SONA COLLEGE OF TECHNOLOGY, SALEM-5

(An Autonomous Institution)

M.E-Civil Engineering

(Structural Engineering)

CURRICULUM and SYLLABI

[For students admitted in 2021-2022]

M.E / M.Tech Regulation 2019

Approved by BOS and Academic Council meetings

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR101	Finite Element Analysis	3	1	0	4	60
2	P19STR102	Theory of Elasticity and Plasticity	3	1	0	4	60
3	P19STR503	**Elective:** Experimental Techniques and Instrumentation	3	0	0	3	45
4	P19STR510	**Elective:** Advanced Concrete Technology	3	0	0	3	45
5	P19GE101	**Research Methodology and IPR**	2	0	0	2	30
6	P19GE701	**Audit Course:** English for Research Paper Writing	2	0	0	0	30
Practical							
7	P19STR103	Structural Engineering Laboratory	0	0	4	2	60
					Total Credits	**18**	

Approved by

Chairperson, Civil Engineering BOS
Dr.R.Malathy

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/Civil, First Semester ME STR Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME II Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR201	Advanced Design of Concrete Structures	3	0	0	3	45
2	P19STR202	Advanced Design of Steel Structures	3	0	0	3	45
3	P19STR512	**Elective –** Design of Offshore Structures	3	0	0	3	45
4	P19STR514	**Elective –** Formwork Engineering	3	0	0	3	45
5	P19GE702	**Audit Course** – Stress Management by Yoga	2	0	0	0	30
Practical							
7	P19STR203	Structural Software Application Laboratory	1	0	4	3	75
8	P19STR204	Mini Project	0	0	4	2	60
					Total Credits	**17**	

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Copy to:-
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Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR301	Design of Steel Concrete Composite Structures	3	0	0	3	45
2	P19STR525	**Professional Elective-** Internet of Things of Civil Engineering	3	0	0	3	45
3	P19END601	**Open Elective-** Product Design and Manufacturing	3	0	0	3	45
	P19ISE601	**Open Elective-** Transport Safety					
	P19PSE601	**Open Elective-** Smart Grid Technologies					
Practical							
4	P19STR302	Technical Seminar	0	0	2	1	30
5	P19STR303	Practical Training	0	0	4	2	60
6	P19STR304	Project Phase – I	0	0	16	8	240
					Total Credits	**20**	

Approved by

Chairperson, Civil Engineering BOS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.R.Malathy	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/Civil, Third Semester ME STR Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	P19STR401	Project Phase – II	0	0	28	14	420
					Total Credits	**14**	

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Copy to:-
HOD/Civil, Fourth Semester ME STR Students and Staff, COE

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME I Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR101	Finite Element Analysis	3	1	0	4	60
2	P19STR102	Theory of Elasticity and Plasticity	3	1	0	4	60
3	P19STR503	**Elective:** Experimental Techniques and Instrumentation	3	0	0	3	45
4	P19STR510	**Elective:** Advanced Concrete Technology	3	0	0	3	45
5	P19GE101	**Research Methodology and IPR**	2	0	0	2	30
6	P19GE701	**Audit Course:** English for Research Paper Writing	2	0	0	0	30
Practical							
7	P19STR103	Structural Engineering Laboratory	0	0	4	2	60
					Total Credits	**18**	

Approved by

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Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/Civil, First Semester ME STR Students and Staff, COE

COURSE CODE	COURSE NAME	L	T	P	C
P19STR101	FINITE ELEMENT ANALYSIS	3	1	0	4

Course Objective (s): The Purpose of learning this course is to:

- Understand the concepts of strain displacement relation and numerical techniques.
- Solve the problems on calculating shape function and formation displacement and stiffness matrix.
- Evaluate the problems on iso parametric element and dynamic Problems using finite element method.
- Recognize the concept of FEM applications in engineering problems.
- Analyse two-dimensional truss and beam element and to solve problems on rectangular and triangular elements.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Discuss the displacement models to solve practical problems in Structural engineering. (K3)
CO2	Apply numerical techniques of finite element analysis to solve real time problems. (K3)
CO3	Manipulate the shape function and interpolation function to study structural behaviour. (K4)
CO4	Implement linear and quadratic elements in the finite element analysis of various types of structures. (K2)
CO5	Predict structural behaviour using strain displacement matrix and element stiffness matrix. (K5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	2	-	-	1	-	1	1
CO2	3	3	3	3	2	-	-	1	-	1	1
CO3	3	3	3	3	2	-	-	1	-	1	1
CO4	3	3	3	3	2	-	-	1	-	1	1
CO5	3	3	3	3	2	-	-	1	-	1	1
CO	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**1**	**-**	**1**	**1**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial

