MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING

An Autonomous Institution

Department of M.E.
Stuctural Engineering

Curriculum and Syllabus
(I - IV Semester)
2024 - 2025

[Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai |
Recognised by UGC 12(B) & 2(f) Act | An ISO 9001:2015 Certified |
NAAC Accredited with 'A' Grade | NBA – Mechanical]

34, Rajiv Gandhi Salai (OMR) Siruseri IT Park, Chennai - 603 103

MOHAMED SATHAK A.J. COLLEGE OF ENGINEERING

M. E. STRUCTURAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M E Structural Engineering will

PEO1 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

PEO2 Become consultants in Structural Engineering and solve complex real-life issues related to the analysis, design and maintenance of structures under various environmental conditions.

PEO3 Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or Research organizations or Academia.

PEO4 Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.

PEO5 Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation

2. PROGRAMME OUTCOMES (POs):

PO1	An ability to independently carry out research/investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document
PO3	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

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Structural Engineering will be able to

PSO1	Knowledge of Structural Engineering discipline	Acquire in-depth knowledge of the Structural Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge in structural design.
PSO2	Critical analysis of Structural Engineering issues and innovation	Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	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

Mohamed Sathak A J College of Engineering, Chennai - 603103

(An Autonomous Institution)

Curriculum for the students Admitted from 2024 - 2025

M.E - STRUCTURAL ENGINEERING

SEMESTER I								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24MAP02	Advanced Mathematical Methods	4	0	0	4	4	FC
2	24ST101	Theory of Elasticity and Plasticity	3	1	0	4	4	PCC
3	24ST102	Structural Dynamics and Earthquake Engineering	3	1	0	4	4	PCC
4	24RM101	Research Methodology and IPR	2	0	0	2	2	RMC
5		Professional Elective I	3	0	0	3	3	PEC
6		Audit Course I*	2	0	0	2	0	AC
7	24ST121	Advanced Construction Engineering and Experimental Techniques Laboratory	0	0	4	4	2	PCC
8	24ST122	Technical Seminar	0	0	2	2	1	EEC
Total						**25**	**20**	

SEMESTER II								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST201	Advanced Steel Structures	3	1	0	4	4	PCC
2	24ST202	Advanced Concrete Structures	3	1	0	4	4	PCC
3	24ST203	Finite Element Analysis in Structural Engineering	3	0	0	3	3	PCC
4		Professional Elective II	3	0	0	3	3	PEC
5		Professional Elective III	3	0	0	3	3	PEC
6		Audit Course II*	2	0	0	2	2	AC
7	24ST221	Numerical and Finite Element Analysis Laboratory	0	0	4	4	0	PCC
8	24ST222	Structural Design Studio	0	0	4	4	2	PCC
Total						**27**	**21**	

SEMESTER III								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1		Professional Elective IV	3	0	0	3	3	PEC
2		Professional Elective V	3	0	0	3	3	PEC
3		Open Elective	3	0	0	3	3	OEC
4	24ST321	Practical Training (4 Weeks)	0	0	0	0	2	EEC
5	24ST322	Project Work I	0	0	12	12	6	EEC
Total						**21**	**17**	

SEMESTER IV								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST421	Project Work II	0	0	24	24	12	EEC
Total						**24**	**12**	

TOTAL CREDITS 70

PROFESSIONAL ELECTIVE

VERTICAL I								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST191	Non-linear Analysis of Structures	3	0	0	3	3	PEC
2	24ST192	Structural Stability	3	0	0	3	3	PEC
3	24ST193	Wind and Cyclone Effects on Structures	3	0	0	3	3	PEC
4	24ST194	Prefabricated Structures	3	0	0	3	3	PEC

VERTICAL II								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST291	Advanced Concrete Technology	3	0	0	3	3	PEC
2	24ST292	Advanced Prestressed Concrete	3	0	0	3	3	PEC
3	24ST293	Reliability Analysis of Structures	3	0	0	3	3	PEC
4	24ST294	Design of Formwork	3	0	0	3	3	PEC

VERTICAL III								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST295	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3	PEC
2	24ST296	Mechanics of Fiber Reinforced Polymer Composite Materials	3	0	0	3	3	PEC
3	24ST297	Design of Steel-Concrete Composite Structures	3	0	0	3	3	PEC
4	24ST298	Design of Masonry Structures	3	0	0	3	3	PEC

Chairman BoS Director IQAC Head Academics Principal

VERTICAL IV								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST391	Design of Industrial Structures	3	0	0	3	3	PEC
2	24ST392	Advanced Design of Foundation Structures	3	0	0	3	3	PEC
3	24ST393	Optimization of Structures	3	0	0	3	3	PEC
4	24ST394	Structural Health Monitoring	3	0	0	3	3	PEC

VERTICAL V								
S.No	**Subject Code**	**Subject**	**L**	**T**	**P**	**Contact Periods**	**Credits**	**Category**
1	24ST395	Design of Offshore Structures	3	0	0	3	3	PEC
2	24ST396	Performance of Structures with Soil-Structure Interaction	3	0	0	3	3	PEC
3	24ST397	Design of Bridge Structures	3	0	0	3	3	PEC
4	24ST398	Design of Shell and Spatial Structures	3	0	0	3	3	PEC

OPEN ELECTIVE / EMERGING TECHNOLOGY COURSES

S.No	Subject Code	Subject	L	T	P	Contact Periods	Credits	Category
1	24MGOE3	Ethical Management	3	0	0	3	3	OEC
2	24OE905	Vibration and Noise Control Strategies	3	0	0	3	3	OEC
3	24OE906	Energy Conservation and Management in Domestic Sectors	3	0	0	3	3	OEC
4	24OE907	Additive Manufacturing	3	0	0	3	3	OEC
5	24OE908	Electric Vehicle Technology	3	0	0	3	3	OEC
6	24OE909	New Product Development	3	0	0	3	3	OEC
7	24OE910	Sustainable Management	3	0	0	3	3	OEC
8	24OE911	Micro and Small Business Management	3	0	0	3	3	OEC
9	24OE912	Intellectual Property Rights	3	0	0	3	3	OEC
10	24OE914	IoT for Smart Systems	3	0	0	3	3	OEC
11	24OE915	Machine Learning and Deep Learning	3	0	0	3	3	OEC
12	24OE916	Renewable Energy Technology	3	0	0	3	3	OEC
13	24OE917	Smart Grid	3	0	0	3	3	OEC
14	24OE918	Big Data Analytics	3	0	0	3	3	OEC
15	24OE919	Internet of Things and Cloud	3	0	0	3	3	OEC
16	24OE920	Medical Robotics	3	0	0	3	3	OEC
17	24OE921	Embedded Automation	3	0	0	3	3	OEC
18	24OE922	Environmental Sustainability	3	0	0	3	3	OEC
19	24OE923	Textile Reinforced Composites	3	0	0	3	3	OEC
20	24OE924	Nanocomposite Materials	3	0	0	3	3	OEC
21	24OE925	IPR, Biosafety and Entrepreneurship	3	0	0	3	3	OEC
22	24OE926	Blockchain Technologies	3	0	0	3	3	OEC

23	24OE927	Deep Learning	3	0	0	3	3	OEC
24	24OE928	Security Practices	3	0	0	3	3	OEC
25	24OE929	Cloud Computing Technologies	3	0	0	3	3	OEC
26	24OE930	Design Thinking	3	0	0	3	3	OEC
27	24OE931	Principles of Multimedia	3	0	0	3	3	OEC

AUDIT COURSES

S.No	Subject Code	Subject	L	T	P	Contact Periods	Credits	Category
1	24AX901	English for Research Paper Writing	2	0	0	2	0	AC
2	24AX902	Disaster Management	2	0	0	2	0	AC
3	24AX903	Constitution of India	2	0	0	2	0	AC
4	24AX904	நற்றமிழ் இலக்கியம்	2	0	0	2	0	AC

Sl. No.	Subject Type	Credits per semester					
		I	II	III	IV	Total Credits	%
1	FC	4	0	0	0	4	6%
2	PCC	10	13	0	0	23	33%
3	RMC	2	0	0	0	2	3%
4	PEC	3	6	6	0	15	21%
5	AC	0	2	0	0	2	3%
6	EEC	1	0	8	12	21	30%
7	OEC	0	0	3	0	3	4%
Total		**20**	**21**	**17**	**12**	**70**	100%

Chairman BoS | Director IQAC | Head Academics | Principal

University Nominee

ADVANCED MATHEMATICAL METHODS

Course Code	24MAP02	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	4:0:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT	ESE
				50 Marks	50 Marks

Prerequisite: Basic knowledge of calculus, differential equations, linear algebra, vector analysis, and complex variables

COURSE OBJECTIVES:

1. To provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. The application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT III CALCULUS OF VARIATIONS 12

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications - Fluid flow and heat flow problems.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT V TENSOR ANALYSIS 12

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

TOTAL: 60

OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

CO1	Application of Laplace and Fourier transforms to the initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
CO2	Maximizing and minimizing the functions that occur in various branches of Engineering Disciplines.
CO3	Construct conformal mappings between various domains and use conformal mapping in studying problems in physics and engineering, particularly fluid flow and heat flow problems.
CO4	Understand tensor algebra and its applications in applied sciences and engineering and develops the ability to solve mathematical problems involving tensors.
CO5	Competently use tensor analysis as a tool in the field of applied sciences and related fields.

REFERENCES:

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", 6^{th} Edition, Jones and Bartlett Publishers, 2011.
4. Kay, D. C., "Tensor Calculus", Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
5. Naveen Kumar, "An Elementary Course on Variational Problems in Calculus ", Narosa Publishing House, 2005.
6. Saff, E.B and Snider, A.D, "Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics", 3^{rd} Edition, Pearson Education, New Delhi, 2014.
7. Sankara Rao, K., "Introduction to Partial Differential Equations", 3^{rd} Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
8. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.
9. Ramaniah. G. "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.

