ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

Effective from the Academic Year 2020-21 onwards

M. Tech. Two Year Degree Course

(MR20 Regulations)

in

Structural Engineering (SE)

Department of Civil Engineering

MALLA REDDY ENGINEERING COLLEGE (Autonomous)

(An UGC Autonomous Institution, Approved by AICTE and Affiliated to JNTUH Hyderabad, Recognized under 2(f) &12 (B) of UGC Act 1956, Accredited by NAAC with 'A' Grade (II Cycle)
Maisammaguda, Dhulapally (Post Via Kompally), Secunderabad-500 100
www.mrec.ac.in E-mail: principal@mrec.ac.in

MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

MR20 ACADEMIC REGULATIONS (CBCS)
For M. Tech. (REGULAR) DEGREE PROGRAMME

Applicable for the students of M. Tech. (Regular) programme admitted from the Academic Year ***2020-2021*** and onwards.

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

INSTITUTION VISION

To be a premier center of professional education and research, offering quality programs in a socio-economic and ethical ambience.

INSTITUTION MISSION

- To impart knowledge of advanced technologies using state-of-art infrastructure facilities
- To inculcate innovation and best practices in education, training and research.
- To meet changing socio-economic needs in an ethical ambience.

DEPARTMENT VISION

To establish a centre of excellence in civil engineering with research and innovative technical skills with ethical ambience.

DEPARTMENT MISSION

- To import quality education and research to undergraduate and postgraduate students in Civil Engineering to produce entrepreneurs, professionals, scientists and bureaucrats.
- To impart conceptual and practical education in advanced technologies keeping in view socio-economic and ethical needs.
- To enhance research and consultancy activities in collaboration with government, public and private sector units.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To expose the post graduate students to advanced structural analysis, structural dynamics, allied theory in elasticity and plasticity, FEM etc.

PEO2: To impart training to graduate students to work in team for analysis and design of various structures as per the codal provisions.

PEO3: To orient the post graduate students to high value research related to Structural Engineering so that they get impetus to pursue research and lifelong learning.

PROGRAMME OUTCOMES(POs)

PO1: Graduates of the program will be able to independently carry out research /investigation and development work to solve practical problems.

PO2: Graduates of the program will be able to write and present a substantial technical report/document.

PO3: Graduates of the program will be able to demonstrate in depth knowledge of structural engineering discipline.

PO4: Graduates of the program will be able to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

PO5: Graduates will develop enthusiasm and confidence to pursue lifelong learning for professional advancement.

PO6: Graduates of the program will be able to identify and analyze the impact of structural engineering in development projects and find a suitable solution from number of alternatives using software.

MALLA REDDY ENGINEERING COLLEGE (Autonomous)
COURSE STRUCTURE – M. Tech. STRUCTURAL ENGINEERING
(MR20 Regulations - Effective from Academic Year 2020-21 onwards)

Course Structure for PG - M. Tech. (STRUCTURAL ENGINEERING) Programme

I SEMESTER

S. No.	Category	Course code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PCC	A1101	Theory of Elasticity	2	1	-	3
2	PCC	A1102	Advanced Structural Analysis	2	1	-	3
3	PEC-I	A1103	PDE and Numerical Techniques	2	1	-	3
		A1104	Bridge Engineering				
		A1105	Advanced Reinforced Concrete Design				
4	PEC-II	A1106	Design of Shells and Folded Plate Structures	3	-	-	3
		A1107	Advanced Concrete Technology				
		A1108	Prefabricated Structures				
5	HSMC	A0H18	Research Methodology and IPR	2	-	-	2
6	PCC	A1109	Modeling and Analysis Lab	-	-	4	2
7	PCC	A1110	Advanced Concrete Lab	-	-	4	2
8	AC	A0A04	English for Research Paper Writing	2	-	-	-
Total				13	3	8	**18**
Total Contact Hours				24			

II SEMESTER

S. No.	Category	Course code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PCC	A1111	Finite Element Method	2	1	-	3
2	PCC	A1112	Structural Dynamics	2	1	-	3
3	PEC-III	A1113	Design of Prestressed Concrete Structures	2	1	-	3
		A1114	Offshore Structures				
		A1115	Theory and Applications of Cement Composites				
4	PEC-IV	A1116	Stability of Structures	3	-	-	3
		A1117	Advanced Steel Design				
		A1118	Earthquake Resistant Design of Structures				
5	PCC	A1119	Structural Design Lab	-	-	4	2
6	PCC	A1120	CADD Lab	-	-	4	2
7	PROJ	A1121	Mini Project	-	-	4	2
8	AC	A0A05	Value Education	2	-	-	-
Total				11	3	12	**18**
Total Contact Hours				26			

III SEMESTER

S. No.	Category	Course code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PEC-V	A1122	Repair and Rehabilitation of Structures	2	1	-	3
		A1123	Ground Improvement Techniques				
		A1124	Design of High Rise Structures				
2	OEC	A1125	Optimization Techniques	3	-	-	3
		A1126	Safety in Construction				
		A1127	Waste to Energy				
3	PROJ	A1128	Seminar			4	2
4	PROJ	A1129	Dissertation Phase - I	-	-	16	8
Total				5	1	20	**16**
Total Contact Hours				26			

IV SEMESTER

S. No.	Category	Course code	Name of the course	Contact hours/week			Credits
				L	T	P	
1	PROJ	A1130	Dissertation Phase - II	-	-	32	16
Total				-	-	32	**16**
Total Contact Hours				32			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1101	THEORY OF ELASTICITY	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the basic concepts of theory of elasticity in solving Structural Engineering problems.

MODULE I: [9 Periods]

Introduction: Elasticity – notation for forces and stresses – components of stresses – components of strain – Hooks law. Plane stress and plane strain analysis – plane stress – plane strain – differential equations of equilibrium – boundary conditions – compatibility equations –stresss function – boundary condition.

MODULE II: [9 Periods]

Two dimensional problems in rectangular coordinates – solution by polynomials – Saint-Venant's principle – determination of displacements – bending of simple beams – application of fourier series for two dimensional problems – gravity loading. Two dimensional problems in polar coordinates – stress distribution symmetrical about an axis – pure bending of curved bars – strain components in polar coordinates – displacements for symmetrical stress distributions – simple symmetric and asymmetric problems – general solution of two-dimensional problem in polar coordinates – application of general solution in polar coordinates.

MODULE III: [10 Periods]

A. Analysis of stress and strain in three dimensions – principal stresses – stress ellipsoid – director surface – determination of principal stresses – max shear stresses – homogeneous deformation – principal axes of strain rotation.

B. General Theorems: Differential equations of equilibrium – conditions of compatibility – determination of displacement – equations of equilibrium in terms of displacements – principle of super position – uniqueness of solution – the reciprocal theorem.

MODULE IV: [10 Periods]

Torsion of Prismatic Bars – torsion of prismatic bars – bars with elliptical cross sections – other elementary solution – membrane analogy – torsion of rectangular bars – solution of torsion problems by energy method – use of soap films in solving torsion problems – hydro dynamical analogies – torsion of shafts, tubes and bars etc.

Bending of Prismatic Bars – Stress function – bending of cantilever – circular cross section – elliptical cross section – rectangular cross section – bending problems by soap film method – displacements.

MODULE V: **[10 Periods]**

Principles of Experimental Approach: Merit of Experimental Analysis introduction, uses of experimental stress analysis – Advantages of experimental stress analysis, Different methods, Simplification of problems.

TEXT BOOKS

1. S. P. Timoshenko and J. N. Goodier, "**Theory of Elasticity**", Tata McGraw-Hill Piblication, 3rd Edition.
2. Dr. Sadhu Singh, "**Theory of Elasticity**", Khanna Publications.

REFERENCES

1. Y. C. Fung, "**An Introduction to the Theory of Aeroelasticity**", Dover Publication.
2. L. D. Landau, L. P. Pitaevskii, A. M. Kosevich& E. M. Lifshitz, "**Theory of Elasticity**", Butterworth-Heinemann, 3rd Edition.

E – RESOURCES

1. http://www.iue.tuwien.ac.at/phd/dhar/node17.html
2. http://web.mit.edu/16.20/homepage/6_Torsion/Torsion_files/module_6_no_solutions.pdf
3. https://engineering.purdue.edu/~ce597m/Handouts/Theory%20of%20elasticity%20by%20Timoshenko%20and%20Goodier.pdf
4. http://www2.mae.ufl.edu/haftka/adv-elast/lectures/Sections6.1-2.pdf
5. http://nptel.ac.in/courses/105108070/

Course Outcomes:

After the completion of the course students will be able to:

1. Understand the principles of elasticity and plane stress and plane strain problems with boundary conditions.
2. Evaluate the symmetric and asymmetric stress distribution with rectangular and polar coordinates in 2dimensional analysis by Saint-Venant's principles using boundary conditions and solving their relative problems.
3. Recognize the analysis of stress and strain in reciprocal 3 dimensions with ellipsoid principles and theorems.
4. Understand the torsion and bending of prismatic bars for elliptical circular cross sections, hydro dynamical analogies with their solutions by soapfilm method.
5. Understand the uses of experimental stress analysis and their methods with application.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**	**2**	
CO2	**3**		**3**	**2**	**2**	
CO3	**3**		**3**	**2**	**2**	
CO4	**3**		**3**	**2**	**2**	
CO5	**3**		**3**	**2**	**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code:A1102	ADVANCED STRUCTURAL ANALYSIS	L	T	P
Credits: 3		2	1	-

Course Objectives:
To impart knowledge on matrix methods of structural analysis of indeterminate structures like continuous beams, trusses and portal frames.

MODULE I: **[9 Periods]**
Introduction to matrix methods of analysis – static indeterminacy and kinematic indeterminacy – degree of freedom – coordinate system – structure idealization stiffness and flexibility matrices – suitability element stiffness equations – elements flexibility equations – mixed force – displacement equations – for truss element, beam element and tensional element. Transformation of coordinates – element stiffness matrix and load vector – local and global coordinates.

MODULE II: **[9 Periods]**
Assembly of stiffness matrix from element stiffness matrix – direct stiffness method – general procedure – band matrix – semi band width – computer algorithm for assembly by direct stiffness matrix method.

MODULE III: **[10 Periods]**
A. Assumptions in flexibility matrix method – Analysis of plane truss and continuous beam using flexibility matrix methods.
B. Analysis of plane frame and grids by flexibility matrix methods.

MODULE IV: **[10 Periods]**
Analysis of plane truss – continuous beam – plane frame and grids by stiffness methods.

MODULE V: **[10 Periods]**
Special analysis procedures – static condensation and sub structuring – Initial and thermal stresses.
Shear walls– Necessity – structural behaviour of large frames with and without shear walls – approximate methods of analysis of shear walls.