UNIT-I	INDRODUCTION	12 Hrs.

Differential equilibrium equations - Strain displacement relation - Linear constitutive relation - Special cases - Principle of stationary potential energy - Application to finite element methods. Some numerical techniques in finite element analysis.

UNIT-II	DISPLACEMENT MODELS	12

Displacement models - Convergence requirements. Natural coordinate systems - Shape function. Interpolation function - Linear and quadratic elements - Lagrange and Serendipity elements - Strain displacement matrix - Element stiffness matrix and nodal load vector.

UNIT-III	ISPARAMETRIC ELEMENTS	12
Two dimensional isoparametric elements - Four noded quadrilateral elements - Triangular elements - Computation of stiffness matrix for isoparametric elements - Numerical integration (Gauss quadrature) - Convergence criteria for isoparametric elements.		
UNIT-IV	**APLLICATIONS OF FEM**	**12**
Assemblage of elements – Direct stiffness method - Special characteristics of stiffness matrix - Boundary condition and reaction - Gauss elimination and LDLT decomposition - Basic steps in finite element analysis.		
UNIT-V	**ANALYSIS OF STRUCTURES**	**12**
Analysis of framed Structures - 2D truss element - 2D beam element. Analysis of plate bending: Basic theory of plate bending - Displacement functions - plate bending Elements. Plane stress and plane strain analysis: Triangular elements - Rectangular elements.		
		TOTAL:60 Hours

REFERENCES:

1.	Bhavikatti.S.S, “Finite Element Analysis”, New Age International Publishers, 2015.
2.	Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”,
3.	Rao.S.S, “Finite Element Method in Engineering”, Butterworth – Heinmann, UK, 2008.
4.	Logan D. L., A First Course in the Finite Element Method, Cengage Learning, 2015.
5.	R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons, 2011.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR102	THEORY OF ELASTICITY AND PLASTICITY	3	1	0	4

Course Objective (s): The Purpose of learning this course is to:

- Understand the concepts of stresses, strains and stress-strain relationships, basic theory of elasticity and plasticity
- Expose students to two dimensional problems in Cartesian coordinates
- Understand the problem formulations and solution techniques
- Familiarize students with the principle of torsion of prismatic bars of non-circular sections.
- Expose the students to elasto-plastic problems involving plastic deformation of beams and bars.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Explain the concept of stress and strain and their relationships (k2)
CO2	Analyze the two-dimensional problems in Cartesian and polar coordinates (K4)
CO3	Apply the concept of torsion to Prismatic bars of different sections (k3)
CO4	Solve simple problems of elasticity and plasticity understanding the basic concepts. (k4)
CO5	Apply numerical methods to solve continuum problems. (k5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	2	2	2	1	-	2	2	1	1
CO2	3	3	2	2	2	1	-	2	2	1	1
CO3	3	3	3	3	2	1	-	2	3	2	1
CO4	3	3	3	3	2	1	-	2	3	2	1
CO5	3	3	3	3	2	1	-	2	3	3	1
CO	**3**	**3**	**2.6**	**2.6**	**2**	**1**		**2**	**2.6**	**1.8**	**1**

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	ANALYSIS OF STRESS AND STRAIN IN CARTESIAN COORDINATES	12

Displacement, Analysis of stress (two and three dimension)- Body force, surface force - Uniform state of stress – Principal stresses - stress transformation laws - Differential equations of equilibrium. Analysis of strain (two and three dimension) Strain displacement relations - Compatibility equations - state of strain at a point – strain transformation - principal strain - principle of superposition. Stress-strain relations - generalized Hooke's law - Lame's constants, Boundary value problems

UNIT-II	TWO DIMENSIONAL PROBLEMS OF ELASTICITY IN CARTESIAN	12

Plane stress and Plane strain problems - Airy's stress function - Polynomials – Direct method of determining Airy's polynomial stress function - Solution of Biharmonic equation by fourier series - St. Venant principle.