COs- PO's & PSO's MAPPING

	PO01	PO02	PO03	PO04	PO05	PO06
CO1	1	-	3	-	-	-
CO2	2	1	3	-	-	-
CO3	2	1	3	-	-	-
CO4	2	1	3	-	-	-
CO5	2	1	3	-	-	-
Avg.	**1.8**	**0.8**	**3**	**-**	**-**	**-**

THEORY OF ELASTICITY AND PLASTICITY

Course Code	24ST101	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:1:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT	ESE
				50 Marks	50 Marks

Prerequisite: Basic knowledge of engineering mathematics, solid mechanics, strength of materials, and continuum mechanics concepts.

COURSE OBJECTIVE: To impart the knowledge of

1.To develop the ability to use the principles of theory of elasticity in engineering problems and to introduce theoretical fundamentals of theory of plasticity

UNIT I ELASTICITY **12**

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law-Constitutive Equations

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT II 2D STRESS STRAIN PROBLEMS **12**

Plane stress and plane strain - Simple two-dimensional problems in Cartesian and Polar Coordinates.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT III TORSION OF NON-CIRCULAR SECTION **12**

St. Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled- Open and Closed sections-Design approach to open web section subjected to torsion - Finite Difference Method

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT IV BEAMS ON ELASTIC FOUNDATIONS **12**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT V PLASTICITY **12**

Physical Assumptions – Yield Criteria – Failure Theories –Thick Cylinder – Plastic Stress Strain Relationship - Bending and Torsion in Elasto-Plastic Materials -Strain hardening Materials

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

TOTAL: 60

OUTCOMES:
On completion of this course, the student is expected to 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 Analyse beams resting on elastic foundations

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

REFERENCES:

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional Technical Reference, New Jersey, 2003.
2. Chakrabarty. J, "Theory of Plasticity", Third Edition, Elsevier Butterworth – Heinmann – UK, 2007.
3. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
4. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
5. Timoshenko, S. and GoodierJ.N " Theory of Elasticity", Third Edition, McGraw Hill Book Co., New York, 2017.

COs- PO's & PSO's MAPPING

CO	**PO**			**PSO**		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	2	3	2	3
2	3	3	3	3	3	2
3	3	2	3	3	2	2
4	3	2	2	3	2	2
5	3	3	2	3	3	2
Avg	**3**	**2.4**	**2.4**	**3**	**2.4**	**2.2**

STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

Course Code	24ST102	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:1:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

Prerequisite: Basic knowledge of structural analysis, engineering mechanics, strength of materials, and vibration theory.

COURSE OBJECTIVE: To impart the knowledge of

1. To make the students understand the basics of structural dynamics and earthquake engineering and to develop the ability to design an earthquake resistant structure,

UNIT I PRINCIPLES OF VIBRATION ANALYSIS 12

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Evaluation of damping, Transmissibility, vibration control, Tuned mass damper.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT II DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 12

Mathematical models of two-degree of freedom systems and multi-degree of freedom systems, free and forced vibrations of two-degree and multi-degree of freedom systems, normal modes of vibration, applications. orthogonality of normal modes, free and forced vibrations of multi-degree of freedom systems, Mode superposition technique, Applications.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT III DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 12

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh-Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work, Applications. Damping in MDOF systems, Nonlinear MDOF systems, and step-by-step numerical integration algorithms.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L4

UNIT IV EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES12

Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures - Lessons Learnt

from Past Earthquakes -Evaluation of Earthquake Forces as per codal provisions - Response Spectra, Design Spectra

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT V EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES 12

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations – effect of material of construction on the performance of structures - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Design of Masonry Buildings and R.C.C. Buildings. Design consideration - Rigid Frames – Shear walls - Lateral load analysis of structures- Capacity based Design and detailing

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

TOTAL: 60

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1	Do vibration analysis of system/structures with a single degree of freedom and can explain the method of damping the systems
CO2	Do the 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	Explain the causes and effects of an earthquake
CO5	Design masonry and RC structures for the earthquake forces as per their commendations of IS codes of practice

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2020.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill,2014.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, Fifth Edition, 2006.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.
5. Brebbia C. A.," Earthquake Resistant Engineering Structures VIII", WIT Press, 2015
6. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science& Technology, 2013
7. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2014.
8. Paulay.T and Priestley M.J.N., "Seismic Design of Reinforced Concrete and MasonryBuildings", John Wiley and Sons, 2013.
9. Duggal S K, "Earthquake Resistant Design of Structures", Oxford University Press, 2013.
10. Madhujit Mukhopadhyay," Structural Dynamics: Vibrations and Systems", Ane's Student Edition,2017

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	3	3	3	3	2
2	3	2	3	3	2	2
3	3	2	2	3	3	2
4	3	1	-	3	-	1
5	3	3	1	3	3	2
Avg	**3**	**2.20**	**2.25**	**3**	**2.75**	**1.80**

RESEARCH METHODOLOGY AND IPR

Course Code	24RM101	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	30	L:T:P	2:0:0	Credits	2
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of academic writing, research fundamentals, critical thinking, and legal/ethical awareness in innovation.

COURSE OBJECTIVE: To impart the knowledge of

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II DATA COLLECTION AND SOURCES 6

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property – The 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V PATENTS 6

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL:30

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 12e (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.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", December 2018.

ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTALTECHNIQUES LABORATORY

A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY

Course Code	24ST121	Course Type		PRACTICAL	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	0:0:4	Credits	2
Handled by	CIVIL	Assessment Methods		IAT	ESE
				60 Marks	40 Marks

Prerequisite: Basic knowledge of construction materials, structural engineering, concrete technology, and strength of materials.

COURSE OBJECTIVE: To impart the knowledge of

1. To provide a thorough knowledge of material selection through the material testing based on specification

LIST OF EXPERIMENTS

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self Compacting concrete.
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability test on hardened concrete (RCPT) – Demonstration

TOTAL: 30

OUTCOMES:

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

CO1 Do the mix proportion using IS and ACI codal provisions.
CO2 Test the concrete in a non-destructive manner using rebound hammer.
CO3 Know the permeability characteristics of concrete.
CO4 Observe the effect of mineral and chemical admixture in concrete.
CO5 Study the flow characteristics of self-compacting concrete

B) EXPERIMENTAL TECHNIQUES

LABORATORY OBJECTIVE:

1. To provide a detailed account of modern experimental techniques in construction Engineering research.
2. To introduce the basic working principles, the operational know-how, and the strength and limitations of the techniques.

LIST OF EXPERIMENTS

1. Determination of elastic constants – Hyperbolic fringes
2. Determination of elastic constants – Elliptical fringes
3. Strain gauge meter – Determination of Young's modulus of a metallic wire
4. Ultrasonic interferometer – ultrasonic velocity in liquids
5. Electrical conductivity of metals and alloys with temperature-four probe method
6. Resistivity measurements

7. NDT – Ultrasonic flaw detector
8. Calibration of Proving Ring and LVDT

TOTAL: 30

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1	Gain practical knowledge by applying the experimental methods to correlate with the theory
CO2	Learn the usage of electrical and optical systems for various measurements.
CO3	Apply the analytical techniques and graphical analysis to interpret the experimental data
CO4	Gain practical knowledge of non-destructive testing
CO5	Learn to calibrate and use proving rings and LVDTs

COs- PO's & PSO's MAPPING

CO	**PO**			**PSO**		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	2	3	3	3
2	3	1	-	2	1	1
3	2	-	2	3	2	3
4	3	1	2	3	2	2
5	3	-	1	2	1	1
Avg	**2.8**	**0.8**	**1.4**	**2.6**	**1.8**	**2**

TECHNICAL SEMINAR

Course Code	24ST122	Course Type		PRACTICAL	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	30	L:T:P	0:0:2	Credits	1
Handled by	CIVIL	Assessment Methods		IAT 60 Marks	ESE 40 Marks

Prerequisite: Completion of core courses in the respective discipline and basic knowledge of technical communication, presentation skills, and research literature review.

COURSE OBJECTIVE: To impart the knowledge of

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

SYLLABUS:

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Structural Engineering and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as the audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30

OUTCOMES:

On completion of the course, the student is expected to 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

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	2	2	3	1	1
2	3	1	-	3	-	3
3	2	-	2	2	1	2
4	2	1	3	3	3	3
5	3	2	2	3	1	2
Avg	2.6	1.2	1.8	2.8	1.2	2.2

ADVANCED STEEL STRUCTURES

Course Code	24ST201	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:1:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

Prerequisite: Basic knowledge of structural analysis, steel structures, strength of materials, and design of steel members.

COURSE OBJECTIVE: To impart the knowledge of

1,To study the behavior of members, connections and industrial buildings

UNIT I GENERAL **12**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT II DESIGN OF CONNECTIONS **12**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS **12**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT IV PLASTIC ANALYSIS OF STRUCTURES **12**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES 12

Introduction to Direct Strength Method - Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

TOTAL: 60

OUTCOMES:

On completion of the course, the student is expected to be able to

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

REFERENCES:

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.
4. Wie Wen Yu, Design of Cold-Formed Steel Structures, McGraw Hill Book Company, 2019
5. S.K. Duggal, Limit State Design of Steel Structures, McGraw Hill Book Company, 2017

COs- PO's & PSO's MAPPING

CO	**PO**			**PSO**		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	3	3
2	3	2	3	3	3	2
3	3	3	2	3	3	2
4	3	2	2	3	2	3
5	3	2	2	3	2	3
Avg	**3**	**2.2**	**2.4**	**3**	**2.6**	**2.6**

ADVANCED CONCRETE STRUCTURES

Course Code	24ST202	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:1:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

Prerequisite: Basic knowledge of strength of materials, structural analysis, reinforced concrete design, and construction materials.