TEXT BOOKS

1. William Weaver and James M. Gere, "**Matrix Analysis of Frame structures**", CBS publishers & Distributors Pvt. Ltd., New Delhi.
2. Ashok K. Jain, "**Advanced Structural Analysis**" by, Nem Chand & Bros., 3rd Edition.

REFERENCES

1. C. S. Reddy, "**Basic Structural Analysis**", Tata McGraw Hill Education Private Limited, 3rd Edition.
2. Madhu B. Kanchi, "**Matrix Methods of Structural Analysis**", John Wiley & Sons, 2nd Edition
3. K. U. Muthu, Azmi Ibrahim, Vijayanand M and Maganti Janardhana, "**Basic Structural Analysis**", I. K. International Publishing House Pvt. Ltd., 3rd Edition.
4. John L. Meek, "**Matrix Structural Analysis**", McGraw-Hill Inc., 1st Edition.
5. Amin Ghali, Adam Neville and Tom G. Brown, "**Structural Analysis: A Unified Classical and Matrix Approach**", CRC Press (Taylor & Francis Group), 6th Edition.

E – RESOURCES

1. http://web.iitd.ac.in/~sbhalla/flexibility.pdf
2. https://engineering.purdue.edu/~aprakas/CE474/CE474-Ch3-ForceMethod.pdf
3. http://www.colincaprani.com/files/notes/SAIV/4%20-%20Matrix%20Stiffness%20Method.pdf
4. http://nptel.ac.in/courses/105106050/20#
5. http://freevideolectures.com/Course/3015/Advanced-Structural-Analysis
6. http://www.nptelvideos.in/2012/11/advanced-structural-analysis.html

Course Outcomes:

After the completion of the course students will be able to:

1. Solve statically indeterminate structures using matrix method and apply the coordinate transformation method for stiffness and flexibility method.
2. Understand formulation of various stiffness matrices and concept of direct stiffness by computer algorithm.
3. Understand and perform analysis of trusses, continuous beams and rigid frames using flexibility method.
4. Understand and perform analysis of trusses, continuous beams and rigid frames using stiffness method.
5. Analyse a structure under static condensation due to initial and thermal stresses and to understand the structural behaviour of shear wall.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**1**	**1**	
CO2	**3**	**1**	**3**	**1**	**2**	**3**
CO3	**3**		**3**	**1**	**1**	
CO4	**3**		**3**	**1**	**1**	
CO5	**3**		**3**	**1**	**1**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Semester		
Code: A1103	PDE AND NUMERICAL TECHNIQUES [PROFESSIONAL ELECTIVE-I]	L	T	P
Credits: 3		3	0	-

Pre-requisite: Numerical Methods

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in Multivariate analysis. It deals with acquainting the students with standard concepts to advanced level that will serve them well towards tackling applications that they would find useful in their profession. To understand types of partial differential equations and their applications in Engineering.

Module I: Approximation Theory [9 Periods]

Polynomial and function interpolations, Orthogonal Collocations method for solving ODE-BVPs, Orthogonal Collocations method for solving ODE-BVPs with examples, Orthogonal Collocations method for solving PDEs with examples, Necessary and sufficient conditions for unconstrained multivariate optimization, Least square approximations

Module II: Partial Differential Equations [9 Periods]

Introduction to methods for solving sparse linear systems: Thomas algorithm for tridiagonal and block tridiagonal matrices.

Introduction to PDE, Formation by eliminating arbitrary constants and arbitrary functions, Linear PDE(Lagrangian Equation), Non-Linear PDE of First order (Standard forms), Charpit's Method.

Introduction to higher order PDE, Homogeneous Linear equations with constant coefficients, Rules finding Complimentary functions, Rules finding Particular Integrals, Non Homogeneous Linear equations. Equations reducible to PDEs with constant coefficients.

Module III: Applications to Partial Differential Equations [10 Periods]

A. Application to one-dimensional wave equation.
Interpolation: Linear Interpolation - Higher order Interpolation - Lagrange Interpolation – Interpolating polynomials using finites differences- Hermite Interpolation -piece-wise and spline Interpolation.

B. Finite Element Analysis implicit and Explicit Methods – ADI Methods Elliptic Equations: Laplace Equation, Poisson Equation, Iterative Schemes Dirchlet's Problem, Neumann Problem, mixed boundary value problem, ADI Methods.

Module IV: **[10 Periods]**

Numerical Integration: Method based on interpolation-method based on undetermined coefficient – Gauss – Lagrange interpolation method- Radaua integration method- composite integration method – Double integration using Trapezoidal and Simpson's method.

Module V: **[10 Periods]**

Projections and least square solution, Function approximations and normal equation in any inner product space, Model Parameter Estimation using linear least squares method, Gauss Newton Method, Gelarkin's method and generic equation forms arising in problem discretization, Errors in Discretization, Generaic equation forms in transformed problems

REFERENCES:

1. "**An Introduction to Non-Linear Finite Element Analysis**" – J N Reddy, Oxford University Press
2. "**Numerical methods**" by S.S. Shastry.
3. "**Applied numerical analysis**" by – Curtis I.Gerala- Addission Wasley – published campus.
4. "**Numerical methods for Engineers**" Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill book company.
5. "**C Language and Numerical methods**" by C.Xavier – New age international publisher.
6. "**Computer based numerical analysis**" by Dr. M.Shanta Kumar, Khanna Book publishers, New Delhi.

E – RESOURCES

1. https://www.math.cmu.edu/~wn0g/2ch6a.pdf (Differential Calculus)
2. http://www.nptel.ac.in/courses/122104018/node120.html
3. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/pde/second/second.html (Partial Differential Equations)
4. http://nptel.ac.in/courses/111103021/ (Partial Differential Equations)

Course Outcomes:

1. To learn the concept of iteration techniques to solve system of algebraic equations to the desired level of accuracy.
2. To learn the concept of interpolation method in order to calculate the missed data in data analysis problems..
3. Able to learn advanced interpolation & Extrapolation techniques to solve some real problems.
4. Application of Numerical differentiation and integration to calculate areas of a given data curves. Able to find optimum values of the tabular data.
5. Able to solve ordinary differentia equations of the Initial value problems by using various developed methods to get the numerical solution for studying the solution patters.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**		**3**	**1**	
CO2	**3**	**2**		**2**	**3**	
CO3				**3**	**3**	
CO4		**1**		**3**	**3**	
CO5		**2**		**3**	**3**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1104	BRIDGE ENGINEERING [PROFESSIONAL ELECTIVE-I]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the behavior and design aspects of various types of bridges.

MODULE I: **[9 Periods]**

Concrete Bridges: Introduction – Types of Bridges – Economic span length – Types of loading – Dead load – live load – Impact Effect – Centrifugal force – wind loads – Lateral loads – Longitudinal forces – Seismic loads – Frictional resistance of expansion bearings – Secondary Stresses – Temperature Effect – Erection Forces and effects – Width of roadway and footway – General Design Requirements.

MODULE II: **[9 Periods]**

Solid slab Bridges: Introduction – Method of Analysis and Design – Design of RC slab, skew slab and box culverts. Design of T-beam bridges.

MODULE III: **[10 Periods]**

A. Girder Bridges: Introduction – Method of Analysis and Design – bow string girder bridges – Design of plate girder bridges – steel trussed bridges – Courbon's Theory, Grillage analogy.

B. Introduction to long span bridges: Cable stayed bridges and suspension bridges, Forces on piers and abutments – Design of piers and abutments.

MODULE IV: **[10 Periods]**

Pre-Stressed Concrete Bridges: Basic principles – General Design requirements – Mild steel reinforcement in prestessed concrete member – Concrete cover and spacing of pre-stressing steel – Slender beams – Composite Section – Propped – Design of Propped Composite Section – Unproped composite section – Two-stage Prestressing – Shrinking stresses – General Design requirements for Road Bridges.

MODULE V: **[10 Periods]**

Analysis of Bridge Decks: Harmonic analysis and folded plate theory – Grillage analogy – Finite strip method and FEM. Sub– Structure of bridges: Substructure – Beds block – Piers – Pier Dimensions–Abutments.

TEXT BOOKS

1. M. G. Aswani, V. N. Vazirani and M. M. Ratwani, "**Design of Concrete Bridges**", Khanna Publishers.
2. Johnson Victor, "**Essentials of Bridge Engineering**", Oxford & IBH., 6th Edition.

REFERENCES

1. E. C. Hambly, "Bridge Deck Behaviour", CRC Press, 2nd Edition.
2. N. Krishna Raju, "Design of Bridges", Oxford &IBH Publishing Co. Pvt. Ltd., 4th Edition.
3. S. Ponnuswamy, "Bridge Engineering", Tata McGraw Hill, 2nd Edition.
4. V. K. Raina, "Concrete Bridge Practice Analysis, Design &Economics", Shroff Publication & Distribution Pvt. Ltd., 4th Edition.

E – RESOURCES

1. http://www.in.gov/dot/div/contracts/training/2010/StructConf/1015aReinfConcrete.pdf
2. http://home.iitk.ac.in/~vinaykg/Iset453.pdf
3. http://content.iospress.com/journals/bridge-structures/12/1-2
4. http://www.iospress.nl/journal/bridge-structures/
5. http://nptel.ac.in/syllabus/105999906/

Course Outcomes:

After the completion of the course students will be able to:

1. Demonstrate different types of bridges with diagrams as per IRC loading standards.
2. Analyze and design solid slab bridges.
3. Analyze and design girder bridges and to familiarize with the design principles of long span bridges like cable stayed and suspension bridges.
4. Analyze and design prestressed concrete bridges.
5. Analyze the bridge deck using finite element methods and analysis of substructure of bridge.

CO – PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3	2	1
CO2	2		3	2	2	2
CO3	2		3	2	2	2
CO4	2		3	2	2	2
CO5	2		3	2	2	2

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1105	ADVANCED REINFORCED CONCRETE DESIGN	L	T	P
Credits: 3	[PROFESSIONAL ELECTIVE-I]	3	1	-

Course Objectives:

To study the fundamentals of designing advanced RCC structure like Deep beam, Corbel, Curved beam, Domes and Multi storied buildings.

MODULE I: Design of RC Deep Beams and Corbels [9 Periods]

Introduction, Minimum thickness, Steps of Designing, Design by IS456 method, Checking for Local Failures, Detailing, Design of corbel, Analysis for design forces, Determination of reinforcement

MODULE II: Design of Beams Curved in Plan [9 Periods]

Introduction, Circular beam symmetrically supported, Semi-circular beam supported on three equally spaced columns.