UNIT-III	TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES	12

General equations in polar coordinates - Stress distribution symmetrical about an axis - Pure bending of curved bars - Strain components in polar coordinates - Displacements for symmetrical stress distribution - Rotating Disc - Bending of a curved bar by force at the end

UNIT-IV	TORSION OF PRISMATIC BARS	12
General solutions of the problem by displacement (St. Venant's warping function) and force (Prandtl's stress function) approaches - Membrane analogy-Torsion of shafts of circular and noncircular (elliptic, triangular and rectangular) cross sectional shapes. Torsion of hollow thin walled single and multicelled sections.		
UNIT-V	**PLASTIC DEFORMATION**	**12**
Introduction to stress-strain curve - Ideal plastic body - Criterion of yielding - Rankine's theory - St.Venant's theory - Tresca's criterion - Beltramis theory - Von-mises criterion - Mohr's theory of yielding - yield surface – Plastic potential, Isotropic Hardening-Flow rule (plastic stress- strain relation) Prandtl Reuss equations - Plastic work - Plastic potential Nadai's sand heap analogy.		
		TOTAL: 60 Hours

REFERENCES:

1.	Sadhu Singh, Theory of Plasticity, Khanna Publishers, N.Delhi, 2008.
2.	S. Timoshenko and J. N. Goodier, Theory of Elasticity, Mc Graw Hill Book Co., 2010.
3.	RagabA.R., Bayoumi S.E., Engineering Solid Mechanics, CRC Press,1999
4.	Computational Elasticity, AmeenM, Narosa, 2005.
5.	Advanced Mechanics of Solids, Srinath L.S, Tata McGraw Hill, 2009.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR103	STRUCTURAL ENGINEERING LABORATORY	0	0	4	2

Course Objective (s): The Purpose of learning this course is to:

- Practice the design of high strength concrete
- Gain the knowledge to conduct various Non-destructive tests
- Practice various engineering principles to understand the behavior of structures

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Design high strength concrete and study the parameters affecting its performance (k4)
CO2	Conduct Non-Destructive tests on existing concrete structures (k5)
CO3	Apply Engineering principles to understand behaviour of structural elements (k5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	1	3	3	2	1	2	2	3	1
CO2	3	2	1	3	3	2	1	3	3	3	1
CO3	3	3	1	3	3	2	1	1	1	3	1
CO	**3.0**	**2.3**	**1.0**	**3.0**	**3.0**	**2.0**	**1.0**	**2.0**	**2.0**	**3.0**	**1.0**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

CONTENTS:- **60**

Study of stress-strain curve of high strength concrete

Correlation between cube strength, cylindrical strength, split tensile strength and modulus of rupture

Effect of cyclic loading on steel

Non-Destructive testing of existing concrete members

Behaviour of beams under flexure, shear and torsion

Model study on continuous beam with influence line coefficients

Total: **60**

REFERENCES:

1. Properties of Concrete, Neville A.M, 5th Edition, Prentice Hall, 2013.
2. Concrete Technology, Shetty M.S., S.Chand and Co., 2008.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR503	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Determine the force and strain Measurements.
- Determine the Vibration Measurements
- Describe the Data Acquisition Systems.
- Describe the methods of Stress Separation and Photo Elasticity
- Describe the Non Destructive Methods

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Demonstrate strain measuring equipments. (K1)
CO2	Discuss various vibration measuringequipments. (K2)
CO3	Choose various data indicating and recordinginstrument.(K3)
CO4	Outline the concept ofphotoelasicity(K3)
CO5	Apply suitable non-destructive testingmethods(K3)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	3	2	3	2	3	2
CO2	2	3	3	2	2	2	2	3	2	2	2
CO3	3	2	2	2	3	2	2	2	1	2	2
CO4	3	3	3	2	3	3	2	2	2	2	3
CO5	2	3	3	3	3	2	1	3	3	3	2
CO	**2.6**	**2.8**	**2.8**	**2.4**	**2.8**	**2.4**	**1.8**	**2.6**	**2**	**2.6**	**2.2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	FORCE AND STRAIN MEASUREMENTS	9 Hours