COURSE OBJECTIVE: To impart the knowledge of

1.To make the students familiar with the behaviour of RCC beams and columns and to design special structural members with proper detailing

UNIT I BEHAVIOUR AND DESIGN OF R.C. BEAMS 12

Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT II BEHAVIOUR AND DESIGN OF R.C. COLUMNS 12

Behaviour of short and long columns - behaviour of short column under axial load with uniaxial and bi-axial moments - construction of P_u - M_u interaction curves - Design of slender columns –

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 12

Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT IV FLAT SLABS AND YIELD LINE BASED DESIGN 12

Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and design of slabs - virtual work method - equilibrium method.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 12

Inelastic behaviour of concrete beams - Moment-curvature curves - moment redistribution - Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L4

TOTAL: 60

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Explain the structural behaviour 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 beams
CO5 Predict the moment curvature behavior and design and detail concrete elements based on ductility

REFERENCES:

1. Gambhir.M. L., "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
2. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 1986
3. Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2017.
4. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2020.
5. Sinha.S.N., Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd.2017

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	3	2	2
2	3	2	2	3	2	2
3	3	2	2	3	2	2
4	3	2	2	2	3	2
5	3	2	2	2	3	2
Avg	**3**	**2**	**2**	**2.6**	**2.4**	**2**

FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING

Course Code	24ST203	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of engineering mechanics, strength of materials, structural analysis, matrix methods, and numerical techniques

COURSE OBJECTIVE: To impart the knowledge of

1.To make the students understand the basics of the Finite Element Technique, and to cover the analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

UNIT I INTRODUCTION **9**

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity- Steps in Finite Element Analysis - Finite Element Formulation Techniques - Virtual Work and Variational Principle - Galerkin Method - Finite Element Method: Displacement Approach - Stiffness Matrix and Boundary Conditions

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II ELEMENT PROPERTIES **9**

Natural Coordinates - Triangular Elements-Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional – Problems

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III ANALYSIS OF FRAME STRUCTURES **9**

Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysis of Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV TWO AND THREE DIMENSIONAL SOLIDS **9**

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V APPLICATIONS OF FEM **9**

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method - Finite Element Analysis of Shell -Finite Elements for Elastic Stability - Dynamic Analysis

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Formulate a finite element problem using basic mathematical principles

CO2 Explain the various types of elements and select the appropriate element for modelling

CO3 Analyse a frame using truss element

CO4 Formulate and analyse the two- and three-dimensional solid finite element problems

CO5 Analyse shells, thick and thin plates and explain the dynamic analysis using FEM

REFERENCES:

1. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
2. Logan D. L,A First Course in the Finite Element Method, Thomson- Engineering, 3rd edition, 2010.
3. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", Seventh Edition, McGraw – Hill, 2013.
4. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Fourth Edition, Prentice Hall of India, 2015.
5. Moaveni, S., "Finite Element Analysis Theory and Application with ANSYS", Prentice Hall Inc., 2020.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	2	2	2
2	3	3	-	2	2	2
3	3	2	3	2	3	2
4	3	2	3	2	3	2
5	3	3	2	2	3	2
Avg	**3**	**2.4**	**2.75**	**2**	**2.6**	**2**

NUMERICAL AND FINITE ELEMENT ANALYSIS LABORATORY

Course Code	24ST221	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	0:0:4	Credits	2
Handled by	CIVIL	Assessment Methods		IAT	ESE
				50 Marks	50 Marks

Prerequisite: Basic knowledge of numerical methods, engineering mathematics, programming fundamentals, and finite element analysis concepts

COURSE OBJECTIVE: To impart the knowledge of

1. To solve the mathematical equations and finite element analysis with computational methods like MATLAB and Finite element software using software like ANSYS, ABAQUS etc

EXPERIMENTS/ EXERCISES

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

TOTAL: 60

OUTCOMES:

At the end of the course, the student will be able to carry out

CO1 Thorough knowledge to handle FE software

CO2 Dynamic analysis of frames

CO3 Analysis of thin and thick plates

CO4 Stability Analysis

CO5 Learn to use MATLAB and import MATLAB codes for FE modelling

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	3	3	3	3
2	3	2	3	3	3	2
3	3	3	2	2	3	2
4	3	3	2	2	3	3
5	3	1	3	2	3	3
Avg	3	1.8	2.6	2.4	3	2.6

STRUCTURAL DESIGN STUDIO

Course Code	24ST222	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	0:0:4	Credits	2
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

Prerequisite: Basic knowledge of structural analysis, reinforced concrete design, steel structures, engineering drawing, and construction practices.

COURSE OBJECTIVE: To impart the knowledge of

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

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Understand 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 Observe the flow of forces in a structure and its response to it.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	2	3	3	3
2	3	3	1	2	3	2
3	2	-	3	2	3	2
4	3	3	2	3	-	1
5	3	1	3	3	3	3
Avg	**2.8**	**1.4**	**2.2**	**2.6**	**2.4**	**2.2**

PRACTICAL TRAINING (4 Weeks)

Course Code	24ST321	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	0:0:0	Credits	2
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

COURSE OBJECTIVE: To impart the knowledge of

To train the students in the field work so as to have firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.

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.

OUTCOMES:

- On completion of the course, the student is expected to be able to

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

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	2	1	3	3	3
2	3	-	-	2	1	2
3	2	1	2	2	1	1
4	3	1	3	3	3	3
5	3	2	3	2	3	3
Avg	2.8	1.2	1.8	2.4	2.2	2.4

PROJECT WORK I

Course Code	24ST322	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	180	L:T:P	0:1:2	Credits	6
Handled by	CIVIL	Assessment Methods		IAT	ESE
				50 Marks	50 Marks

COURSE OBJECTIVE: To impart the knowledge of

1. 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.
2. To develop the methodology to solve the identified problem.
3. 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

OUTCOMES:

On completion of the course, the student 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 with

CO5 Report and present the findings of the work conducted.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	2	3	3	1	2
2	3	-	-	2	1	2
3	2	1	2	2	3	2
4	2	-	2	2	2	2
5	2	3	3	2	2	1
Avg	2.4	1.2	2	2.2	1.8	1.8

PROJECT WORK II

Course Code	24ST421	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	360	L:T:P	0:2:4	Credits	12
Handled by	CIVIL	Assessment Methods		IAT	ESE
				50 Marks	50 Marks

COURSE OBJECTIVE: To impart the knowledge of

1. To solve the identified problem based on the formulated methodology.
2. To develop skills to analyze and discuss the test results, and make conclusions.

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.

TOTAL: 360 PERIODS

OUTCOMES:

On completion of the course, the student 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

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	2	3	3	3	3	2
2	2	1	3	3	2	1
3	1	3	1	1	2	1
4	2	3	2	1	2	2
5	3	3	3	2	1	2
Avg	**2**	**2.6**	**2.4**	**2**	**2**	**1.6**

PROFESSIONAL ELECTIVE COURSES
NON-LINEAR ANALYSIS OF STRUCTURES

Course Code	24ST191	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

OBJECTIVE:

1. To study the concept of non-linear behaviour and analysis of elements and simple structures.

UNIT I INTRODUCTION TO NON-LINEAR ANALYSIS 9

Material non-linearity, geometric non-linearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to geometric and material non-linearity; inelastic analysis of bars of uniform and variable stiffness members with and without axial Restraints

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V NON-LINEAR VIBRATION AND INSTABILITY **9**

Nonlinear vibration and Instabilities of elastically supported beams.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOME:

On completion of the course, the student is expected to be able to

CO1 Analyze the bar system considering the material and geometric nonlinearity
CO2 Perform inelastic analysis of flexural members
CO3 Perform vibration analysis of flexural members
CO4 Perform elastic and inelastic analysis of Plates
CO5 Perform nonlinear and instability analysis of elastically supported beams

REFERENCES:

1. Fertis, D.G, Non-linear Mechanics, CRC Press, 1999.
2. Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2014.
3. Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2017.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	2	3	-	2	2	2
2	2	2	3	2	3	1
3	2	2	3	2	2	1
4	2	2	3	2	2	2
5	2	2	3	2	2	2
Avg	2	2.20	3	2	2.2	1.60

STRUCTURAL STABILITY

Course Code	24ST192	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60Marks

Prerequisite: Basic knowledge of engineering mechanics, strength of materials, structural analysis, and theory of structures

OBJECTIVE:

- To study the concept of buckling and analysis of structural elements

UNIT I BUCKLING OF COLUMNS 9

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III TORSIONAL AND LATERAL BUCKLING 9

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV BUCKLING OF PLATES 9

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V INELASTIC BUCKLING **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course, the student is expected to 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 beam – 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

REFERENCES:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
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.
4. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
5. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", Dover Publication, 2012.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	3	2	2
2	3	2	3	2	2	2
3	3	-	3	3	2	3
4	3	2	3	3	1	2
5	3	2	3	2	3	2
Avg	3	2	3	2.6	2	2.2

WIND AND CYCLONE EFFECTS ON STRUCTURES

Course Code	24ST193	Course Type		INTEGRATED	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 50 Marks	ESE 50 Marks

Prerequisite: Basic knowledge of structural analysis, fluid mechanics, structural dynamics, and reinforced concrete/steel structures

OBJECTIVE:

- To study the concept of wind and cyclone effects for the analysis and design of structures.

UNIT I INTRODUCTION **9**

Introduction, Types of wind – Characteristics of wind – Method of Measurement of wind velocity, variation of wind speed with height, shape factor, aspect ratio, drag and lift effects - Dynamic nature of wind –Pressure and suctions - Spectral studies, Gust factor.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II EFFECT OF WIND ON STRUCTURES **9**

Classification of structures – Rigid and Flexible – Effect of wind on structures –Vortex shedding, translational vibration of structures - Static and dynamic effects on Tall buildings – Chimneys

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III DESIGN OF SPECIAL STRUCTURES **9**

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – Design of Industrial Structures– Tall Buildings – Chimneys – Transmission towers and steel monopoles

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV CYCLONE EFFECTS **9**

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V WIND TUNNEL STUDIES **9**

Wind Tunnel Studies, Types of wind tunnels, Types of wind tunnel models - Modelling requirements - Aero dynamic and Aero-elastic models, Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Explain the characteristics of wind

CO2 Evaluate the intensity of wind on structures

CO3 Design some special structures subjected to wind loading

CO4 Design of structures for cyclone

CO5 Model and analyse a structure in a wind tunnel

REFERENCES:

1. Cook.N.J., "The Designer's Guide to Wind Loading of Building Structures", Butterworths, 1990.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, "Wind Effects on Civil Engineering Structures", Elsevier Publications, 1984
3. Lawson T.V., "Wind Effects on Building Vol. I and II", Applied Science Publishers, London,1980.
4. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York, 2014.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	-	2	1	2
2	3	-	3	2	1	2
3	3	2	3	2	2	3
4	3	2	3	2	2	2
5	3	2	3	2	3	2
Avg	**3**	**1.75**	**3**	**2**	**1.80**	**2.2**

PREFABRICATED STRUCTURES

Course Code	24ST194	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of construction materials, structural analysis, reinforced concrete design, and construction techniques

OBJECTIVE:

- To study the design principles, analysis and design of Prefabricated structures.