MODULE III: Flat Slabs and Yield Line Based Design of Slabs [10 Periods]

A. Introduction - Design of Flat slabs and flat plates according to IS method - Check for shear.

B. Yield line theory and Hillerborg's strip method of design of slabs.

MODULE IV: Design of Domes [10 Periods]

Introduction, Stresses in domes, Formulae for forces in spherical domes, Design of a spherical dome

MODULE V: Design of Multi-Storey Buildings [10 Periods]

Introduction, Example frame, Structural layout, Estimation of loads, Load combinations, Analysis, Design of elements of frames, Use of computer software for analysis and design, Design example.

TEXT BOOKS

1. Dr. H. J. Shah, "**Reinforced Concrete**", Vol-1 and Vol-2, Charotar, 8th Edition – 2009 and 6th Edition – 2012 respectively.
2. P.C Varghese "**Advanced Reinforced Concrete Design**" -. Prentice Hall of India – 2004.
3. Gambhir.M.L, " **Design of Reinforced Concrete Structures**", Prentice Hall of India, 2012.

REFERENCES

1. N. Krishna Raju "**Advanced Reinforced Concrete Design**", 2nd edition, CBS Publishers and Distributors.- 2009.
2. Varghese, P.C., "**Limit State Design of Reinforced Concrete**", Prentice Hall of India, 2007.
3. IS456, SP16, SP34

E – RESOURCES

1. http://nptel.ac.in/courses/105105105/
2. http://nptel.ac.in/noc/individual_course.php?id=noc17-ce23
3. http://www.darshan.ac.in/DIET/CI/137/advanced-design-of-concrete-structures/SubjectDetail

Course Outcomes:

After the completion of the course students will be able to:

1. Understand the concept of designing a deep beam.
2. Design beams curved in plan.
3. Understand the design concept of Flat slabs and Yield Line theory.
4. Analyze and design a spherical dome.
5. Analyze and design a multistoried building.

CO – PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	1		
CO2	3		3	1	1	1
CO3	3		3	2	1	1
CO4	3	1	3	2	1	1
CO5	3	1	3	3	1	1

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1106	DESIGN OF SHELLS AND FOLDED PLATES STRUCTURES [PROFESSIONAL ELECTIVE-II]	L	T	P
Credits: 3		2	1	-

Course Objectives:

Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

MODULE I: Classification of Shells [9 Periods]

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

MODULE II: Folded Plates [9 Periods]

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

MODULE III: Introduction to Space Frame [10 Periods]

Space frames - configuration - types of nodes - general principles of design Philosophy - Behaviour.

MODULE IV: Analysis and Design [10 Periods]

Analysis of space frames – detailed design of Space frames – Introduction to Computer Aided Design and Software Packages.

MODULE V: Special Methods [10 Periods]

Application of Formex Algebra, FORMIAN for generation of configuration.

TEXT BOOKS

1. Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982.
2. Santhakumar.A.R and Senthil.R, “Proceedings of International Conference on Space Structures”, Anna University, Chennai, 1997.

REFERENCES

1. Subramanian.N ,”Principles of Space Structures”, Wheeler Publishing Co. 1999.
2. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBS Publishers, 1986.
3. ASCE Manual No.31, “Design of Cylindrical Shells”.

E – RESOURCES

1. https://ocw.mit.edu/courses/mechanical-engineering/2-081j-plates-and-shells-spring-2007/readings/lecturenote.pdf
2. https://pdhonline.com/courses/s275/s275content.pdf

Course Outcomes:

After the completion of the course students will be able to:

1. Identify the different types of shells.
2. Analyze and design a folded plate.
3. Understand the concept of space frames.
4. Analyze and design a space frame.
5. Analyze plates and shells using softwares.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**	**2**	
CO2	**3**		**3**	**2**	**2**	**1**
CO3	**3**		**3**	**2**	**2**	
CO4	**3**		**3**	**2**	**2**	**1**
CO5	**3**		**3**	**2**	**2**	**2**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1107	ADVANCED CONCRETE TECHNOLOGY	L	T	P
Credits: 3	[PROFESSIONAL ELECTIVE-II]	3	-	-

Course Objectives:

To impart knowledge on concrete making materials, concrete mix design for proportioning and their testing.

MODULE I: **[9 Periods]**

Concrete Making Materials: Cement – Bogue's compounds – Hydration Process– Types of cement – Aggregates – Gradation Charts – Combined aggregate-Alkali Silica Reaction - Admixtures – Chemical and Mineral admixtures.

MODULE II: **[10 Periods]**

Fresh Concrete: Fresh Concrete – workability tests on Concrete Setting times of Fresh Concrete – Segregation and bleeding.

Hardened Concrete: Abram's law – Gel space ratios, Maturity Concept – Stress Behaviour – Creep and Shrinkage – Durability tests on concrete – Non destructive testing of concrete.

MODULE III: **[10 Periods]**

A. High Strength Concrete – Micro structure – Manufacturing and Properties – Design of HSC Using Erintroy Shaklok Method – Ultra High Strength Concrete.

B. High Performance Concrete – Requirements and properties of High Performance Concrete – Design Considerations.

MODULE IV: **[10 Periods]**

Special Concrete: Self Compacting concrete – Polymer concrete – Fiber reinforced concrete – Reactive Powder concrete – Requirements and Guidelines – Advantages and Applications – Light weight concrete.

Concrete mix design: Quality Control – Quality assurance – Quality audit – Mix Design method – BIS method, ACI method, DOE method.

MODULE V: **[9 Periods]**

Form work – materials – structural requirements – form work systems – connections – specifications – design of form work – shores – removal for forms – reshoring – failure of form work.

TEXT BOOKS

1. A. M. Neville, "**Properties of Concrete**", Prentice Hall, 5th Edition.
2. A. R. Santhakumar, "**Concrete Technology**", Oxford University Press.
3. M. S. Shetty, "**Concrete Technology (Theory and Practice)**", S. Chand Publishing.

REFERENCES

1. P. K. Mehta, "**Concrete: Micro Structure, Properties and Materials**", Tata McGraw Hill Publishing House Pvt. Ltd.
2. Rafat Siddique, "**Special Structural concretes**", Galgotia Publications.
3. N. Krishna Raju, "**Design of Concrete Mixes**", CBS Publications.

E – RESOURCES

1. https://en.wikipedia.org/wiki/Properties_of_concrete
2. http://civil-resources.blogspot.in/2010/06/high-performance-concrete.html
3. www.cee.mtu.edu/~llsutter/classes/cet1141/present/hvalue.ppt
4. http://www.nbmcw.com/concrete/26923-high-performance-concrete.html
5. http://nptel.ac.in/courses/105102012/

Course Outcomes:

After the completion of the course students will be able to:

1. Acquire good knowledge in concrete making materials.
2. Determine the properties of fresh and hardened concrete.
3. Understand the properties and performance of high strength concrete and high performance concrete.
4. Identify the application of special concrete and able to do the mix design as per codes
5. Acquire deep knowledge in form work and structural requirements.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**		**3**	**3**	**2**	**1**
CO2	**3**	**2**	**3**	**1**	**3**	**1**
CO3	**2**		**2**	**2**	**2**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**2**
CO5			**1**	**1**	**1**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1108	PREFABRICATED STRUCTURES [PROFESSIONAL ELECTIVE-II]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the design principles, analysis and design of elements.

MODULE I: Design Principles [9 Periods]

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

MODULE II: Reinforced Concrete [9 Periods]

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.

MODULE III: Floors, Stairs and Roofs [10 Periods]

A. Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements,

B. Description of joints between elements, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

MODULE IV: Walls [10 Periods]

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

MODULE V: Industrial Buildings and Shell Roofs [10 Periods]

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

TEXT BOOKS

1. R Ganesan and A Latha, "**Prefabricated Structures**", Sri Kamalamani Publications, 2014.

REFERENCES

1. Laszlo Mokk, "**Prefabricated Concrete for Industrial and Public Structures**", Akademiai Kiado, Budapest, 2007.
2. Lewicki.B, "**Building with Large Prefabricates**", Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
3. "**Structural Design Manual**", Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 2009.

E – RESOURCES

1. https://civildigital.com/prefabricated-structures-prefabrication-concept-components-advantages-ppt/
2. http://nptel.ac.in/syllabus/105102088/
3. https://www.svce.ac.in/departments/cve/downloads/Prefabricated%20Structures/UNIT%20II%20copy.pdf

Course Outcomes:

After the completion of the course students will be able to:

1. Understand the requirements for planning the requirements for a prefabrication unit.
2. Understand the different methods of connecting beam to column and column to column.
3. Know the different types of floors, stairs and roofs.
4. Know the different types of wall panels and its connections.
5. Understand the erection and jointing of prefabricated members.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**		**3**	**3**	**2**	**1**
CO2	**3**	**2**	**3**	**1**	**3**	**1**
CO3	**2**		**2**	**2**	**2**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**2**
CO5			**1**	**1**	**1**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech I Semester		
Code: A0H18	RESEARCH METHODOLOGY AND IPR	L	T	P
Credits: 2		2	-	-

Prerequisites: Nil

Course Objectives: The objective of the course is to make students familiar with the basics of research methodology and various types of Intellectual Properties, IPR legislations and policies.

MODULE I: Research Problem [6 Periods]

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

MODULE II: Technical Writing and Research Proposal [7 Periods]

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

MODULE III: Intellectual Property Rights [6 Periods]

A. Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

B. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE IV: Patent Rights [6 Periods]

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

MODULE V: Case Studies [7 Periods]

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

REFERENCES

1. Prabhuddha Ganguli: "**Intellectual Property Rights**" Tata Mc-Graw –Hill, New Delhi

2. M. Ashok Kumar and Mohd. Iqbal Ali: "**Intellectual Property Right**" Serials Pub.

3. Carlos M.Correa- **''Intellectual property rights , The WTO and Developing countries"**-Zed books
4. Law relating to patents, trademarks, copyright designs, Wadehra, B.L. & 2 ed. Universal Law Publishing 2000.
5. C.R.Kothari, "**Research Methodology**", New Age International Publishers, Fourth edition, 2018.
6. Donald Cooper & Pamela Schindler, **"Business Research Methods",** TMGH, 9th edition.
7. Alan Bryman & Emma Bell, **"Business Research Methods"**, Oxford University Press.

E – RESOURCES

1. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
2. https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
3. http://nptel.ac.in/courses/110999906/
4. http://nptel.ac.in/courses/109105112/

Course Outcomes:

After completion of the course, students will be able to:

1. Comprehend the concepts of research methodology and its concepts.
2. Realize the concepts of literature review and developing a research proposal.
3. Understand the basic concepts of Intellectual property rights.
4. Understand the types of patents and their procedures.
5. Recognize the recent developments in IPR administration.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**		**3**	**1**	
CO2	**3**	**2**		**2**	**3**	
CO3				**3**	**3**	
CO4		**1**		**3**	**3**	
CO5		**2**		**3**	**3**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1109	MODELING AND ANALYSIS LAB	L	T	P
Credits: 2		-	-	4

Course Objectives:

To impart knowledge on modeling of structural elements and analyzing using ANSYS software for stress, strain, deflection, etc.