Basic Concept – Measurements of displacement, strain pressure, force, torque etc, Strain gauges(Mechanical, Electrical, Acoustical etc) – Strain gauge circuits - Potentiometer and wheat stone bridge – Rosette analysis. Hydraulic Jack, Load cell, ProvingRing.

UNIT-II	VIBRATION MEASUREMENTS	9 Hours

Liner Variable Differential Transducers (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs.

UNIT-III	DATA ACQUISITION SYSTEMS	9 Hours

Indicating and recording devices - Static and dynamic data recording –Data acquisition and processing systems – Cathode Ray Oscilloscope – XY Plotter – Chart plotters – Digital data acquisition systems.

UNIT-IV	PHOTOELASTICITY	9 Hours

Photoelasticity – Optics of photoelasticity – Polariscope: Circular and plane polariscope – Isoclinics and Isochromatics - Methods of stress separation

UNIT-V	NON DESTRUCTIVE TESTING METHODS	9 Hours

Ultrasonic testing principles and application – Rebound Hammer – Holography – Use of laser for structural testing – Advanced NDT methods – Ultrasonic pulse echo, impact echo, impulse radar techniques, GECOR, Ground penetrating radar (GPR).

	TOTAL: 45 Hours
REFERENCES:	
1.	Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi,1996
2.	Ravisankar.K. and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures” SERC, Chennai, 2007.
3.	Rangan C S., ”Instrumentation – Devices and Systems”, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1997
4.	Sirohi. R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997
5.	Dally J W and Riley W.F, “Experimental stress Analysis”, McGraw-Hill, Inc. NewYork, 1991
6.	Charles J Hellier, Handbook of Non destructive Evaluation, Second Edition, Mc graw Hill Education, 2013.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR510	ADVANCED CONCRETE TECHNOLOGY	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Analyse the characterisation of concrete matrix with influencing factors like strength and behaviour
- Signify the various method of mix proportions
- Evaluate and study of the factors to affecting the durability of concrete
- Apply the special concrete with specified quality and study the limitations
- Evaluate the Concrete properties based on Non destructive methods

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Discuss microstructure concrete and dimensional stability (K4)
CO2	Prepare a mix design for the various concrete grades (K3)
CO3	Enumerate the properties of ingredients considered for durability of concretes (K4)
CO4	Explain the different types of special concrete and their applications in construction (K3)
CO5	Explain different types of non-destructive testing methods (K4)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	1	2	1	3	1	1	--	1	3	2	2
CO2	1	2	1	3	1	1	--	1	3	2	2
CO3	1	2	1	3	1	1	--	1	3	2	2
CO4	1	2	1	3	1	1	--	1	3	2	2
CO5	1	2	1	3	1	1	--	1	3	2	2
CO	1	2	1	3	1	1	--	1	3	2	2

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	CONCRETE CHARACTERISATION	9 Hours

Microstructure of concrete: Aggregate phase, hydrated cement paste, interfacial transition zone. Strength: strength-porosity relationship, failure modes in concrete, factors affecting compressive strength, behavior of concrete under various stress states. Dimensional stability: Elastic behavior, drying shrinkage and creep, thermal shrinkage and thermal properties of concrete.

UNIT-II	PROPORTIONING CONCRETE MIXTURES	9 Hours

Significance and objectives, general considerations, procedures, Methods of concrete mix design, design of high strength and high performance concrete using relevant codes. Testing and control of concrete quality: Methods and significance, accelerated strength testing, core tests and quality control charts.

UNIT-III	DURABILITY OF CONCRETE	9 Hours

Water as an agent of deterioration: structure of water, permeability, causes of deterioration of concrete: surface wear, crystallization of salts in pores, frost action, effect of fire, sulfate attack, alkali aggregate reaction, and corrosion of embedded steel in concrete: Mechanism-control, development of holistic model of concrete deterioration, concrete in the marine environment. Methods of providing durable concrete, short-term tests to assess long-term behaviour.