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III FLOORS, STAIRS AND ROOFS **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV WALLS **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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. Cylindrical, Folded plate and paraboloid shells, Erection and jointing of components in industrial buildings.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to 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

REFERENCES:

1. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2. Koncz.T. Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH, 1971.
3. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, AkademiaiKiado, Budapest, 2007.
4. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, 1988.
5. Structural Design manual, Precast concrete connection details, Society for studies in the use of Precast concrete, Netherland BetorVerlag, 2009.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	1	2	2	2	2
2	3	2	2	3	2	3
3	3	2	3	3	3	3
4	2	1	3	3	3	3
5	2	2	3	3	3	2
Avg	**2.6**	**1.60**	**2.60**	**2.80**	**2.60**	**2.60**

ADVANCED CONCRETE TECHNOLOGY

Course Code	24ST291	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	4
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of construction materials, concrete technology, strength of materials, and structural engineering concepts

OBJECTIVE:

- To study the properties of concrete making materials, tests, mix design, special concretes, and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS **9**

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Develop knowledge on various materials needed for concrete manufacture
CO2 Apply the rules to do mix designs for concrete by various methods
CO3 Develop the methods of manufacturing of concrete.
CO4 Explain about various special concrete
CO5 Explain various tests on fresh and hardened concrete

REFERENCES:

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. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

CO-PO MAPPING

CO	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	2	2	1	1
CO2	2	2	2	2	2	2
CO3	3	2	3	3	1	2
CO4	3	2	3	2	2	1
CO5	2	2	2	2	2	2

ADVANCED PRESTRESSED CONCRETE

Course Code	24ST292	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of reinforced concrete design, prestressed concrete, strength of materials, and structural analysis

OBJECTIVE:

1. To develop an understanding of the philosophy of design of prestressed concrete
2. To be able to design indeterminate prestressed concrete structure
3. 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II DESIGN FOR FLEXURE, SHEAR AND TORSION **9**

Behaviour 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of the course, the student is expected to 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

REFERENCES:

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.andBurns.H "Design of Prestressed Concrete Structures", John Wiley and Sons Inc, 3rd Edition, 2010.
4. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2014.
5. Sinha.N.C.and.Roy.S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co., 1998.
6. Johnson Victor, D., Essentials of Bridge Engineering, Oxford and IBH Publishing Co., New Delhi 2019

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	1	1	1	2	2	3
2	2	2	2	2	1	2
3	3	2	3	2	3	1
4	3	2	3	1	1	2
5	3	2	3	2	3	1
Avg	2.4	1.8	2.4	1.8	2	1.8

RELIABILITY ANALYSIS OF STRUCTURES

Course Code	24ST293	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of probability and statistics, structural analysis, strength of materials, and structural design principles

OBJECTIVE:

- To develop knowledge to solve structural analysis problems using reliability concepts.

UNIT I DATA ANALYSIS **9**

Graphical representation Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$, and parabola, Coefficient of correlation

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II PROBABILITY CONCEPTS **9**

Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III RANDOM VARIABLES **9**

Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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).

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V SYSTEM RELIABILITY **9**

Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1 Achieve the Knowledge of design and development of problem-solving skills.
CO2 Understand the principles of reliability.
CO3 Design and develop analytical skills.
CO4 Summarize the Probability distributions
CO5 Understands the concept of System reliability.

REFERENCES:

1. A Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, New York, 2017.
2. R E Melchers, Structural Reliability Analysis and Prediction, Third Edition, John Wiley & Sons Ltd, Chichester, England,2018.
3. O. Ditlevsen, H. O. Madsen, Structural Reliability Methods, Wiley, 1st Edition, 1996.
4. Srinivasan Chandrasekaran, Offshore Structural Engineering: Reliability and Risk Assessment, CRC Press, Florida, 2016.
5. Jack R Benjamin, C. Allin Cornell, Probability, Statistics, and Decision for Civil Engineers, Dover Publications, New York, 2014.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	3	2	2	2
2	2	1	-	2	3	2
3	3	2	2	2	2	2
4	2	-	1	1	2	2
5	2	2	1	1	2	3
Avg	2.4	1.75	1.75	1.60	2.20	2.20

DESIGN OF FORMWORK

Course Code	24ST294	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of construction materials, reinforced concrete design, structural analysis, and construction practices

OBJECTIVE:

- To study and understand the detailed planning of formwork, Design of forms for various elements such as foundation, slabs, beams, columns and walls.

UNIT I INTRODUCTION **9**

General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNITII FORMWORK MATERIALS AND TYPES **9**

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete,

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III FORMWORK DESIGN **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV FORMWORK DESIGN FOR SPECIAL STRUCTURES **9**

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V FORMWORK FAILURES **9**

Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Select proper formwork, accessories and material
CO2 Design the form work for Beams, Slabs, columns, Walls and Foundations

CO3 Design the form work for Special Structures
CO4 Describe the working of flying formwork.
CO5 Judge the formwork failures through case studies

REFERENCES:

1. Formwork for Concrete Structures, R.L.Peurifoy, McGraw Hill India, 2010.
2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996
5. Michael P. Hurst, Construction Press, London and New York, 2003.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	2	2	1
2	3	1	2	2	2	2
3	3	2	3	2	2	3
4	3	-	-	2	3	2
5	2	2	2	2	3	2
Avg	2.8	1.67	2.33	2	3	2

MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

Course Code	24ST295	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of construction materials, concrete technology, structural analysis, and building construction practices

OBJECTIVE: To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various 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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES 9

Various 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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

REFERENCES:

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012
2. DovKominetzky.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.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
5. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD, Govt of India, New Delhi – 2002
6. BS EN 1504 - Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity

OUTCOMES:

- On completion of the course, the student is expected to 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 Explain the techniques for repair and protection methods

CO5 Explain the repair, rehabilitation and retrofitting of structures and demolition methods.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	2	3	2	2
2	3	1	-	2	2	1
3	3	-	2	2	3	1
4	3	1	-	3	2	2
5	3	2	1	2	2	1
Avg	3	1.33	1.67	2.40	2.20	1.40

MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE MATERIALS

Course Code	24ST296	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of engineering mechanics, strength of materials, material science, and composite materials.

OBJECTIVE:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V APPLICATIONS AND DESIGN **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course, the student is expected to 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

REFERENCES

1. Agarwal. B.D. Broutman. L.J. and Chandrashekara. 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. Hyer M.W., and White S.R., "Stress Analysis of Fiber-Reinforced Composite Materials", D.Estech Publications Inc., 2009
4. Jones R.M., "Mechanics of Composite Materials", Taylor and Francis Group 1999.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press, India, 2005.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	-	3	1	1
2	3	2	2	2	2	2
3	2	3	2	2	3	2
4	3	-	1	2	2	2
5	3	2	2	2	3	2
Avg	2.8	2.33	1.75	2.20	2.20	1.80

DESIGN OF STEEL -CONCRETE COMPOSITE STRUCTURES

Course Code	24ST297	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, steel structures, reinforced concrete design, and strength of materials.

OBJECTIVE:

- To develop an understanding of the behavior and design concrete composite elements and structures.

UNIT I INTRODUCTION **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II DESIGN OF COMPOSITE MEMBERS **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III DESIGN OF CONNECTIONS **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV COMPOSITE BOX GIRDER BRIDGES **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V CASE STUDIES **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Explain composite action

CO2 Design composite elements

CO3 Design connections

CO4 Explain the concept of design of composite box girder bridges

CO5 Study and evaluate case studies

REFERENCES:

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

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	3	2	1
2	3	2	2	2	2	1
3	2	2	1	2	2	1
4	2	2	2	2	2	2
5	3	-	-	3	2	2
Avg	**2.6**	**2**	**1.67**	**2.40**	**2**	**1.40**

DESIGN OF MASONRY STRUCTURES

Course Code	24ST298	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of strength of materials, structural analysis, building materials, and structural design principles.

OBJECTIVE:

- To design, detail and retrofit a masonry structure

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III DESIGN OF MASONRY UNDER 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. Behaviour of Masonry – Shear and flexure – Combined bending and axial loads – Reinforced and unreinforced masonry – Infill masonry

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Explain 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

REFERENCES:

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. R.S. Schneider and W.L. Dickey, "Reinforced Masonry Design", Prentice Hall, 3rd edition, 1994.
4. Paulay, T. and Priestley, M. J. N., "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley, 1992.
5. A.W. Hendry, "Structural Masonry", 2nd Edition, Palgrave McMillan Press, 1998.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	-	3	2	2
2	3	2	2	2	2	3
3	3	2	2	3	2	2
4	3	2	2	2	2	3
5	3	-	-	3	2	2
Avg	3	2	2	2.60	2	2.40

DESIGN OF INDUSTRIAL STRUCTURES

Course Code	24ST391	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, steel structures, reinforced concrete design, and engineering drawing

OBJECTIVE:

- To disseminate knowledge about planning and design of RCC and Steel Industrial structures**.**

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II INDUSTRIAL BUILDINGS 9

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III POWER PLANT STRUCTURES 9

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of self-supporting and guyed chimney, Design of Chimney bases.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V FOUNDATION **9**

Foundation for Towers, Chimneys and Cooling Towers –Design of Block foundations for machines - Design of Turbo Generator Foundation.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1 Develop the concept of planning & functional requirements of industrial standards.

CO2 Analyse and design Steel Gantry girders & Crane girders and RCC design of corbels, nibs and staircase.

CO3 Analyse & design cooling towers, bunkers, silos and pipe supporting structures.

CO4 Analyse and design Steel transmission line towers and chimneys.

CO5 Design foundations for cooling tower, chimneys and turbo generator.