SYLLABUS:

1. Modeling and Analysis of Simply Supported Beam for stress and deflection.
2. Modeling and Analysis of Cantilever Beam for stress and deflection.
3. Modeling and Analysis of Fixed Beam for deflection.
4. Modeling and Analysis of Link Elements in Trusses for force and stress.
5. Modeling and Analysis of Flat Plate for stress.
6. Modeling and Analysis of Steel Column
7. Modeling and Analysis of RCC Beam.
8. Modeling and Analysis of RCC Column
9. Modeling and Analysis of RCC Slab.
10. Modeling and Analysis of RCC Deep Beam.
11. Modeling and Analysis of Non Linear Plastic deformation of I-section.
12. Modeling and Harmonic Analysis of Simple System.

Course Outcomes:

After the completion of the course students will be able to:

1. Model the structural elements made of steel.
2. Model the reinforced concrete elements.
3. Analyze the structural elements with various end conditions.
4. Perform non linear analysis using software.
5. Perform the harmonic analysis.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**2**	**2**	**3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**2**	**2**	**3**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**3**	**2**	**2**	**3**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1110	ADVANCED CONCRETE LABORATORY	L	T	P
Credits: 2		-	-	4

Course Objectives:

To impart knowledge on testing of fresh/hardened concrete and non destructive testing on concrete.

SYLLABUS:

1. Tests on cement - Consistency, Setting times, Soundness, Compressive Strength.
2. Gradation Charts of Aggregates.
3. Bulking of fine Aggregate.
4. Aggregate Crushing and Impact value
5. Workability Tests on Fresh self compacting concrete
6. Air Entrainment Test on fresh concrete.
7. Marsh cone test.
8. Permeability of Concrete.
9. Non Destructive Testing of Concrete.
10. Accelerated Curing of Concrete.
11. Influence of W/C ratio on strength and Aggregate/Cement ratio on workability and Strength
12. Influence of Different Chemical Admixtures on concrete.

Course Outcomes:

1. After the completion of the course students will be able to:
2. Identify the properties of various materials used for making concrete.
3. Test the properties of fresh/ self compacting concrete.
4. Understand the properties of hardened concrete.
5. Perform nondestructive testing of hardened concrete.
6. Find the influence of W/c ratio and the usage of chemical admixtures.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**2**	**3**	**2**	**2**	**3**
CO2	**3**	**2**	**3**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**2**	**2**	**3**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**3**	**2**	**2**	**3**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A0A04	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P
Credits: Nil		2	-	-

Prerequisites: Nil

Course Objectives:

The objective of the course is to provide the knowledge on structuring paragraphs, paraphrasing and preparation of research documents related to abstract, literature review, methods and results.

MODULE I: **[6 Periods]**

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

MODULE II: [**7 Periods]**

Clarifying Who Did What, Highlighting Your Findings, Hedging and criticising, paraphrasing and plagiarism, sections of a paper, abstracts. Introduction.

MODULE III: **[6 Periods]**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

MODULE IV: **[6 Periods]**

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.

MODULE V: **[7 Periods]**

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

REFERENCES

1. Goldbort R (2006) "**Writing for Science**", Yale University Press.
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

After the completion of the course students will be able to

1. Structure the sentences and paragraphs.
2. Elaborate the various sections of research papers.
3. Explore the check list in research documents.
4. Apply the key skills to coin the title, abstract, introduction and literature review.
5. Inspect the skills required for preparing experimental results and discussions.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		**3**		**2**	**2**	
CO2		**3**		**2**	**2**	
CO3		**3**		**2**	**2**	
CO4		**3**		**2**	**2**	
CO5		**3**		**2**	**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1111	FINITE ELEMENT METHOD	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the basic principles of finite element analysis procedure and to perform 1D, 2D and 3D structural analysis using finite element methods.

MODULE I: **[9 Periods]**

Introduction: Concepts of FEM – steps involved – merits and demerits – energy principles – discrimination – Raleigh-Ritz method of functional approximation.

Principles of Elasticity: Stress equations – strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

MODULE II: **[9 Periods]**

One dimensional FEM: Stiffness matrix for beam and bar elements – shape functions foe ID elements.

Two dimensional FEM: Different types of elements for plane stress and plane strain analysis – displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – geometric invariance – natural coordinate system – area and volume coordinates – generation of element stiffness and nodal load matrices

MODULE III: **[10 Periods]**

A. Isoparametric formulation: Concept – different isoparametric elements for 2D analysis – formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrange elements – serendipity elements.

B. Axi Symmetric Analysis: bodies of revolution –axi symmetric modeling – strain displacement relationship – formulation of axi symmetric elements.
Three dimensional FEM: Different 3-D elements – strain-displacement relationship – formulation of hexahedral and isoparametric solid element.

MODULE IV: **[10 Periods]**

Introduction to Finite Element Analysis of Plates: basic theory of plate bending – thin plate theory – stress resultants – Mindlin's approximations – formulation of 4-noded isoperimetric quadrilateral plate element – Shell Element.

MODULE V: **[10 Periods]**

Introduction to non-linear analysis – basic methods – application to Special structures.

TEXT BOOKS

1. Robert D. Cook, David S. Malkus, Michael E. Plesha & Robert J. Witt, "**Concepts and Applications of Finite Element Analysis**", John Wiley & Sons, 4th Edition.

REFERENCES

1. Zienkiewicz O. C. and Taylor R. L., "**Finite element Method – Volume 1**", McGraw-Hill Publishing Co., 4th Edition.
2. Krishnamoorthy C. S., "**Finite element analysis: Theory and Programming**", McGraw Hill Education, 2nd Edition.
3. TirupathiR. Chandrupatla and Ashok D. Belegundu, "**Introduction to Finite Elements in Engineering**", Pearson, 3rd Edition.

E – RESOURCES

1. https://www.comsol.co.in/multiphysics/finite-element-method
2. http://www.iitg.ernet.in/engfac/rtiwari/resume/usdixit.pdf
3. https://www.iitk.ac.in/tkic/workshop/FEM/ppt/TK_2.pdf
4. http://www.cs.rpi.edu/~flaherje/pdf/fea2.pdf
5. http://nptel.ac.in/courses/112104115/
6. http://nptel.ac.in/courses/105105041/

Course Outcomes:

After the completion of the course students will be able to:

1. Understand the basic concept of FEM with energy principles and understand fundamental theory of elasticity including plane stress, plane strain & axi symmetric problems.
2. Know the generation of stiffness matrix for 1D and 2D elements for plane stress, plane strain, generalized coordinates and shape function.
3. Understand isoperimetric elements, axi symmetric and 3D elements and their formulation.
4. Formulation of 4 noded isoperimetric for thin plates and shell elements.
5. Understand the non-linear analysis and application of FEM to special structures.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**	**2**	**1**
CO2	**3**		**3**	**2**	**2**	**1**
CO3	**3**		**3**	**2**	**2**	**1**
CO4	**3**		**3**	**2**	**2**	**1**
CO5	**3**		**3**	**2**	**2**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1112	STRUCTURAL DYNAMICS	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the structural dynamics of single degree of freedom system and multi degree of freedom system.

MODULE I: Theory of vibrations [9 Periods]

Introduction – Elements of vibratory system – Degrees of Freedom – Continuous System – Lumped mass idealization – Oscillatory motion – Simple Harmonic motion – Vectorial representation of S.H.M. – Free vibrations of single degree of freedom system – undamped and damped vibrations – critical damping – Logarithmic decrement – Forced vibration of SDOF systems – Harmonic excitation – Dynamic magnification factor – Phase angle – Bandwidth

MODULE II: [9 Periods]

A. Introduction to Structural Dynamics : Fundamental objectives of dynamic analysis – Types of prescribed loading – Methods of discretization – Formulation of equations of motion by different methods – Direct equilibration using Newton's law of motion / D'Alembert's principle, Principle of virtual work and Hamilton principle.

B. Single Degree of Freedom Systems: Formulation and solution of the equation of motion – Free vibration response – Response to Harmonic, Periodic, Impulsive and general dynamic loadings – Duhamel integral.

MODULE III: Multi Degree of Freedom Systems [10 Periods]

A. Selection of the degrees of Freedom – Evaluation of structural property matrices – Formulation of the MDOF equations of motion – Undamped free vibrations – Solutions of Eigen value problem for natural frequencies and mode shapes.

B. Analysis of Dynamic response – Normal co-ordinates – Uncoupled equations of motion – Orthogonal properties of normal modes – Mode superposition procedure.

MODULE IV: [10 Periods]

A. Practical Vibration Analysis: Introduction – Stodola method – Fundamental mode analysis – Analysis of second and higher modes – Holzer method – Basic procedure.

B. Continuous Systems: Introduction – Flexural vibrations of beams – Elementary case – Derivation of governing differential equation of motion – Analysis of undamped free vibrations of beams in flexure – Natural frequencies and mode-shapes of simple beams with different end conditions – Principles of application to continuous beams.

MODULE V: **[10 Periods]**

Introduction – Excitation by rigid base translation – Lumped mass approach – SDOF and MDOF systems – I.S. Code methods of analysis for obtaining response of multi storied buildings.

TEXT BOOKS

1. Mario Paz, "**Structural Dynamics**", C.B.S Publishers, New Delhi.
2. Anil K. Chopra, "**Dynamics of Structures**", Pearson Education (Singapore),3rd Edition.

REFERENCES

1. Clough & Penzien, "Dynamics of Structures", McGraw Hill, New York.
2. IS:1893-1984, "Code of practice for Earthquake resistant design of Structures" and latest IS:1893-2002 (version) Part-1

E – RESOURCES

1. http://www.learnengineering.org/2012/12/theory-of-vibration.html
2. http://personal.cityu.edu.hk/~bsapplec/theoryof.htm
3. http://www.tech.plym.ac.uk/soe/james/my_papers/STRC201_SDOF_JMWB.pdf
4. http://trove.nla.gov.au/work/7612381?selectedversion=NBD969606
5. http://nptel.ac.in/courses/105101006/

Course Outcomes:

After the completion of the course students will be able to:

1. Understand various vibratory systems like SHM, damped and undamped vibrations, free and forced vibrations.
2. Understand formulation of equation of motion by D'Alembert's principle, Principle of virtual work and Hamilton Principle.
3. Formulate and solve equations of motion for SDOF systems, Eigen value problem for natural frequency and mode shapes.
4. Evaluate the vibration analysis using Stodola Method, Analysis of second and higher modes using Holzer method and flexural vibration of simple beams.
5. Recognize earthquake analysis with Lumped mass approach and IS Code methods for the analysis of multistoried buildings.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		**3**	**2**	**1**	**1**
CO2	**1**		**3**	**2**	**1**	**1**
CO3	**1**		**3**	**2**	**1**	**1**
CO4	**1**		**3**	**2**	**1**	**1**
CO5	**2**		**3**	**2**	**3**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. I Semester		
Code: A1113	DESIGN OF PRESTRESSED CONCRETE STRUCTURES	L	T	P
Credits: 3	[PROFESSIONAL ELECTIVE-III]	2	1	-

Course Objectives:

To impart knowledge on the principles of prestressed concrete structures, design of section for Flexure and Shear.