UNIT-IV	SPECIAL TYPES OF CONCRETE	9 Hours

Roller compacted concrete-self compacted concrete-shrinkage compensation concrete, pervious concrete-concrete containing polymers-heavy weight concrete for radiation shielding-high performance concrete, high strength concrete, shotcrete, fibre reinforced concrete- bacterial concrete-Mass concrete – their materials, mix proportions, properties, applications and limitations.

UNIT-V	NON-DESTRUCTIVE METHODS	9 Hours
Surface hardness methods, Penetration resistance techniques, pull out tests, maturity method, stress wave propagation methods, electrical methods, electrochemical methods, electromagnetic methods, Tomography of reinforced concrete.		
		TOTAL: 45Hrs.

REFERENCES:-

1.	Kumar Mehta, Paulo J.M Monteiro., Concrete Microstructure, properties and Materials, McGraw Hill Education(India) Pvt Ltd, New Delhi,2014
2.	Job Thomas, "Concrete Technology", Cengage Learning India, 2015
3.	Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2011
4.	Gupta.B.L, Amit Gupta, "Concrete Technology, Jain Book Agency, 2010
5.	Neville, A.M., Properties of Concrete, Prentice Hall, 2013, London
6.	Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2008
7.	IS 10262:2019, Concrete Mix Proportioning – Guidelines (Second Revision), Bureau of Indian Standards, New Delhi.2019

COURSE CODE	COURSE NAME	L	T	P	C
P19GE101	RESEARCH METHODOLOGY AND IPR	2	0	0	2

Course Objective (s): The Purpose of learning this course is to:

- Impart the knowledge of various steps involved in scientific research
- Educate students on different types of sampling, test hypothesis and one tailed chi-square test
- Introduce students to the types of report and the mechanism to write reports along with intellectual property rights and its importance
- Explain the theories and functions of international trademark law and law of patents

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Review the literature of the research problem (K2)
CO2	Choose appropriate data collection and sampling method according to the research problem (K4)
CO3	Interpret the results of research and communicate effectively with their peers (K4)
CO4	Explain the Importance of intellectual property rights (K1)
CO5	Evaluate trade mark, develop and register patents (K5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	3	2	1	1	3	2
CO2	3	3	3	3	3	3	1	2	1	3	1
CO3	3	3	3	3	3	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	2	1	2	1
CO5	3	3	3	3	3	3	2	2	1	2	2
CO (Avg)	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2.6**	**1.6**

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	Introduction to Research Methods	6

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria for Good Research, Defining Research Problem, Research Design , Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules

UNIT-II	Sampling Design and Hypothesis Testing	6

Steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques - Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), concerning variance – one tailed Chi-square test.

UNIT-III	Interpretation and Report Writing	6

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report.

UNIT-IV	Introduction to Intellectual Property	6

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

UNIT-V	Trade Marks, Copy Rights and Patents	6

Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes, trademark claims –trademark Litigations- International trademark law. Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

TOTAL: 30 Hours

REFERENCES:	
1.	C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques ,4th Edition, New Age International Publishers, 2019.
2.	Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets”, Delmar Cengage Learning, 4th Edition, 2012.
3.	Prabuddha Ganguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, Tata Mc Graw Hill Education, 1st Edition, 2008.
4.	Panneerselvam, R., Research Methodology, Second Edition, Prentice-Hall of India, New Delhi, 2013.
5.	Ranjith Kumar, Research Methodology – A step by step Guide for Begineers, 4th edition, Sage publisher, 2014.
6.	D Llewelyn & T Aplin W Cornish, “Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights”, Sweet and Maxwell, 1st Edition, 2016.
7.	Ananth Padmanabhan, “Intellectual Property Rights-Infringement and Remedies”, Lexis Nexis, 1st Edition, 2012.
8.	Ramakrishna B and Anil Kumar H.S, “Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers”, Notion Press, 1st Edition, 2017.
9.	M.Ashok Kumar and Mohd.Iqbal Ali :”Intellectual Property Rights” Serials Pub