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
3. Swami saran, Analysis & Design of substructures, Limit state Design second Edition.2018.N.Subramaniyan, Design of Steel Structures, United Press, 2018
4. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd edition 2016,

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	3	2	2
2	3	2	2	3	3	2
3	3	2	2	2	3	3
4	3	2	2	3	2	3
5	3	2	2	2	3	3
Avg	**3**	**2**	**2**	**2.6**	**2.60**	**2.60**

ADVANCED DESIGN OF FOUNDATION STRUCTURES

Course Code	24ST392	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of soil mechanics, foundation engineering, structural analysis, and reinforced concrete design

OBJECTIVE:

- To design various types of foundations to fulfill the required criteria.

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V SPECIAL FOUNDATIONS **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course student 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

REFERENCES:

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.
4. Braja M. Das, Principles of Foundations Engineering, Eighth Edition, Thomson Asia (P) Ltd., 2017.
5. Bowels J.E., Foundation Analysis and Design, Fifth Edition, McGraw-Hill International Book Co., 2017.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	2	2	3	2	2
2	3	3	2	2	3	2
3	3	2	2	3	3	3
4	3	2	2	3	2	2
5	3	2	2	2	3	2
Avg	**3**	**2.2**	**2**	**2.60**	**2.60**	**2.20**

OPTIMIZATION OF STRUCTURES

Course Code	24ST393	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of engineering mathematics, structural analysis, numerical methods, and structural design principles

OBJECTIVE: To study the optimization methodologies applied to structural engineering

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9

Definition – Objective Function; Constraints – Equality and inequality – Linear and non-linear Side, Non-negativity, Behaviour and other constraints – Design space – Feasible and infeasible- Convex and Concave – Active constraint – Local and global optima. Differential calculus – Optimality criteria – Single variable optimization – Multivariable optimization with no constraints- - (Lagrange Multiplier method) – with inequality constraints (Khun – Tucker Criteria).

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II LINEAR AND NON-LINEAR PROGRAMMING 9

LINEAR PROGRAMMING: Formulation of problems -Graphical solution – Analytical methods- Standard form - Slack, surplus and artificial variables – Canonical form – Basic feasible solution - simplex method – Two phase method – Penalty method- Duality theory – Primal – Dual algorithm, Dual Simplex method. Non-linear programming: One Dimensional minimization methods: Unidimensional - Unimodal function – Exhaustive and unrestricted search – Dichotomous search - Fibonacci Method – Golden section method -Interpolation methods. Unconstrained optimization Techniques.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III GEOMETRIC PROGRAMMING 9

Polynomial – degree of difficulty – reducing G.P.P to a set of simultaneous equations – Unconstrained and constrained problems with zero difficulty – Concept of solving problems with one degree of difficulty.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV DYNAMIC PROGRAMMING 9

Bellman's principle of optimality – Representation of a multistage decision problem- concept of sub-optimization problems using classical and tabular methods.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory -Minimum weight design for truss members - Fully stressed design – Optimization principles to design of R.C. structures such as multistory buildings, water tanks and bridges.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES: On completion of the course, the student is expected to be able to

CO1 Apply the knowledge of engineering fundamentals to formulate and solve engineering problems by classical optimization techniques.

CO2 Identify, formulate and solve engineering problems by linear and non-linear programming.

CO3 Analyse the problem and reduce G.P.P to a set of simultaneous equations.

CO4 Apply the Engineering knowledge to understand the concept of dynamic programming.

CO5 Design various structural elements with minimum weight.

REFERENCES:

1. Iyengar. N.G.R and Gupta. S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997
2. Rao, S.S. "Engineering Optimization: Theory and Practice", Fourth Edition, Wiley Eastern (P) Ltd., 2013.
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
4. Uri Kirsch, "Optimum Structural Design", McGraw Hill Book Co. 1981.
5. Haftka, R. T. and Gurdal, Z., Elements of Structural Optimization, Springer, 3 rd Edition, 1992

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	2	2	3	2	2
2	3	3	3	2	3	3
3	3	3	3	2	3	2
4	3	-	1	3	2	2
5	3	2	2	2	2	2
Avg	3	2.5	2.2	2.40	2.40	2.20

STRUCTURAL HEALTH MONITORING

Course Code	24ST394	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, sensors and instrumentation, structural dynamics, and data analysis techniques

OBJECTIVE:

- To make the students familiar with various structural health monitoring tools and techniques.

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1 Understand the need, advantages and challenges of SHM

CO2 Know 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

REFERENCES

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
4. Ansari, F Karbhari, Structural health monitoring of civil infrastructure systems, V.M,Woodhead Publishing, 2009
5. J. P. Ou, H. Li and Z. D, "Duan Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
6. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

CO-PO-PSO MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	2	-	-	2	2	2
2	2	1	3	2	2	2
3	2	-	-	3	2	2
4	3	2	3	2	2	2
5	3	3	-	3	2	2
Avg	2.4	2	3	2.40	2	2

DESIGN OF OFFSHORE STRUCTURES

Course Code	24ST395	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, fluid mechanics, reinforced concrete and steel structures, and ocean engineering concepts

OBJECTIVE:

- To impart knowledge about the concept of wave theories, forces, offshore foundation, analysis and design of jacket towers, pipes and cables**.**

UNIT I WAVE THEORIES **9**

Wave generation process, small, finite amplitude and nonlinear wave theories.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II FORCES OF OFFSHORE STRUCTURES **9**

Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING **9**

Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES **9**

Static method of analysis, foundation analysis and dynamics of offshore structures.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V DESIGN OF OFFSHORE STRUCTURES **9**

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to 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 Analyse offshore structures by means of static and dynamic methods

CO5 Design of jacket towers, mooring cables and pipelines

REFERENCES:

1. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
2. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer – Verlag, 2003.
3. Chakrabarti, S.K. 1994, Offshore Structure Modelling: World Scientific
4. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures.
5. B. Gou, S.Song, J Chacko and A. Ghalambar, offshore pipelines, GPP publishers, 2006.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	3	1	2
2	3	2	-	3	2	1
3	3	2	2	2	1	1
4	3	1	2	2	2	2
5	3	2	2	3	2	2
Avg	**3**	**1.75**	**2**	**2.60**	**1.60**	**1.60**

PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION

Course Code	24ST396	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of soil mechanics, foundation engineering, structural analysis, and structural dynamics.

OBJECTIVE:

- To study the concept of soil-structure – interaction in the analysis and design of structures.

UNIT I SOIL-FOUNDATION INTERACTION 9

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II BEAM ON ELASTIC FOUNDATION- SOIL MODELS 9

Infinite beam – Two-parameters models – Isotropic elastic half space model – Analysis of beams of finite length – combined footings.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III PLATES ON ELASTIC CONTINUUM 9

Thin and thick rafts – Analysis of finite plates - Numerical analysis of finite plates.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV ANALYSIS OF AXIALLY AND LATERALLY LOADED PILES AND PILE GROUPS 9

Elastic analysis of single pile – Theoretical solutions for settlement and load distributions – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile-raft system.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V GROUND-FOUNDATION-STRUCTURE INTERACTION 9

Effect of structure on ground-foundation interaction – Static and dynamic loads- Contact pressure and its estimation – Estimation of the settlement from the constitutive laws – Free-field response – Kinetic interaction – Inertial interaction

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of the course, the student is expected to 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 Analyse 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

REFERENCES:

1. John P. Wolf, (1985) 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.
4. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.
5. A.P.S. Selvadurai, Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co., 1979.
6. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice."John Wiley & Sons, New York, 1990.
7. Rolando P. Orense, Nawawi Chouw& Michael J. Pender – Soil-Foundation-Structure Interaction, CRC Press, Taylor & Francis Group, London, UK, 2010.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	-	-	3	2	2
2	3	2	2	2	3	3
3	3	2	2	2	3	3
4	3	2	3	3	2	2
5	3	2	3	3	2	2
Avg	**3**	**2**	**2.5**	**2.60**	**2.40**	**2.40**

DESIGN OF BRIDGE STRUCTURES

Course Code	24ST397	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, reinforced concrete design, steel structures, transportation engineering, and foundation engineering**.**

OBJECTIVE:

- To study the loads, forces on bridges and design principles of several types of 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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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 superstructure (RCC and PSC); Longitudinal Analysis of Bridge - Transverse Analysis of Bridge

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV SUBSTRUCTURE, BEARINGS AND DECK JOINTS **9**

Design of bridge bearings and substructure

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

- On completion of this course, student will be able to

CO1 Explain the different types of bridges and design philosophies

CO2 Design an RC solid slab culvert bridge

CO3 Design an 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

REFERENCES:

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.
4. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi,2014.
5. Design of Highway Bridges, Richard M. Barker & Jay A. Puckett, John Wiley & Sons, Inc., 2021

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	**2**	**3**	**1**	**2**	**3**
1	3	-	-	3	1	2
2	3	2	2	2	3	3
3	3	2	2	2	3	2
4	3	2	2	2	3	3
5	3	2	2	2	3	3
Avg	**3**	**2**	**2**	**2.20**	**2.60**	**2.60**

DESIGN OF SHELL AND SPATIAL STRUCTURES

Course Code	24ST398	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of structural analysis, strength of materials, theory of structures, and reinforced concrete or steel design

OBJECTIVE:

- To study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNITI CLASSIFICATION OF SHELLS **9**

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II FOLDED PLATES **9**

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof- Prismoidal roof.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III INTRODUCTION TO SPACE FRAME **9**

Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV ANALYSIS AND DESIGN **9**

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to Computer- Aided Design.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V SPECIAL METHODS **9**

Application of Formex Algebra, FORMIAN for generation of configuration.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1 Explain the different forms of shells and design the domes and shells

CO2 Evaluate the structural behaviour and design of folded plate structures

CO3 Explain the various functional configurations of space frames

CO4 Design of space frames and apply the knowledge of CAD for the analysis of space structures

CO5 Analyse the configurations of space structures using FORMIAN software

REFERENCES

1. Billington. D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, ASCE Manual No.31, Design of Cylindrical Shells,1982.
2. Varghese. P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.
3. Subramanian. N," Space Structures: Principles and Practice", Multi-Science Publishing Co. Ltd. 2008.
4. Ramasamy, G.S., "Analysis, Design and Construction of Steel Space Frames", Thomas Telford Publishing, 2002.
5. Wilby. C "Concrete Folded Plate Roofs", Elsevier, 1998.