MODULE I: [9 Periods]

A. General Principles of Prestressed Concrete : Pre-tensioning and post-tensioning – Prestressing by straight, concentric, eccentric, bent and parabolic tendons – Different methods and systems of prestressing like Hoyer system, Freyssinet system, Magnel Blaton system – Lee-Mccall system.

B. Losses of Prestress : Loss of prestress in pre-tensioned and post-tensioned members due tovarious causes like elastic shortening of concrete, shrinkage of concrete, creep of concrete, relaxation of steel, slip in anchorage, bending of member and frictional loss – Analysis ofsections for flexure.

MODULE II: [9 Periods]

A. Design of Section for Flexure: Allowable stresses – Elastic design of simple beams having rectangular and I-section for flexure – kern lines – cable profile and cable layout.

B. Design of Sections for Shear: Shear and Principal Stresses – Improving shear resistance by different prestressing techniques – horizontal, sloping and vertical prestressing– Analysis of rectangular and I-beam – Design of shear reinforcement – Indian code provisions.

MODULE III: [10 Periods]

A. Limit State design of partially prestressed concrete beams – Analysis and design of prestressed concrete pipes, tanks, slabs – one way and two way (numerical problems restricted to pipes and tanks only).

B. Short term deflections of uncracked members–Prediction of long-time deflections – load-deflection curve for a PSC beam – IS code requirements for maximum deflections.

MODULE IV: Transfer of Prestress in Pretensioned Members [10 Periods]

Transmission of prestressing force by bond –Transmission length – Flexural bond stresses – IS code provisions – Anchorage zone stresses in post tensioned members – stress distribution in End block – Analysis by approximate, Guyon and Magnel methods – Anchorage zone reinforcement.

MODULE V: Statically Indeterminate Structures [10 Periods]

Advantages & disadvantages of continuous PSC beams – Primary and secondary moments – P and C lines – Linear transformation concordant and non-concordant cable profiles – Analysis of continuous beams and simple portal frames (single bay and single story)

TEXT BOOKS

1. N. Krishna Raju, "**Prestressed Concrete**", Tata McGraw Hill Education, 5th Edition.
2. S. Ramamrutham, "**Prestressed Concrete**", Dhanpat Rai Publishing Company Pvt. Ltd.

REFERENCES

1. N. Krishna Raju, "Prestressed Concrete Problems and Solutions", CBS Publishers and Distributors, 3rd Edition.
2. T.Y. Lin and Ned H. Burns, "Design of prestressed Concrete Structures", Wiley India Pvt. Ltd., 3rd Edition.

E – RESOURCES

1. https://www.quora.com/What-is-the-basic-principle-of-pre-stressed-concrete
2. https://theconstructor.org/concrete/prestressed/lossess-in-prestress-of-prestressed-concrete/3287/
3. http://www.nptel.ac.in/courses/105106117/

Course Outcomes:

After the completion of the course students will be able to:

1. Realize the importance of prestressing in construction, methods and systems of prestressed concrete members.
2. Design the sections for flexure and shear by different prestressing techniques.
3. Acquire the knowledge of deflection of short and long term deflection using IS code provisions.
4. Analyze and design for the transmission of prestress in post tensioned members.
5. Design the statically indeterminate structures.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		**3**	**2**	**2**	**1**
CO2	**2**		**3**		**1**	**1**
CO3			**3**		**2**	**1**
CO4	**3**	**2**	**3**		**1**	**1**
CO5			**3**		**1**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1114	OFFSHORE STRUCTURES [PROFESSIONAL ELECTIVE-III]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the behavior of offshore structures which are subjected to hydrodynamic loads, different analysis procedure for different offshore structures and wave structure interaction.

MODULE I: Introduction [9 Periods]

Types of Offshore structures – Types of Offshore Platforms – Functions of offshore structures – Components of a typical offshore structure.

MODULE II: Loads on Offshore Structures [9 Periods]

Gravity Loads – Wind Loads – Offshore Loads – Fatigue Load – Seismic Loads.

MODULE III: Concept of Fixed Platform Jacket and Deck [9 Periods]

A: Jacket concept - redundant framing arrangement – Launch and Lift jackets

B: Simple Deck configurations for Lift and Float – Over Installations – In-service and Pre-service loads and analysis.

MODULE IV: Wave Theories [9 Periods]

Wave generation and propagation – Small and finite amplitude wave theories – Wave energy and pressure distribution.

MODULE V: Wave force on Offshore Structures [9 Periods]

Slender vertical cylindrical members – Linearization of Nonlinear wave drag force – Wave force on arbitrarily oriented cylindrical members – Wave force on large diameter structures.

Text Books:

1. D.V.Reddy, A.S.J.Swamidas(2014) Essentials of Offshore Structures, CRC Press, Taylor & Francis Group

Reference Books

1. Mohamed A. El-Reedy (2012), Offshore Structure, Design, Construction and Maintenance, Gulf Professional Publishing.
2. API (2014), Recommended Practice for Planning, designing and Construction, Fixed offshore platform, American Petroleum Institute publication, RP2A, Dallas, Texas.

E-Resourses

1. https://nptel.ac.in/courses/114/106/114106011/
2. http://www.fkm.utm.my/~koh/smk4122/Day1AM-new.pdf

3. https://www.coursehero.com/file/12350730/Module-1-Lecture-1-Introduction/
4. https://www.fossen.biz/wiley/ed1/Ch7.pdf
5. https://repository.tudelft.nl/islandora/object/uuid%3A43b1de50-ec4b-4ec9-9ff1-d5d5c209e7f7

Course Outcomes:

Upon completion of this course, the student will be able to

1. Understand the types and functions of offshore structure
2. Evaluate the loads experienced by offshore structure
3. Understand the concept of fixed offshore structures
4. Understand the wave hydrodynamics
5. Evaluate the wave forces on offshore structures

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		3	2	2	1
CO2	2		3		1	1
CO3			3		2	1
CO4	3	2	3		1	1
CO5			3		1	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1115	THEORY AND APPLICATIONS OF CEMENT COMPOSITES [PROFESSIONAL ELECTIVE-III]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on the behavior and application of cement composites in civil engineering construction.

MODULE I: **[9 Periods]**

Introduction – Classification and characteristics of composite materials – Basic terminology – advantages.

MODULE II: **[9 Periods]**

Stress-strain relations – Orthotropic and anisotropic materials – Engineering constants for orthotropic materials – restrictions on elastic constants – plane stress problem – Biaxial strength – theories for an orthotropic lamina.

MODULE III: **[10 Periods]**

A. Mechanical behaviour – Mechanics of materials approach to stiffness – determination of relations between elastic constants – Elasticity approach to stiffness – bounding techniques of elasticity – exact solutions –

B. Elasticity solutions with contiguity – Halpin – Tsai equations – comparison of approaches to stiffness.

MODULE IV: **[10 Periods]**

Cement composites – Types of cement composites – terminology – Constituent materials and their properties – Construction techniques for fibre reinforced concrete, Ferrocement, SIFCON, Polymer concretes – Preparation of reinforcement – casting and curing.

MODULE V: **[10 Periods]**

Mechanical properties of cement composites: Behaviour of ferrocement, fiber reinforced concrete in tension, compression, flexure, shear, fatigue, impact, durability and corrosion. Applications of cement composites – FRC and Ferrocement in housing,Water storage, Boats and miscellaneous structures.

TEXT BOOKS

1. Madhujit Mukhopadhyay, "**Mechanics of Composite Materials and Structures**", Universities Press, 2010.
2. Robert M Jones, "**Mechanics of Composite Materials**", 2 nd Edition, Taylor and Francis/BSP Books, 1998.

REFERENCES

1. R.P. Pama, "**Ferrocement – Theory and Applications**", IFIC, 1980.
2. R.N. Swamy, "**New Concrete Materials**", 1st Edition, Blackie, Academic and Professional, Chapman & Hall, 1983.

E – RESOURCES

1. https://deepblue.lib.umich.edu/bitstream/handle/2027.42/84890/asceforum_98.pdf%3Bjsessionid%3D15C892392CEDA73AA65FEACE9D865DA3?sequence%3D1
2. https://repository.asu.edu/attachments/134956/content/Aswani_asu_0010N_13857.pdf
3. https://www.youtube.com/watch?v=dor47_FVCGg
4. http://nptel.ac.in/courses/112107086/21

Course Outcomes:

After the completion of the course students will be able to:

1. Classify the different types of composite materials and its advantages.
2. Understand stress-strain behaviour and formulate constitutive behaviour of composite materials.
3. Understand the classification of materials based on orthotropic and anisotropic behaviour.
4. Estimate elastic constants using theories applicable to composite materials.
5. Analyse and Design structural elements made of cement composites as ferrocement, SIFCON and fibre reinforced concrete.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**	**2**	
CO2	**3**		**3**	**2**	**2**	
CO3	**3**		**3**	**2**	**2**	
CO4	**3**		**3**	**2**	**2**	
CO5	**3**		**3**	**2**	**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1116	STABILITY OF STRUCTURES [PROFESSIONAL ELECTIVE-IV]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart knowledge on behaviour of beam columns, elastic buckling of bars, frames, inelastic buckling and torsion buckling.

MODULE I: **[10 Periods]**

Beam Columns: Differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads – couples – beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – Effects of initial curvature on deflections – Determination of allowable stresses.

MODULE II: **[9 Periods]**

Elastic Buckling of bars and frames: Elastic Buckling of straight columns – Effect of shear stress on buckling – Eccentrically and laterally loaded columns – Buckling of frames – large deflections of buckled bars – Energy methods – Buckling of bars on elastic foundations – Buckle line of bar with intermediate compressive forces – Buckling of bars with change in cross-section – Effect of shear force on critical load – built up columns.

MODULE III: **[9 Periods]**

A. Inelastic Buckling: Buckle line of straight bar – Double modulus theory – Tangent modulus theory, Inelastic lateral Buckling.

B. Experiments and design formulae: Experiments on columns – Critical stress diagram – Empirical formulae for design – various end conditions

MODULE IV: **[10 Periods]**

Torsion Buckling: Pure torsion of thin walled bars of open cross section – Non-uniform torsion of thin walled bars of open cross section – Torsional buckling – Buckling by torsion and flexure.