P19GE701 **English for Research Paper Writing**

2 0 0 0

Course Outcomes:

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

- Demonstrate research writing skills both for research articles and thesis
- Frame suitable title and captions as sub-headings for articles and thesis
- Write each section in a research paper and thesis coherently
- Use language appropriately and proficiently for effective written communication
- Exhibit professional proof-reading skills to make the writing error free

Unit – I **6**

Planning and preparation, word order, breaking up long sentences, organising ideas into paragraphs and sentences, being concise and avoiding redundancy, ambiguity and vagueness

Unit – II **6**

Interpreting research findings, understanding and avoiding plagiarism, paraphrasing sections of a paper/ abstract.

Unit- III **6**

Key skills to frame a title, to draft an abstract, to give an introduction

Unit – IV **6**

Skills required to organise review of literature, methods, results, discussion and conclusions

Unit – V **6**

Usage of appropriate phrases and key terms to make the writing effective - proof-reading to ensure error-free writing.

Text Books:

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

REFERENCES

Martin Cutts, Oxford Guide to Plain English, Oxford University Press, Second Edition, 2006

Total: 30 hours

Dr. M. Renuga
BoS – Chairperson,
Science & Humanities
HOD / H&L

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME II Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR201	Advanced Design of Concrete Structures	3	0	0	3	45
2	P19STR202	Advanced Design of Steel Structures	3	0	0	3	45
3	P19STR512	**Elective –** Design of Offshore Structures	3	0	0	3	45
4	P19STR514	**Elective –** Formwork Engineering	3	0	0	3	45
5	P19GE702	**Audit Course** – Stress Management by Yoga	2	0	0	0	30
Practical							
7	P19STR203	Structural Software Application Laboratory	1	0	4	3	75
8	P19STR204	Mini Project	0	0	4	2	60
					Total Credits	**17**	

Approved by

Chairperson, Civil Engineering BOS
Dr.R.Malathy

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

Copy to:-
HOD/Civil, Second Semester ME STR Students and Staff, COE

COURSE CODE	COURSE NAME	L	T	P	C
P19STR201	Advanced Design of Concrete Structures	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Calculation of Crack width, deflection and behaviour of beams
- Design of Special Reinforced Concrete Elements
- Design of flat slab and Yield line approach
- Inelastic behaviour of Concrete beams and columns
- Understand the concept of ductile and detailing of structural members

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Describe the design philosophy of Concrete Structures
CO2	Design the columns, walls, corbels, deep beams and grid floors
CO3	Design the flat slabs by yield line approach
CO4	Discuss the inelastic behaviour of concrete beams and columns
CO5	Deliberate the detailing for ductility of beams, columns and frames

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	2	2	2
CO2	3	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	3	3	2	1	2	2	2	2
CO4	3	3	3	3	3	2	1	2	2	2	2
CO5	3	3	3	3	3	2	1	2	2	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

UNIT-I	INTRODUCTION	9 Hrs.

Calculation of deflection and crack width according to IS Code. Construction of Interaction curve for compression member with axial force and bending – Design of slender column. Behaviour of beams for flexure, shear and torsion.

UNIT-II	DESIGN OF SPECIAL REINFORCED CONCRETE ELEMENTS	9 Hrs.

Design of Reinforced Concrete walls, Design of shear wall, – Strut and tie method of analysis for corbels and deep beams, Design of corbels, deep beams and grid floors.

UNIT-III	FLAT SLABS AND YIELD LINE APPROACH	9 Hrs.

Design of flat slabs according to IS method - Design of spandrel beams - Yield line analysis and design of square, rectangular, triangular and circular slabs with various boundary conditions. Hillerborg's strip method.

UNIT-IV	INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS	9 Hrs.

Inelastic behaviour of concrete beams by Baker's method, moment – rotation - curvature characteristics. Limit analysis – Conditions for moment redistribution - Stress-Strain behaviour of confined and unconfined columns.

UNIT-V	DUCTILE DETAILING	9 Hrs.

Concept of Ductility – Design and detailing of beams, columns for ductility - Design of cast-in-situ joints in frames – Determination of ductility factor for singly and doubly reinforced beams.