COs- PO's & PSO's MAPPING

CO	PO			PSO		
	1	2	3	1	2	3
1	3	2	2	3	3	2
2	3	2	-	3	2	2
3	2	-	-	2	2	2
4	2	2	2	2	2	2
5	3	3	3	2	2	2
Avg	2.6	2.25	2.33	2.20	2.20	2

AUDIT COURSES

ENGLISH FOR RESEARCH PAPER WRITING

Course Code	24AX091	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	2:0:0	Credits	0
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of English grammar, technical communication, research methodology, and academic writing skills.

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II PRESENTATION SKILLS **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III TITLE WRITING SKILLS **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV RESULT WRITING SKILLS **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V VERIFICATION SKILLS **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 30

OUTCOMES

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES

1. Adrian Wallwork, 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.

DISASTER MANAGEMENT

Course Code	24AX902	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	2:0:0	Credits	0
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of environmental science, geography, public safety, and emergency response concepts.

OBJECTIVES

1. Summarize basics of disaster
2. Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3. Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4. Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5. Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III DISASTER PRONE AREAS IN INDIA 6

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V RISK ASSESSMENT 6

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 30

OUTCOMES

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES

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.

CONSTITUTION OF INDIA

Course Code	24AX903	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	30	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of Indian history, civics, governance, and social studies.

OBJECTIVES:Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION 6

History, Drafting Committee, (Composition & Working)

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES 6

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV ORGANS OF GOVERNANCE 6

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V LOCAL ADMINISTRATION **6**

District's Administration head: Role and Importance. Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT VI ELECTION COMMISSION **6**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 30

OUTCOMES

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization
3. of social reforms leading to revolution in India.
4. Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

நற்றமிழ் இலக்கியம்

Course Code	24AX904	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	30	L:T:P	2:0:0	Credits	0
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

24AX904 **நற்றமிழ் இலக்கியம்** **L T P C**
2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்

5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
- தமிழின் முதல் புதினம்,
- தமிழின் முதல் சிறுகதை,
- கட்டுரை இலக்கியம்,
- பயண இலக்கியம்,
- நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

OPEN ELECTIVES

VIBRATION AND NOISE CONTROL STRATEGIES

Course Code	24OE905	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of engineering mechanics, vibrations, acoustics, dynamics, and control systems.

OBJECTIVES

- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT I BASICS OF VIBRATION **9**

Introduction – Sources and causes of Vibration-Mathematical Models - Displacement, velocity and Acceleration - Classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration - Single Degree Freedom Systems - Vibration isolation - Determination of natural frequencies

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II BASICS OF NOISE **9**

Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III INSTRUMENTATION FOR VIBRATION MEASUREMENT **9**

Experimental Methods in Vibration Analysis.- Vibration Measuring Instruments - Selection of Sensors - Accelerometer Mountings - Vibration Exciters - Mechanical, Hydraulic, Electromagnetic and Electrodynamics – Frequency Measuring Instruments -. System Identification from Frequency Response -Testing for resonance and mode shapes

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS 9

Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL 9

Specification of Vibration Limits – Vibration severity standards - Vibration as condition Monitoring Tool – Case Studies - Vibration Isolation methods - Dynamic Vibration Absorber – Need for Balancing - Static and Dynamic Balancing machines – Field balancing - Major sources of noise - Noise survey techniques – Measurement technique for vehicular noise - Road vehicles Noise standard – Noise due to construction equipment and domestic appliances – Industrial noise sources and its strategies – Noise control at the source – Noise control along the path – Acoustic Barriers – Noise control at the receiver -- Sound transmission through barriers – Noise reduction Vs Transmission loss – Enclosures

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

OUTCOMES:

On Completion of the course the student will be able to

1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

1. Singiresu S. Rao, “Mechanical Vibrations”, Pearson Education Incorporated, 2017.
2. Graham Kelly. Sand Shashidhar K. Kudari, “Mechanical Vibrations”, Tata McGraw –Hill Publishing Com. Ltd., 2007.
3. Ramamurti. V, “Mechanical Vibration Practice with Basic Theory”, Narosa Publishing House, 2000.
4. William T. Thomson, “Theory of Vibration with Applications”, Taylor & Francis, 2003.
5. G.K. Grover, “Mechanical Vibrations”, Nem Chand and Bros.,Roorkee, 2014.
6. A.G. Ambekar, “Mechanical Vibrations and Noise Engineering”, PHI Learning Pvt. Ltd., 2014.
7. David A. Bies and Colin H. Hansen, “Engineering Noise Control – Theory and Practice”, Spon Press, London and New York, 2009.

ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

Course Code	24OE906	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of energy resources, electrical systems, environmental science, and sustainable energy concepts.

COURSE OBJECTIVES:

- To learn the present energy scenario and the need for energy conservation.
- To understand the different measures for energy conservation in utilities.
- Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
- To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
- To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement

UNIT I ENERGY SCENARIO 9

Primary energy resources - Sectorial energy consumption (domestic, industrial and other sectors), Energy pricing, Energy conservation and its importance, Energy Conservation Act-2001 and its features – Energy star rating.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II HEATING, VENTILLATION & AIR CONDITIONING 9

Basics of Refrigeration and Air Conditioning – COP / EER / SEC Evaluation – SPV system design & optimization for Solar Refrigeration.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III LIGHTING, COMPUTER, TV 9

Specification of Luminaries – Types – Efficacy – Selection & Application – Time Sensors – Occupancy Sensors – Energy conservation measures in computer – Television – Electronic devices.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV ENERGY EFFICIENT BUILDINGS 9

Conventional versus Energy efficient buildings – Landscape design – Envelope heat loss and heat

gain – Passive cooling and heating – Renewable sources integration.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V ENERGY STORAGE TECHNOLOGIES 9

Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

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

1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:

1. Yogi Goswami, Frank Kreith, Energy Efficiency and Renewable energy Handbook, CRC Press, 2016
2. ASHRAE Handbook 2020 – HVAC Systems & Equipment
3. Paolo Bertoldi, Andrea Ricci, Anibal de Almeida, Energy Efficiency in Household Appliances and Lighting, Conference proceedings, Springer, 2001
4. David A. Bainbridge, Ken Haggard, Kenneth L. Haggard, Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows, Chelsea Green Publishing, 2011.
5. Guide book for National Certification Examination for Energy Managers and Energy Auditors (Could be downloaded from www.energymanagertraining.com)
6. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.
7. Robert Huggins, Energy Storage: Fundamentals, Materials and Applications, 2nd edition, Springer, 2015
8. Ru-shiliu, Leizhang, Xueliang sun, Electrochemical technologies for energy storage and conversion, Wiley publications, 2012.

ADDITIVE MANUFACTURING

Course Code	24OE907	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of engineering graphics, manufacturing processes, engineering materials, and computer-aided design (CAD).

Course Objectives

1. To understand the fundamentals, evolution, and process chain of Additive Manufacturing (AM).
2. To learn design principles, CAD model preparation, slicing, and tool path generation for AM.
3. To study various additive manufacturing technologies, materials, advantages, limitations, and applications.
4. To analyze powder-based, extrusion-based, vat polymerization, and sheet lamination processes.
5. To explore industrial applications, business opportunities, intellectual property issues, and future trends in Additive Manufacturing.

UNIT I INTRODUCTION **9**

Need - Development - Rapid Prototyping Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification – Benefits.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II DESIGN FOR ADDITIVE MANUFACTURING **9**

CAD Model Preparation - Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation Customized Design and Fabrication - Case Studies.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III VAT POLYMERIZATION **9**

Stereolithography Apparatus (SLA)- Materials -Process -Advantages Limitations- Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and Limitations.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION 9

Fused Deposition Modeling (FDM)- Process-Materials - Applications and Limitations. Sheet Lamination Process: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials- Application and Limitation - Bio-Additive Manufacturing Computer Aided Tissue Engineering (CATE) – Case studies

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

POWDER BASED PROCESS

Selective Laser Sintering (SLS): Process –Mechanism– Typical Materials and Application- Multi Jet Fusion - Basic Principle-– Materials- Application and Limitation - Three Dimensional Printing - Materials -Process - Benefits and Limitations. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS)- Process -Material Delivery - Process Parameters -Materials - Benefits -Applications.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES 9

Education and training - Automobile- pattern and mould - tooling - Building Printing-Bio Printing - medical implants -development of surgical tools Food Printing -Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.

TOTAL: 45 PERIODS

REFERENCES:

1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1- 56990-582-1.
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126.
3. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590
4. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
5. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.

ELECTRIC VEHICLE TECHNOLOGY

Course Code	24OE908	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Pre requisite: Basic knowledge of electrical circuits, electrical machines, power electronics, energy systems, and automotive engineering concepts**.**

Course Objectives

1. To understand the fundamentals, architecture, and classifications of electric and hybrid electric vehicles.
2. To study electric propulsion systems, power electronics, motors, and control strategies used in EVs.
3. To learn the principles of battery technologies, energy storage systems, and battery management systems.
4. To analyze charging infrastructure, vehicle performance, energy efficiency, and environmental impacts of EVs.
5. To explore recent advancements, challenges, and future trends in electric vehicle technology and sustainable transportation.

Top of Form

Bottom of Form

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II ELECTRIC VEHICLE ARCHITECHTURE 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III ENERGY STORAGE **9**

Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical 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 cell

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

REFERENCES:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition CRC Press, 2011.
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

NEW PRODUCT DEVELOPMENT

Course Code	24OE909	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of engineering design, manufacturing processes, product lifecycle concepts, and management principles**.**

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Appling the principles of Industrial design and prototype for new product design and development.