MODULE V: **[10 Periods]**

Lateral buckling of simply supported Beams: Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported Rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.

TEXT BOOKS

1. Stephen P. Timshenko & James M. Gere, "**Theory of Elastic Stability**", Dover Publications Inc. 2nd Edition.

REFERENCES

1. Blunch, "**Stability of metallic structures**", Tata McGraw Hill.
2. Wai-Fah Chen & Toshio Atsuta, "**Theory of Beam-Columns Vol. I**", J. Ross Publishing Classics.

E – RESOURCES

1. http://www.colorado.edu/engineering/CAS/courses.d/Structures.d/IAST.Lect23.d/IAST.Lect23.pdf
2. https://theconstructor.org/structural-engg/stability-of-structure/1887/
3. http://www.brad.ac.uk/staff/vtoropov/burgeon/thesis_sameh/chap3.pdf
4. http://nptel.ac.in/syllabus/105999912/

Course Outcomes:

After the completion of the course students will be able to:

1. Solve the differential equation for beam column along with various boundary conditions and end conditions.
2. Learn the buckling of members and frames with various boundary conditions and forces acting up on them using energy methods.
3. Understand the in elastic buckling using modulus theories and develop empirical formulas for design.
4. Find out the torsion buckling for uniform and non uniform thin walled bars of open cross section.
5. Learns the behavior of buckling and bending of simply supported rectangular plates and derive the plates subjected to compression in one and two direction.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		**3**	**2**	**1**	**1**
CO2	**1**		**3**	**2**	**1**	**1**
CO3	**1**		**3**	**2**	**1**	**1**
CO4	**1**		**3**	**2**	**1**	**1**
CO5	**2**		**3**	**2**	**3**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1117	ADVANCED STEEL DESIGN [PROFESSIONAL ELECTIVE-IV]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To design the simple, eccentric connections and design of industrial buildings and steel bunkers.

MODULE I: Simple Connections – Riveted, Bolted Pinned and Welded Connections: **[9 Periods]**

Riveted connections – Bolted Connections – Load Transfer Mechanism – Failure of Bolted Joints – Specifications for Bolted Joints – Bearing – Type Connections – Tensile Strength of Plate – Strength and Efficiency of the Joint – Combined Shear and Tension – Slip – Critical Connections – Praying Action – Combined Shear and Tension for Slip – Critical Connections. Design of Groove welds – Design of Fillet Welds – Design of Intermittent fillet welds – Failure of Welds.

MODULE II: Eccentric and Moment Connections [9 Periods]

Introduction – Beams – Column Connections – Connections Subjected to Eccentric Shear – Bolted Framed Connections- Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections – Welded Bracket Connections – Moment Resistant Connections.

MODULE III: Analysis and Design of Industrial Buildings [10 Periods]

A. Dead loads, live loads and wind loads on roofs. Design wind speed and pressure, wind pressure on roofs; wind effect on cladding and louvers; Design of angular roof truss, tubular truss, truss for a railway platform.

B. Design of purlins for roofs, design of built up purlins, Design of knee braced trusses and stanchions. Design of bracings.

MODULE IV: Design of Steel Truss Girder Bridges [10 Periods]

Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self weight of truss girders, design of bridge compression members, tension members; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal Bracing; sway bracing.

MODULE V: Design of Steel Bunkers and Soils [10 Periods]

Introduction – Janseen's Theory – Airy's Theory – Design of Parameters – Design Criteria – Analysis of Bins – Hopper Bottom – Design of Bins.

TEXT BOOKS

1. Subramaniam N., "**Design of Steel Structures**", Oxford University Press.
2. Dayaratnam P., "**Design of Steel Structures**", S. Chand & Company.

REFERENCES

1. S. S. Bhavikatti, "**Design of Steel Structures – by Limit State Method as per IS:800-2007**", I K International Publishing House Pvt. Ltd., 4th Edition.
2. Dr. Ramachandra & Virendra Gehlot, "**Design Steel Structures Volume – II**", Scientific Publishers.
3. S. K. Duggal, "**Limit State Design of Steel Structures**", Tata McGraw Hill Education Private Ltd., 2nd Edition.
4. Indian Standard Code IS:800-2007.

E – RESOURCES

1. http://steel.fsv.cvut.cz/suscos/PP/1C03-12-Footbridges.pdf
2. http://gala.gre.ac.uk/6974/1/WCA091230.pdf
3. http://nptel.ac.in/courses/105106113/2_industrial_building/1_introduction.pdf
4. http://nptel.ac.in/courses/105106112/
5. http://www.nptelvideos.in/2012/11/design-of-steel-structures.html
6. http://nptel.ac.in/courses/105106113/

Course Outcomes:

After the completion of the course students will be able to:

1. Analyze the behavior of simple connections like bolted, riveted, pinned welded and design them for axial forces.
2. Analyze the behavior of bolted, welded connections and design them for eccentric and moment connections.
3. Analyze and design of industrial buildings for various loads and load combinations.
4. Design of steel truss bridges and other components.
5. Carry out wind load calculations for tall structures and design of steel chimneys.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**1**		
CO2	**3**		**3**	**1**	**1**	**1**
CO3	**3**		**3**	**2**	**1**	**1**
CO4	**3**	**1**	**3**	**2**	**1**	**1**
CO5	**3**	**1**	**3**	**3**	**1**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1118	EARTHQUAKE RESISTANT DESIGN OF BUILDINGS [PROFESSIONAL ELECTIVE-IV]	L	T	P
Credits: 3		2	1	-

Course Objectives:

To impart the knowledge about the fundamentals of load calculation, systems, design and detailing aspects of structures subject to earthquake loading including recent techniques.

MODULE I: INTRODUCTION [9 Periods]

Introduction to engineering seismology - various theories - measurement scales - vibration measuring instruments - Past earthquakes in India and world - Response spectrum - significance - construction & use.

MODULE II: STRUCTURAL MATERIALS AND SYSTEMS [9 Periods]

Performance of structural materials under cyclic loads - masonry - steel - concrete - soil. Various structural systems in steel and concrete for horizontal load transfer - their behavior and limitations - braced frames - rigid frames - shear walls - wall-frame systems.

MODULE III: STRUCTURAL PLANNING AND ANALYSIS [9 Periods]

A: Seismic design philosophy - Layout and planning of buildings in seismic zones - regular and irregular buildings - centre of rigidity and centre of mass – torsion

B: Design spectrum - ductility based analysis - capacity design concepts - pushover analysis concepts - energy based design - computing storey shear - drift - using provisions of Bureau of Indian Standards (BIS) codes.

MODULE IV: DESIGN AND DUCTILE DETAILING [9 Periods]

Load combinations - Ductility based design - Detailing for seismic performance - Provisions of IS: 13920 for RCC structural elements, frames, shear walls - design of shear walls..

MODULE V: SEISMIC RETROFITTING AND ISOLATION [9 Periods]

Damage Assessment techniques - safety analysis and rating - Reliability assessment - Retrofitting techniques - materials. Base Isolation techniques - Active and passive control devices.

TEXT BOOKS

1. S. K. Duggal, "**Earthquake Resistant Design of structures**", Oxford University Press, 2nd Edition.
2. Pankaj Agarwal and Manish Shrikhande, "**Earthquake Resistant Design of structures**", Prentice Hall of India Pvt. Ltd.

REFERENCES

1. T. Paulay and M. J. N. Priestley, "**Seismic Design of Reinforced Concrete and Masonry Building**", John Wiley & Sons.

2. Anand S.Arya, "**Masonry and Timber structures including Earthquake Resistant Design**", Nem chand & Sons, 6th Edition.
3. Miha Tomazevic, "**Earthquake Resistant Design of Masonry Building**", Imperial College Press.
4. C.V.R. Murty, "**Earthquake Tips – Learning Earthquake Design and Construction**".National Information Centre of Earthquake Engineering (NICEE), IIT Kanpur.

E – RESOURCES

1. https://www.nicee.org/EQTips.php
2. https://www.nicee.org/iaee/E_Chapter3.pdf
3. http://www.iitk.ac.in/nicee/wcee/article/10_vol7_3659.pdf
4. http://www.nzsee.org.nz/db/Bulletin/Archive/04(2)0222.pdf
5. http://nptel.ac.in/courses/105101004/
6. http://nptel.ac.in/courses/105105104/pdf/m16l39.pdf

REFERENCE CODES

1. IS: 1893 (Part-1) -2002. "Criteria for Earthquake Resistant – Design of structures." B.I.S., New Delhi.
2. IS: 4326-1993, "Earthquake Resistant Design and Construction of Building", Code of Practice B.I.S., New Delhi.
3. IS: 13920-1993, "Ductile detailing of concrete structures subjected to seismic force" – Guidelines, B.I.S., New Delhi.

Course Outcomes:

After the completion of the course students will be able to:

1. Understand earthquake phenomenon cause of earthquakes, faults, plate tectonics, seismic waves and terms associated with earthquake and measuring instruments.
2. Study the functional planning, continuous load path, simplicity and symmetry and learn design earthquake loads, basic load combinations.
3. Understand and Analyse the principles of earthquake resistant design of RC members, structural seismic design and the behavior of building, box action and bands, analysis and lateral load on buildings.
4. Analyse the strategies of structural design and detailing of various types of system.
5. Analyse the fundamentals of rehabilitation and retrofitting of earthquake affected structures.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		**3**	**2**	**1**	**1**
CO2	**1**		**3**	**2**	**1**	**1**
CO3	**1**		**3**	**2**	**1**	**1**
CO4	**1**		**3**	**2**	**1**	**1**
CO5	**2**		**3**	**2**	**3**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1119	STRUCTURAL DESIGN LAB	L	T	P
Credits: 2		-	-	4

Course Objectives:

To impart knowledge on analysing, designing and detailing all the structural components of multistoried buildings using software's.

SYLLABUS:

1. Analysis of cantilever, simply supported beam, fixed beams, continuous beams for different loading conditions.
2. Design of RCC beams.
3. Design of RCC slabs.
4. Design of RCC foundations.
5. Design of steel tension Members.
6. Design and detail all the Structural Components of Frame Buildings.
7. Design and detail a RC Multi-Storey Frame Buildings.
8. Design an Industrial Building.
9. Seismic Analysis of a Multistoried Building
10. Design of Bridge Deck using Staad Pro.

Course Outcomes:

After the completion of the course students will be able to:

1. Analyse different types of beams using Staad Pro.
2. Design RCC beams and slabs using software.
3. Design of Steel tension members using software.
4. Design and detail structural components.
5. Design and detail a multistoried frame building.

CO – PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	3
CO2	3	2	3	2	2	3
CO3	3	2	3	2	2	3
CO4	3	2	3	2	2	3
CO5	3	2	3	2	2	3

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1120	CADD LABORATORY	L	T	P
Credits: 2		-	-	4

Course Objectives:

The objective of the course is to make the students familiar with design of structural components like retaining walls and water tanks and to draw detailing diagram using AutoCAD.

