand fundamental concepts of machine learning and its applications.
- Learn various supervised and unsupervised learning algorithms.
- Explore emerging trends and ethical considerations in machine learning.

UNIT I INTRODUCTION TO MACHINE LEARNING

9

Definition and Types of Learning – Supervised, Unsupervised, Semi-supervised and Reinforcement Learning – Applications of Machine Learning – Steps in Developing ML Models – Hypothesis Space and Inductive Bias – Performance Evaluation Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1 Score, ROC-AUC.

UNIT II SUPERVISED LEARNING ALGORITHMS

9

Linear Regression – Gradient Descent – Logistic Regression – k-Nearest Neighbors – Decision Trees – Random Forest – Support Vector Machines – Bias-Variance Tradeoff – Overfitting and Underfitting – Cross-validation.

UNIT III UNSUPERVISED LEARNING

9

Clustering: k-Means, Hierarchical Clustering, DBSCAN – Dimensionality Reduction: PCA, t-SNE – Association Rule Mining: Apriori, FP-Growth – Evaluation of clustering: Silhouette Score, Davies–Bouldin index.

UNIT IV NEURAL NETWORKS AND DEEP LEARNING BASICS

9

Perceptron – Multilayer Perceptron (MLP) – Activation functions – Backpropagation – Basics of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) – Applications in image and sequence data.

UNIT V ADVANCED TOPICS AND APPLICATIONS

9

Ensemble Learning: Bagging, Boosting, AdaBoost, Gradient Boosting – Introduction to Reinforcement Learning – Basics of Natural Language Processing (NLP) – Model Deployment concepts – Introduction to MLOps – Ethics and fairness in ML.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Evaluate ML models and demonstrate ethical awareness in deploying AI systems.
- CO2: Explain the basic concepts, types and applications of machine learning.
- CO3: Apply appropriate supervised learning techniques to solve classification/regression problems.
- CO4: Implement and interpret unsupervised algorithms for clustering and pattern discovery.
- CO5: Design simple neural network models and their applications.

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education.
2. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2nd Edition.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.

REFERENCE BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.
2. Ethem Alpayd in, Introduction to Machine Learning, MIT Press.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
4. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Publisher: Cambridge University Press.
5. Andriy Burkov, The Hundred-Page Machine Learning Book, Publisher: Andriy Burkov Publications / Amazon Kindle Direct Publishing.

24OECS05 IoT FOR SMART SYSTEMS

L T P C
3 0 0 3

COURSE OBJECTIVES

- To study about Internet of Things technologies and its role in real time applications.
- To familiarize the accessories and communication techniques for IoT.
- To provide insight about the embedded processor and sensors required for IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS

9

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE

9

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy Beacons.

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT PROTOCOLS

9

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth / Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary Systems-Recent trends.

UNIT IV IOT PROCESSORS

9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT: Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V CASE STUDIES

9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On successful completion of this course, the students will be able to

- CO1: Analyze the concepts of IoT and its present developments.
- CO2: Compare and contrast different platforms and infrastructures available for IoT.
- CO3: Explain different protocols and communication technologies used in IoT.
- CO4: Analyze the big data analytic and programming of IoT.
- CO5: Implement IoT solutions for smart applications.

TEXTBOOKS

1. Oliver Hersent , David Boswarthick and Omar Elloumi “ The Internet of Things”, Wiley, 2016.
2. Samuel Greengard, “The Internet of Things”, The MIT press, 2015.
3. Adrian McEwen and Hakim Cassimally “Designing the Internet of Things “Wiley,2014.

REFERENCE BOOKS:

1. Arshdeep Bahga and Vijai Madisetti: A Hands-on Approach “Internet of Things”,Universities Press 2015.
2. Adrian McEwen and Hakim Cassimally “Designing the Internet of Things “Wiley,2014.
3. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.
4. Lingyang Song/Dusit Niyato/ Zhu Han/ Ekram Hossain,” Wireless Device-to-Device.
5. Communications and Networks, Cambridge University Press,2015

COURSE OBJECTIVES

- To understand the basics of software testing.
- To focus on wide aspects of testing and understanding multiple facets of testing.
- To get an insight about test automation and the tools used for test automation.

UNIT I FOUNDATIONS OF SOFTWARE TESTING 9

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing.

UNIT II TEST PLANNING 9

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III TEST DESIGN AND EXECUTION 9

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV ADVANCED TESTING CONCEPTS 9

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.

UNIT V TEST AUTOMATION AND TOOLS 9

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

- CO1: Explain the basic concepts of software testing and the need for software testing.
- CO2: Design Test planning and different activities involved in test planning.
- CO3: Design effective test cases that can uncover critical defects in the application.
- CO4: Carry out advanced types of testing.

- CO5: Automate the software testing using Selenium and Test.

TEXTBOOKS

1. Yogesh Singh, "Software Testing", Cambridge University Press, 2012.
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018.
3. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.

REFERENCES

1. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing.
2. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.
3. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
4. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.
5. Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.