UNIT I INTRODUCTION TO PRODUCTDESIGN & DEVELOPMENT 9

Introduction – Characteristics of Successful Product Development – People involved in Product Design and Development – Duration and Cost of Product Development – The Challenges of Product Development – The Product Development Process – Concept Development: The Front- End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II OPPORTUNITY DENTIFICATION & PRODUCT PLANNING 9

Opportunity Identification: Definition – Types of Opportunities – Tournament Structure of Opportunity Identification – Effective Opportunity Tournaments – Opportunity Identification Process – Product Planning: Four types of Product Development Projects – The Process of Product Planning.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS 9

Identifying Customer Needs: The Importance of Latent Needs – The Process of Identifying Customer Needs. Product Specifications: Definition – Time of Specifications Establishment – Establishing Target Specifications – Setting the Final Specifications

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV CONCEPT GENERATION, SELECTION & TESTING 9

Concept Generation: Activity of Concept Generation – Structured Approach – Five step method of Concept Generation. Concept Selection: Methodology – Concept Screening and Concepts Scoring. Concept testing: Seven Step activities of concept testing.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNITV INDUSTRIAL DESIGN & PROTOTYPING 9

Industrial Design: Need and Impact–Industrial Design Process. Prototyping – Principles of Prototyping – Prototyping Technologies – Planning for Prototypes.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

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

1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

1. Ulrich K.T., Eppinger S. D. and Anita Goyal, "Product Design and Development "McGraw-Hill Education; 7 edition, 2020.

REFERENCES:

1. Belz A., 36-Hour Course: "Product Development" McGraw-Hill, 2010.
2. Rosenthal S.,"Effective Product Design and Development", Business One Orwin,Homewood, 1992,ISBN1-55623-603-4.
3. Pugh.S,"Total Design Integrated Methods for Successful Product Engineering", Addison Wesley Publishing,1991,ISBN0-202-41639-5.
4. Chitale, A. K. and Gupta, R. C., Product Design and Manufacturing, PHI Learning, 2013.
5. Jamnia, A., Introduction to Product Design and Development for Engineers, CRC Press, 2018.

SUSTAINABLE MANAGEMENT

Course Code	24OE910	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of management principles, environmental science, resource management, and sustainable development concepts.

COURSE OBJECTIVES:

- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY 9

Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9

Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9

Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV SUSTAINABILITY AND INNOVATION 9

Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

Energy management, Water management, Waste management, Wild Life Conservation, Emerging trends in sustainable management, Case Studies.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.

CO2: An understanding of corporate sustainability and responsible Business Practices

CO3: Knowledge and skills to understand, to measure and interpret sustainabilityperformances.

CO4: Knowledge of innovative practices in sustainable business and community management

CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:

1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2. Christian N. Madu, Handbook of Sustainability Management 2012
3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

MICRO AND SMALL BUSINESS MANAGEMENT

Course Code	24OE911	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of business management, entrepreneurship, finance, and organizational principles.

COURSE OBJECTIVES

- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I INTRODUCTION TO SMALL BUSINESS 9

Creation, Innovation, entrepreneurship and small business - Defining Small Business –Role of Owner – Manager – government policy towards small business sector –elements of entrepreneurship –evolution of entrepreneurship –Types of Entrepreneurship – social, civic, corporate - Business life cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II CREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9

Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III BUILDING THE RIGHT TEAM AND MARKETING STRATEGY 9

Management and Leadership – employee assessments – Tuckman's stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems, - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV FINANCING SMALL BUSINESS 9

Main sources of entrepreneurial capital; Nature of 'bootstrap' financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9

Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES

CO1. Familiarise the students with the concept of small business

CO2. In depth knowledge on small business opportunities and challenges

CO3. Ability to devise plans for small business by building the right skills and marketing strategies

CO4. Identify the funding source for small start ups

CO5. Business evaluation for buying and selling of small firms

REFERENCES

1. Hankinson,A.(2000). "The key factors in the profile of small firm owner-managers that influence business performance. The South Coast Small Firms Survey, 1997-2000." Industrial and Commercial Training 32(3):94-98.
2. Parker,R.(2000). "Small is not necessarily beautiful: An evaluation of policy support for small and medium-sized enterprise in Australia." Australian Journal of Political Science 35(2):239-253.
3. Journal articles on SME's.

INTELLECTUAL PROPERTY RIGHTS

Course Code	24OE912	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of innovation, research methodology, technology management, and legal awareness.

COURSE OBJECTIVE

- To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION **9**

Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II PROCESS **9**

New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III STATUTES **9**

International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Design Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY **9**

Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V MODELS **9**

The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES

CO1: Understanding of intellectual property and appreciation of the need to protect it

CO2: Awareness about the process of patenting

CO3: Understanding of the statutes related to IPR

CO4: Ability to apply strategies to protect intellectual property

CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES

1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006.
2. Intellectual Property rights and copyrights, EssEss Publications.
3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company.
4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006.
5. WIPO Intellectual Property Hand book.

ETHICAL MANAGEMENT

Course Code	24MGOE3	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of management principles, organizational behaviour, and professional ethics.

COURSE OBJECTIVE

- To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY **9**

Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society's expectations- Individual and organizational responsibility to society and the community.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS **9**

Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT **9**

Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANJAGEMENT **9**

Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS **9**

Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES

CO1: Role modelling and influencing the ethical and cultural context.

CO2: Respond to ethical crises and proactively address potential crises situations.

CO3: Understand and implement stakeholder management decisions.

CO4: Develop the ability, knowledge, and skills for ethical management.

CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES

1. Brad Agle, Aaron Miller, Bill O' Rourke, The Business Ethics Field Guide: the essential companion to leading your career and your company, 2016.
2. Steiner & Steiner, Business, Government & Society: A managerial Perspective, 2011.
3. Lawrence & Weber, Business and Society: Stakeholders, Ethics, Public Policy, 2020.

IoT FOR SMART SYSTEMS

Course Code	24OE914	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of sensors, embedded systems, computer networks, programming, and wireless communication concepts.

COURSE OBJECTIVES:

To study about **Internet of Things** technologies and its role in real time applications.

1. To introduce the infrastructure required for IoT
2. To familiarize the accessories and communication techniques for IoT.
3. To provide insight about the embedded processor and sensors required for IoT
4. To familiarize the different platforms and Attributes 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT 9

PROTOCOLS:

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3.

UNIT V CASE STUDIES **9**

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

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

At the end of this course, the students will have the ability 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

REFERENCES:

1. ArshdeepBahga and VijaiMadisetti : A Hands-on Approach "Internet of Things",Universities Press 2015.
2. Oliver Hersent , David Boswarthick and Omar Elloumi " The Internet of Things", Wiley,2016.
3. Samuel Greengard, " The Internet of Things", The MIT press, 2015.
4. Adrian McEwen and Hakim Cassimally"Designing the Internet of Things "Wiley,2014.
5. Jean- Philippe Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP: The Next Internet" Morgan Kuffmann Publishers, 2010.
6. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and sons, 2014.
7. Lingyang Song/DusitNiyato/ Zhu Han/ Ekram Hossain," Wireless Device-to-Device Communications and Networks, CAMBRIDGE UNIVERSITY PRESS,2015.
8. OvidiuVermesan and Peter Friess (Editors), "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication, 2013.
9. Vijay Madisetti , ArshdeepBahga, "Internet of Things (A Hands on-Approach)", 2014.
10. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", John Wiley and sons, 2009.
11. Lars T.Berger and Krzysztof Iniewski, "Smart Grid applications, communications and security", Wiley, 2015.
12. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama and Nick Jenkins, " Smart Grid Technology and Applications", Wiley, 2015.
13. UpenaDalal,"Wireless Communications & Networks,Oxford,2015.

MACHINE LEARNING AND DEEP LEARNING

Course Code	24OE915	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	60	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of programming, linear algebra, probability, statistics, and artificial intelligence concepts

COURSE OBJECTIVES:

The course is aimed at

1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II NEURAL NETWORKS 9

Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS 9

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V DEEP LEARNING: RNNS, AUTOENCODERS AND GANS 9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL : 45

COURSE OUTCOMES (CO):

At the end of the course the student will be able to

CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.

REFERENCES:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing - A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, Yoshua Bengio and Aaron Courville, MIT Press, ISBN: 9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017

RENEWABLE ENERGY TECHNOLOGY

Course Code	24OE916	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of energy resources, electrical systems, thermodynamics, and environmental science.

OBJECTIVES:

To impart knowledge on

- Different types of renewable energy technologies
- Standalone operation, grid connected operation of renewable energy 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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL : 45

OUTCOMES

After completion of this course, the student 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

REFERENCES:

1. S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford UniversityPress, 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.
5. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006
6. Gray, L. Johnson, "Wind energy system", prentice hall of India, 1995.
7. B.H.Khan, " Non-conventional Energy sources", , McGraw-hill, 2nd Edition,2009.Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.

SMART GRID

Course Code	24OE917	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of electrical power systems, power electronics, communication networks, and control systems.

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS9

Architecture and Standards -Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL : 45

COURSE OUTCOME:

Students able to

CO1: Relate with the smart resources, smart meters and other smart devices.

CO2: Explain the function of Smart Grid.

CO3: Experiment the issues of Power Quality in Smart Grid.

CO4: Analyze the performance of Smart Grid.

CO5**:** Recommend suitable communication networks for smart grid applications

REFERENCES

1. Stuart Borlase ‘Smart Grid: Infrastructure, Technology and Solutions’, CRC Press 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, ‘Smart Grid: Technology and Applications’, Wiley, 2012.
3. Mini S. Thomas, John D McDonald, ‘Power System SCADA and Smart Grids’, CRC Press, 2015
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, ‘Communication Networks for Smart Grids’, Springer, 2014
5. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication

SECURITY PRACTICES

Course Code	24OE928	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of computer networks, operating systems, information security fundamentals, and programming concepts

COURSE OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY 9

Model of network security – Security attacks, services and mechanisms – OSI security architecture -A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II NETWORK SECURITY 9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security - Case Study - Kali Linux.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III SECURITY MANAGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

Cyber Forensics- Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics- Best security practices for automate Cloud infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, “The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics”, Syngress, 2012
6. Cory Altheide and Harlan Carvey, “Digital Forensics with Open Source Tools”,2011 Syngress, ISBN: 9781597495875.
7. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013

CLOUD COMPUTING TECHNOLOGIES

Course Code	24OE929	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of computer networks, operating systems, virtualization, databases, and web technologies.

COURSE OBJECTIVES:

- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II CLOUD PLATFORM ARCHITECTURE 12

Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Architectural Design Challenges

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III AWS CLOUD PLATFORM - IAAS 9

Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes- AWS Developer Tools: AWS Code Commit, AWS Code Build, AWS Code Deploy, AWS Code Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control Tower, Cloud Formation, Cloud Trail, AWS License Manager

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV PAAS CLOUD PLATFORM **9**

Windows Azure: Origin of Windows Azure, Features, The Fabric Controller – First Cloud APP in Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime API- Windows Azure Developer Portal- Service Management API- Windows Azure Storage Characteristics-Storage Services- REST API- Blops

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V PROGRAMMING MODEL **9**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread Programming, Task Programming and Map-Reduce Programming in Aneka

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.