LIST OF EXPERIMENTS:

1. Program for design of deep beam using Excel.
2. Program for design of column using Excel.
3. Program for design of slabs using Excel.
4. Program for design of beams using Excel.
5. Program for design of column and footing using excel.
6. Design and detailing of Cantilever Retaining Wall.
7. Design and detailing of Counterfort Retaining Wall.
8. Design and detailing of Circular Water Tank.
9. Design and detailing of Rectangular Water Tank.
10. Design and detailing of Underground Water Tank.

Course Outcomes:

After the completion of the course students will be able to

1. Design of special elements using Excel.
2. Design of different columns using Excel.
3. Design beams, slabs using Excel.
4. Design and detail a retaining wall.
5. Design and detailing of Water Tank.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	3
CO2	3	2	3	2	2	3
CO3	3	2	3	2	2	3
CO4	3	2	3	2	2	3
CO5	3	2	3	2	2	3

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A1121	MINI PROJECT	L	T	P
Credits: 2		-	-	4

Course Objectives: To utilize basic knowledge and advance techniques to make product/process using experimentation and/or simulation and expose to others as document and oral presentation.

Course Outcomes:

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

1. Identify structural engineering problems reviewing available literature.
2. Study different techniques used to analyze complex structural systems.
3. Work on the solutions given and present solution by using his/her technique applying engineering principles.
4. Summarize the work completed in the form of technical documents
5. Utilize Technology tools for information management and decision support.

Syllabus Contents:

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

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.

Continuous assessment of Mini Project at Mid semester and End semester will be monitored by the departmental committee.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	2	3	3	
CO2		2			2	1
CO3		2	3	3		
CO4	2	2				1
CO5		2	2		2	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. II Semester		
Code: A0A05	VALUE EDUCATION	L	T	P
Credits: Nil		2	-	-

Prerequisites: Nil

Course Objectives: The course deals about value of education and self- development, Imbibe good values in students and know about the importance of character.

MODULE I: **[6 Periods]**

Values and self-development -Social values and individual attitudes. Work ethics, Indian vision of humanism**.** Moral and non- moral valuation. Standards and principles**.** Value judgements.

MODULE II: [**7 Periods]**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness, Honesty, Humanity. Power of faith, National Unity, Patriotism.Love for nature, Discipline.

MODULE III: [**6 Periods]**

C. Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality,

D. Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour.

MODULE IV: **[7 Periods]**

Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

MODULE V: [**6 Periods]**

Character and Competence -Holy books vs Blind faith, Self-management and Good health Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

REFERENCES

1. Chakraborty, S. K. "**Values and Ethics for organizations Theory and practice**", Oxford University Press, New Delhi.

Course Outcomes:

After completion of the course, students should be able to:

1. Understand self-development and moral values
2. Explore the importance of character and cultivation of values
3. Apply the personality development methods
4. Analyze the association and cooperation principles
5. Elaborate the principles of religions and good health science

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3	2	
CO2				3	2	
CO3				3	3	
CO4				3	1	
CO5				3	1	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1122	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P
Credits: Nil	[PROFESSIONAL ELECTIVE – V]	2	-	-

Prerequisites: Concrete Technology

Course Objectives: To get the knowledge on causes of deterioration, assessment of distressed structures, repairing of structure and provides knowledge of Development of other advanced structural materials and technologies for execution for providing durable repairs and strengthening is the need of the day.

MODULE I: Deterioration & Damage of Structures [09 Periods]
Introduction– Deterioration of Structures – Distress in Structures – Causes and Prevention-Mechanism of Damage – Types of Damage.

MODULE II: Corrosion of Steel Reinforcement [09 Periods]
Corrosion of Steel Reinforcement– Causes – Mechanism and Prevention. Damage of Structures due to Fire – Fire Rating of Structures – Phenomena of Desiccation - Case Studies.

MODULE III: Inspection and Testing & Damage Assessment [10 Periods]
A: Inspection: Symptoms and Diagnosis of Distress
B: Testing & Damage assessment: Evaluation Models –Damage Testing Methods –NDT – Core Samples.

MODULE IV: Rehabilitation Methods and Repair of Structure [10 Periods]
Rehabilitation Methods – Grouting – Detailing – Imbalance of Structural Stability –Case StudiesRepair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – ShotCrete – Underpinning – Epoxy - Cement Mortar Injection- Crack Ceiling.

MODULE V: Strengthening of Structures [10 Periods]
Strengthening of Structures– Strengthening Methods – Retrofitting – Jacketing - Health Monitoring of Structures – Use of Sensors – Building Instrumentation –Bridge Repairs – Seismic Strengthening.

TEST BOOKS:
1. W. H. Ranso, ―"Concrete Repair and Maintenance Illustrated", RS Means Company Inc 1st Edition,1981.
2. B.L. Gupta and Amit Gupta, ―"Maintenance and Repair of Civil Structures", Standard Publications New Delhi, 2nd Edition, 2007.

REFERENCES:

1. A.R. Shantakumar, —"Concrete Technology", Oxford University press, 2ndEdition, 2006.
2. Bungey, —"Non-Destructive Evaluation of Concrete Structures", 2nd edition, 2003
3. Bt. A. Richardson —"Building Failures: Diagnosis and Avoidance", EF & N Spon, London, 3rd Ediion, 1991.

E RESOURCES:

1.http://cpwd.gov.in/Units/handbook.pdf
2.https://www.smartzworld.com/notes/rehabilitation-retrofitting-structures-notes-pdf-rrs/
3.http://www.smrcorissa.org/
4.http://getreport.in/idea/rehabilitation-and-retrofitting-of-structures-nptel
5.http://getreport.in/idea/rehabilitation-and-retrofitting-of-structures-notes-nptel
6.https://www.youtube.com/watch?v=fikRPFpbgVo

Course Outcomes:

At the end of the course, students will be able to
1.Understand the causes and prevention of deterioration in structures, interpret the types of damages and understand their mechanisms.
2.Categorize the causes and prevention mechanisms of corrosion in steel reinforcement and fire induced damages
3.Able to Examine to inspect and assess the structures using techniques of visual inspection and NDT
4.Estimate the structural damage and recommend suitable repair and strengthening methods.
5.Make use of the latest health monitoring and building instrumentation methods

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**1**	**2**	**1**
CO2	**2**	**3**	**2**	**2**	**2**	**2**
CO3		**3**	**3**	**1**		
CO4	**1**		**2**	**1**	**2**	**1**
CO5	**1**		**2**	**3**		**3**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1123	GROUND IMPROVEMENT TECHNIQUES [PROFESSIONAL ELECTIVE-V]	L	T	P
Credits: 3		3	-	-

Course Objectives:

To understand the importance of ground improvement and know various ground improvement techniques available to date, and selecting and designing suitable ground improvement technique for given soil conditions.

MODULE I: Introduction to Engineering Ground Modification [9 Periods]

Need and objectives, Identification of soil types, In-situ and laboratory tests to characterize problematic soils; Mechanical, Hydraulic, Physico-chemical, Electrical, Thermal methods, etc. and their applications.

MODULE II: Mechanical Modification [9 Periods]

Principles Compaction control of soil densification – Properties of Compacted soil tests, Specification Dynamic compaction requirements, Blasting, Tamping and Compaction piles of Vibrocompaction.

MODULE III: Hydraulic Modification [10 Periods]

A. Objectives and techniques, traditional dewatering methods and their choice, Design of dewatering system, Electro-osmosis and Filtration.

B. Drainage and seepage control with Geosynthetics, sand drains, Preloading and vertical drains, Electro-kinetic dewatering.

MODULE IV: Physical and Chemical Modification [10 Periods

Modification by admixtures, Shotcreting and GMODULEing Technology, Modification at depth by grouting, Crack Grouting and compaction grouting, Jet grouting, Thermal Modification, Ground freezing.

MODULE V: Modification by Inclusions and Confinement [10 Periods]

Soil reinforcement, reinforcement with strip, bar, mesh, sheet and grid reinforced soil. In-situ ground reinforcement, ground anchors, rock bolting and soil nailing, case studies.

TEXT BOOKS

1. Hausmann, M. R., "**Engineering Principles of Ground Modification**", McGraw Hill publications, New York.
2. P. Purushothama Raj, "**Ground Improvement Techniques**", Laxmi Publications, India.

REFERENCES

1. M. P. Moseley and K. Krisch, "**Ground Improvement**", Taylor and Francis, 2nd Edition.
2. Jones C. J. F. P., "**Earth Reinforcement and soil structures**", Butterworths, London.
3. K. Krisch & F.Krisch, "**Ground Control and Improvement**", John Wiley & Sons, 1994.
4. Peter G. Nicholson, "**Soil Improvement and Ground Modification Methods**", Elsevier Publishers

E – RESOURCES

1. https://theconstructor.org/geotechnical/ground-improvement-techniques-soil-stabilization/1836/
2. http://civil.emu.edu.tr/old_website/data/civl454/CH1-%20Int%20to%20gr%20modf.pdf
3. http://nptel.ac.in/courses/105104034/
4. http://nptel.ac.in/downloads/105108075/#

Course Outcomes:

After the completion of the course students will be able to:

1. Understand the soil types and their insitu and laboratory tests
2. Gain knowledge about the principles of compaction control of soil densification and its tests.
3. Understand the soil dewatering techniques with respect to field conditions.
4. Gain knowledge about the grouting techniques for different field conditions.
5. Identify the soil reinforcements using different techniques and insitu methods.

CO – PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	
CO2	2	1	1	1		
CO3	2	1	1	1	1	1
CO4	1		1	1		
CO5	2		3	1	2	1

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1124	DESIGN OF HIGH RISE STRUCTURES [PROFESSIONAL ELECTIVE-V]	L	T	P
Credits: 3		3	-	-

Course Objectives:

To impart knowledge on the behaviour, analysis and design of tall structures.

MODULE I: **[9 Periods]**

Design philosophy, Loading, sequential loading, materials - high performance, concrete - Fibre reinforced Concrete - Light weight concrete - design mixes. Gravity loading Wind loading Earthquake loading

MODULE II: **[9 Periods]**

Factors affecting growth, Height and Structural form. High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems.

MODULE III: **[10 Periods]**

A. Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction,

B. Analysis for member forces, drift and twist, computerised general three dimensional analysis.

MODULE IV: **[10 Periods]**

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

MODULE V: **[10 Periods]**

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

TEXT BOOKS

1. Bryan Stafford Smith and Alexcoull, "**Tall Building Structures - Analysis and Design**", John Wiley and Sons, Inc., 1991.