REFERENCES

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly,2010.
4. Rajkumar Buyya, Christian Vacchiola, S.Thamarai Selvi, Mastering Cloud Computing , MCGraw Hill Education (India) Pvt. Ltd., 2013.
5. Danielle Ruest, Nelson Ruest, ―Virtualization: A Beginner"s Guide‖, McGraw-Hill Osborne Media, 2009.
6. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
7. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
8. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
9. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

BLOCKCHAIN TECHNOLOGIES

Course Code	24OE926	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of computer networks, cryptography, distributed systems, and programming fundamentals.

COURSE OBJECTIVES:

1. This course is intended to study the basics of Blockchain technology.
2. During this course the learner will explore various aspects of Blockchain technology like application in various domains.
3. By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN 9

Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II BITCOIN AND CRYPTOCURRENCY 9

Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

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UNIT III INTRODUCTION TO ETHEREUM 9

Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING10

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V BLOCKCHAIN APPLICATIONS 8

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016
3. Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014. .
4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018.
5. D. Drescher, Blockchain Basics. Apress, 2017.

DEEP LEARNING

Course Code	24OE927	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of programming, linear algebra, probability, statistics, machine learning concepts, and data analysis**.**

COURSE OBJECTIVES:

1. Develop and Train Deep Neural Networks.
2. Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3. Build and train RNNs, work with NLP and Word Embeddings
4. The internal structure of LSTM and GRU and the differences between them
5. The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS **6**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II NEURAL NETWORKS **9**

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III CONVOLUTIONAL NEURAL NETWORK **10**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R- CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV NATURAL LANGUAGE PROCESSING USING RNN **10**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING **10**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL : 45

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

REFERENCES

2. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
3. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
5. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
6. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

DESIGN THINKING

Course Code	24OE930	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of problem-solving, creativity, innovation, and product development concepts.

COURSE OBJECTIVES:

1. To provide a sound knowledge in UI & UX
2. To understand the need for UI and UX
3. Research Methods used in Design
4. Tools used in UI & UX
5. Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE 8

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II CONTEXTUAL INQUIRY 10

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

Design-informing models: second span of the bridge. Some general “how to” suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV UX GOALS, METRICS, AND TARGETS 8

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V ANALYSING USER EXPERIENCE 10

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL : 45

SUGGESTED ACTIVITIES:

1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

COURSE OUTCOMES:

CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to- Day Development Work, Westley Knight. Apress, 2018
2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and

Dan Goodwin. SitePoint, 2017

PRINCIPLES OF MULTIMEDIA

Course Code	24OE931	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of computer fundamentals, digital media, graphics, and programming concepts.

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION 9

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:

1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II ELEMENTS OF MULTIMEDIA 9

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

1. Flipped classroom on different file formats of various media elements.
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

1. Demonstration on after effects animations.

2. Quizzes on file formats and color models.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III MULTIMEDIA TOOLS **9**

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:

1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV MULTIMEDIA SYSTEMS **9**

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics, basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS **9**

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing – social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL : 45

Course Outcomes:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, "MULTIMEDIA SYSTEMS DESIGN", Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw-Hill Education, 2017

BIG DATA ANALYTICS

Course Code	24OE918	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of databases, programming, statistics, data structures, and data processing concepts

COURSE OBJECTIVES:

1. To understand the basics of big data analytics
2. To understand the search methods and visualization
3. To learn mining data streams
4. To learn frameworks
5. To gain knowledge on R language

UNIT I INTRODUCTION TO BIG DATA 9

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis Vs Reporting - Modern Data Analytic Tools- Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II SEARCH METHODS AND VISUALIZATION 9

Search by simulated Annealing – Stochastic, Adaptive search by Evaluation – Evaluation Strategies –Genetic Algorithm – Genetic Programming – Visualization – Classification of Visual Data Analysis Techniques – Data Types – Visualization Techniques – Interaction techniques – Specific Visual data analysis Techniques

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III MINING DATA STREAMS 9

Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV FRAMEWORKS **9**

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V R LANGUAGE **9**

Overview, Programming structures: Control statements -Operators -Functions -Environment and scope issues -Recursion -Replacement functions, R data structures: Vectors -Matrices and arrays - Lists -Data frames -Classes, Input/output, String manipulations

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL:45

COURSE OUTCOMES:

CO1:understand the basics of big data analytics

CO2: Ability to use Hadoop, Map Reduce Framework.

CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.

CO4:gain knowledge on R language

CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

REFERENCE:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 3rd edition 2020.
3. Norman Matloff, The Art of R Programming: A Tour of Statistical Software Design, No Starch Press, USA, 2011.
4. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & sons, 2012.
5. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007.

INTERNET OF THINGS AND CLOUD

Course Code	24OE919	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT	ESE
				40 Marks	60 Marks

Prerequisite: Basic knowledge of computer networks, cloud computing, embedded systems, sensors, and programming fundamentals

COURSE OBJECTIVES:

1. To understand Smart Objects and IoT Architectures
2. To learn about various IOT-related protocols
3. To build simple IoT Systems using Arduino and Raspberry Pi.
4. To understand data analytics and cloud in the context of IoT
5. To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IoT **9**

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II PROTOCOLS FOR IoT **9**

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage- IoT privacy, security and vulnerability solutions.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS **9**

Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV CLOUD COMPUTING INTRODUCTION **9**

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts –

Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT V IoT AND CLOUD **9**

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

TOTAL:45

COURSE OUTCOMES:

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

CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
4. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.

MEDICAL ROBOTICS

Course Code	24OE920	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of robotics, sensors, control systems, embedded systems, and biomedical engineering concepts.

COURSE OBJECTIVES:

1. To explain the basic concepts of robots and types of robots
2. To discuss the designing procedure of manipulators, actuators and grippers
3. To impart knowledge on various types of sensors and power sources
4. To explore various applications of Robots in Medicine
5. To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS **9**

Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators

Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT II MANIPULATORS & BASIC KINEMATICS **9**

Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning

Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT III SURGICAL ROBOTS **9**

Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS **9**

Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V WEARABLE ROBOTS **9**

Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL:45

COURSE OUTCOMES:

CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

1. Nagrath and Mittal, “Robotics and Control”, Tata McGraw Hill, First edition, 2003
2. Spong and Vidhyasagar, “Robot Dynamics and Control”, John Wiley and Sons, First edition, 2008
3. Fu.K.S, Gonzalez. R.C., Lee, C.S.G, “Robotics, control”, sensing, Vision and Intelligence, Tata McGraw Hill International, First edition, 2008
4. Bruno Siciliano, Oussama Khatib, Springer Handbook of Robotics, 1st Edition, Springer, 2008
5. Shane (S.Q.) Xie, Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances, Springer, 2016
6. Sashi S Kommu, Rehabilitation Robotics, I-Tech Education and Publishing, 2007
7. Jose L. Pons, Wearable Robots: Biomechatronic Exoskeletons, John Wiley & Sons Ltd, England, 2008
8. Howie Choset, Kevin Lynch, Seth Hutchinson, “Principles of Robot Motion: Theory, Algorithms, and Implementations”, Prentice Hall of India, First edition, 2005
9. Philippe Coiffet, Michel Chirouze, “An Introduction to Robot Technology”, Tata McGraw Hill, First Edition, 1983
10. Jacob Rosen, Blake Hannaford & Richard M Satava, “Surgical Robotics: System Applications & Visions”, Springer 2011
11. Jocelyn Troccaz, Medical Robotics, Wiley, 2012
12. Achim Schweikard, Floris Ernst, Medical Robotics, Springer, 2015

EMBEDDED AUTOMATION

Course Code	24OE921	Course Type		THEORY	
Course Offered to	M. E. STRUCTURAL ENGINEERING				
Total Teaching Periods	45	L:T:P	3:0:0	Credits	3
Handled by	CIVIL	Assessment Methods		IAT 40 Marks	ESE 60 Marks

Prerequisite: Basic knowledge of embedded systems, microcontrollers, sensors, control systems, and programming fundamentals.

COURSE OBJECTIVES:

1. To learn about the process involved in the design and development of real-time embedded system
2. To develop the embedded C programming skills on 8-bit microcontroller
3. To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
4. To learn about the tools, firmware related to microcontroller programming
5. To build a home automation system

UNIT I INTRODUCTION TO EMBEDDED C PROGRAMMING 9

C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT II AVR MICROCONTROLLER 9

ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS 9

Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

Teaching-Learning Process **Pedagogy:** Lecture, PPT
RBT Level: L1- L3

UNIT IV VISION SYSTEM **9**

Fundamentals of Image Processing - Filtering - Morphological Operations - Feature Detection and Matching - Blurring and Sharpening - Segmentation - Thresholding - Contours - Advanced Contour Properties - Gradient - Canny Edge Detector - Object Detection - Background Subtraction

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

UNIT V HOME AUTOMATION **9**

Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

Teaching-Learning Process **Pedagogy:** Lecture, PPT

RBT Level: L1- L3

TOTAL: 45

COURSE OUTCOMES:

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

CO1: analyze the 8-bit series microcontroller architecture, features and pin details

CO2: write embedded C programs for embedded system application

CO3: design and develop real time systems using AVR microcontrollers

CO4: design and develop the systems based on vision mechanism **CO5**:

design and develop a real time home automation system

REFERENCES:

1. Dhananjay V. Gadre, "Programming and Customizing the AVR Microcontroller", McGraw-Hill, 2001.
2. Joe Pardue, "C Programming for Microcontrollers ", Smiley Micros, 2005.
3. Steven F. Barrett, Daniel J. Pack, "ATMEL AVR Microcontroller Primer : Programming and Interfacing", Morgan & Claypool Publishers, 2012
4. Mike Riley, "Programming Your Home - Automate With Arduino, Android and Your Computer", the Pragmatic Programmers, Llc, 2012.
5. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
6. Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", the MIT Press Cambridge, Massachusetts, London, 2012.