2. Taranath B.S., "**Structural Analysis and Design of Tall Buildings**", McGraw Hill, 1988.

REFERENCES

1. Gupta. Y. P., (Editor), Proceedings of National Seminar on "**High Rise Structures - Design and Construction Practices for Middle Level Cities**", New Age International Limited, New Delhi,1995.
2. Lin T. Y and Stotes Burry D, "**Structural Concepts and systems for Architects and Engineers**", John Wiley, 1988.
3. Beedle. L. S., "**Advances in Tall Buildings**", CBS Publishers and Distributors, Delhi, 1986.

E – RESOURCES

1. http://www.byggmek.lth.se/fileadmin/byggnadsmekanik/publications/tvsm5000/web5213.pdf
2. http://www.iitk.ac.in/nicee/wcee/article/2340.pdf
3. http://nptel.ac.in/courses/105106113/13
4. https://www.ct.upt.ro/suscos/files/2013-2015/2C08/L13_tall_buildings.pdf

Course Outcomes:

After the completion of the course students will be able to:

1. Idealize different types of loading in tall buildings.
2. Understand the different types of forms and importance of core and shear walls.
3. Analyse a complete high rise building.
4. Perform the buckling analysis of high rise buildings
5. Design a multistoried building for differential movement, creep and shrinkage.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**				**2**	
CO2	**2**	**3**			**2**	
CO3	**2**	**3**	**1**	**2**	**2**	
CO4	**2**		**1**	**2**	**2**	**1**
CO5	**2**			**2**	**2**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1125	**OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**
Credits: 3	[OPEN ELECTIVE]	**2**	**1**	**-**

Pre-requisite: Nil

Course Objectives:

To understand extremely important topics under the broad umbrella of optimization, this is synonymous with efficiency which is the underlying prime rationale for all scientific and technological advances and progress.

Module I: Linear Programming [10 Periods]

Introduction and formulation of models; convexity; graphical & simplex method; Big-M Method, Two phase method; degeneracy, non-existent and unbounded solutions; duality in L.P. Dual simplex method, sensitivity analysis for cost and requirement vector; Revised simplex method; Transportation and Assignment problems.

Module II: Integer Linear Programming [10 Periods]

Gomory's cutting plane method; branch and bound algorithm; traveling salesman problem; knapsack problem; linear C-1 problem.

Module III: Dynamic Programming, CPM & PERT [9 Periods]

A. Belman's Principle of optimality; recursive relations; Solution of L.P. Problem; simple examples.

B. CPM & PERT

Module IV: Non-Linear Programming [9 Periods]

Classical optimization methods; equality and inequality constraints; Lagrange multipliers; Kuhn-tucker conditions; quadratic forms; quadratic programming and Beale's methods.

Module V: Search Methods [10 Periods]

One dimensional optimization; Fibonacci search; multi dimensional search methods; uni-variate search; gradient methods; steepest descent/ascent methods; conjugate gradient method; Fletcher- reeves method; penalty function approach.

TEXT BOOKS

1. J.K. Sharma **"Operations Research Theory & Applications",** 4th Edition, Mc. Millan Publications
2. S. S. Rao -**"Engineering Optimization theory and Practice",** 4th Edition, J Wiley & Sons, New jersey

REFERENCES

1. K.V.Mital -**"Optimization methods in operations research and system analysis**", 3rd Edition, New age International (P) Ltd., publishers.
2. H.A Taha **"Operations Research: An Introduction"** Prentice Hall Edition, 2016 reprint
3. Raul Poler et.al **"Operations Research Problems Statement and solutions"** Springer, 2014 reprint.

E – RESOURCES

1. http://www.mhhe.com/engcs/industrial/hillier/etext/PDF/chap03.pdf (LPP)
2. http://ocw.nctu.edu.tw/upload/classbfs121001503719748.pdf (Transportation Problems)
3. http://shodhganga.inflibnet.ac.in/bitstream/10603/19544/12/7_chapter%201.pdf (Replacement Models)
4. https://www.math.ucla.edu/~tom/GameTheory/mat.pdf (Game Theory)
5. http://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf (Inventory Models)

Course Outcomes

After completion of the course, students will be able to:

1. Find feasible solution to LPP by various methods.
2. Minimize the cost and time by using Travelling salesmen Problem.
3. Understand various methods Dynamic programming.
4. Understand the various concepts on Non-Linear programming.
5. Understand the various concepts of Search methods.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**	**2**	**1**
CO2	**3**		**3**	**2**	**2**	**1**
CO3	**3**		**3**	**2**	**2**	**1**
CO4	**3**		**3**	**2**	**2**	**1**
CO5	**3**		**3**	**2**	**2**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1126	SAFETY IN CONSTRUCTION [OPEN ELECTIVE]	L	T	P
Credits: 3		3	-	-

Course Objective: The objective of this course is to provide the knowledge about safety in construction, Industries and also the fundamentals of maintenance.

MODULE I: Industrial safety [9 Periods]

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting – Equipment and methods.

MODULE II: Fundamentals of maintenance engineering [9 Periods]

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

MODULE III: Wear and Corrosion and their prevention [10 Periods]

A. Wear: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication,

B. Corrosion: Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

MODULE IV: Safety during construction [10 Periods]

Safety during project construction, Training to project staff and operation staff, stages of project construction, safety during receiving, unloading, shifting and storage, safety guidelines for storage, general safety facilities at construction sites, interface between civil and erection works, definition on construction safety, soil classification system, general precaution, hazardous atmosphere and materials, emergency rescue equipment, exhaust gases.

MODULE V: Trench cutting and Electrical Safety [10 Periods]

Hydraulic shoring and timber shoring for trenches, Safety in cutting and brazing, gas welding oxy acetylene equipment and use, gases - storage of cylinders, handling of cylinders, Inspecting equipment, Projective measures for electric arc welding, welding and cutting in tank vessels and drums, confined spaces, personal protection, health hazards. Safety in Concrete, Concrete forms and shoring, reinforcing steel, concrete placement, general

requirements for vertical and tubular welded frame shoring, tube and coupler shoring, vertical slip forms, electrical safety in constructions, work on live equipment, over head and underground cables, safety in use of power tools, hand tools, pneumatic tools, electrically operated tools, cartridge, individual tools and precautions.

REFERENCES

1. Higgins & Morrow, "**Maintenance Engineering Handbook**", Da Information Services.
2. H. P. Garg, "**Maintenance Engineering**", S. Chand and Company.
3. S. Rao and H. L. Saluja, "**Electrical safety, Fire safety Engineering and Safety Management**", Khanna Publishers, 1998.

E – RESOURCES

1. https://onlinecourses.nptel.ac.in/noc18_mg42/preview
2. http://nptel.ac.in/courses/112107143/40
3. http://www.mantenimientopetroquimica.com/en/typesofmaintenance.html

Course Outcomes:

After completion of the course, students will be able to:

1. Understand the basic concepts of industrial safety needs
2. Understand and identify various hazards in industry
3. Understand and avoid wear and tear during manufacturing process
4. Understand the various safety precautions taken during construction.
5. Understand the methods of trench cutting and Electrical safety.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3	3	
CO2			2	2	3	
CO3			2	2	3	
CO4			3	3	3	
CO5			2	2	3	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1127	WASTE TO ENERGY [OPEN ELECTIVE]	L	T	P
Credits: 3		3	-	-

Pre requisites: Nil

Course Objective: The objective if this course is to introduce different waste to energy conversions and its innovative practices, explores the role of energy from waste in resource management and clean energy production.

MODULE I: Introduction [8 Periods]

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

MODULE II: Biomass Pyrolysis [10 Periods]

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

MODULE III: Biomass Gasification [10 Periods]

A: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating.

B: Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

MODULE IV: Biomass Combustion [8 Periods]

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

MODULE V: Biogas [12 Periods]

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES

1. "**Non Conventional Energy**", Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. "**Biogas Technology - A Practical Hand Book**" - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. "**Food, Feed and Fuel from Biomass**", Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. "**Biomass Conversion and Technology**", C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

E – RESOURCES

1. https://www.eia.gov/energyexplained/?page=biomass_waste_to_energy
2. https://www.r-e-a.net/renewable-technologies/energy-from-waste
3. http://www.volund.dk/Waste_to_Energy/How_it_works

Course Outcomes:

After completion of the course, students will be able to:

1. Understand the different types of wastes generated in an industry
2. Produce energy from various resources
3. Convert urban waste to useful energy
4. Assess the environmental impacts of various wastes.
5. Understand the benefits of waste-to-energy conversion.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	**Programme Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		**2**	**2**		**2**	
CO2		**2**	**2**		**2**	
CO3		**2**	**2**		**2**	
CO4		**2**	**2**		**2**	
CO5		**2**	**2**		**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1128	SEMINAR	L	T	P
Credits: 2		-	-	4

Course Objectives: To promote deeper understanding the basic concepts, physical mechanism behind the processes, participate in scientific analysis and comprehensive of scientific writing of verbal presentation. This course is to introduce post graduate student to ideas, methods and techniques that can improve the content and presentation of scientific seminars.

Course Outcomes:

At the end of the course, students should be able to

1. Write technical documents to the standards
2. Give oral presentation on technical and general topics
3. Express ideas clearly with examples
4. Identify the research opportunities related to their area.
5. Communicate effectively.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		3	2	2	2	
CO2		1	3	2	3	
CO3	2	3	2	3	1	
CO4	3	1	3	1	1	
CO5		3		2	2	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. III Semester		
Code: A1129	DISSERTATION PHASE - I	L	T	P
Credits: 8		-	-	16

Course Objectives: To utilize basic knowledge and advance techniques to make product/process using experimentation and/or simulation and expose to others as document and oral presentation.

Course Outcomes:

At the end of the course, students should be able to

1. Summarize the work completed in the form of technical documents
2. Specify the techniques implemented or to be implemented
3. Explain the results obtained in Project Phase I
4. Summarize the ultimate finding of the project
5. Detailed presentation of work carried out.

CO – PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	1	2	1
CO2	3		3	2	2	3
CO3	1	3	2	1	3	2
CO4	3	2	2		2	2
CO5		3	3	2	1	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M. Tech. IV Semester		
Code: A1130	DISSERTATION PHASE - II	L	T	P
Credits: 16		-	-	32

Course Objectives: To utilize science and engineering to make product/process using innovative techniques, predict the results and prepare technical documents.

Course Outcomes:

At the end of the course, students should be able to

1. Identify project goals, constraints, deliverables, performance criteria, control needs and requirements.
2. Implement concepts, tools and techniques to do quality projects.
3. Adapt projects in response to issues that arise internally and externally.
4. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.
5. Utilize technology tools for communication, collaboration, information management, and decision support.

CO – PO Mapping
(3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COS	Programme Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2		2
CO2	3		3	2	2	2
CO3	2		2	1	3	1
CO4	1		2	3	3	1
CO5		3	2	3	2	3