	TOTAL:45 Hours
REFERENCES:	
1.	Gambhir.M. L., "Design of Reinforced Concrete Structures", Prentice Hall of India,
2.	Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis
3.	Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Design', Third Edition,
4.	Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India,
5.	Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India,

COURSE CODE	COURSE NAME	L	T	P	C
P19STR202	Advanced Design of Steel Structures	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Recognize limit states and failure modes in structural steel members and systems.
- Become familiar with design specification for steel structures, and understand their basis in mechanics, testing, and analysis
- Familiar with the relevant BIS codes to be used in steel design.
- Able to design steel structures connections
- Able to analyze and design advance level steel structures.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Explain and design the different types of steel connections
CO2	Analysis and design various components of industrial structures
CO3	Design the steel members subjected to combined forces.
CO4	Design steel chimney subjected to wind loads.
CO5	Evaluate the behaviour and design of light gauge elements.

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	2	2	2
CO2	3	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	3	3	2	1	2	2	2	2
CO4	3	3	3	3	3	2	1	2	2	2	2
CO5	3	3	3	3	3	2	1	2	2	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

UNIT-I	Design of Connections	9 Hrs.

Introduction- Classification of connections. Bolted and Welded connections: Basic concepts-Beam-to-Beam connections. Beam-Column connection: Unstiffened and Stiffened seated Connections-Moment Resistant Connections.

UNIT-II	Analysis and Design of Industrial Buildings	9 Hrs.

Industrial building-Planning-Structural framing-Elements of industrial building- Analysis and design of trusses-Design of Purlins, Gable column and Gable wind girder-Introduction to pre-engineered building. Design and detailing for earthquake and wind loads. Design consideration for durability.

UNIT-III	Design of Combined Forces	9 Hrs.

Design of members subjected to combined forces: Beam-Column-Crane Gantry Girders – Design of simple bases, Gusseted bases and Moment Resisting Base Plates.

UNIT-IV	Design of Steel Chimney	9 Hrs.

Introduction to chimneys -Types-Dimensions of steel stacks-Components: Lining- Breech openings and access ladder-Loading and load combinations-Design considerations-Design of self supporting and guyed steel chimney.

UNIT-V	Design of Light Gauge Steel Structures	9 Hrs.

Light gauge steel section: Introduction-Applications-Advantages-Behaviour-Forms-Edge and Intermediate stiffener-Stiffened, unstiffened and multiple stiffened element-Flat-width ratio-

Effective width for load and deflection determination-Analysis and design of compression and flexural members.	
	TOTAL:45 Hours
REFERENCES:	
1.	Subramanian N, "Design of Steel Structures", Oxford University Press, New Delhi
2.	Duggal S.K, "Design of Steel Structures", Tata McGraw-Hill Education, 2009.
3.	Shiyekar M.R, "Limit State Design in Structural Steel", Prentice Hall of India Pvt.
4.	Punmia B.C., Comprehensive Design of Steel Structures, Lakshmi Publications, New
5.	Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel
6.	Bhavikatti.S.S, "Deign of Steel structures", I.K. International publishing house, New

COURSE CODE	COURSE NAME	L	T	P	C
P19STR203	Structural Software Application Laboratory	1	0	4	3

Course Objective (s): The Purpose of learning this course is to:

- Practice the students to analyse the structural elements with different load combinations.
- Design the elements as per the functional requirements provided in the IS Code provisions.
- Familiar with the Finite element software to be used in steel and concrete design.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Analysis and design of steel roof trusses by softwares
CO2	Analysis and design of Reinforced Concrete frames by softwares
CO3	Analysis of various members by Finite Element Analysis softwares

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	3	2	2
CO2	3	3	3	3	3	2	1	2	3	2	2
CO3	3	3	3	3	3	2	1	2	3	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

CYCLE - I	**25 Hrs.**
Analysis and design of 2D and 3D Steel roof trusses for static, wind and seismic forces.	
CYCLE - II	**25 Hrs.**
Analysis and design of 2D and 3D Reinforced Concrete rigid frames for static, wind and seismic forces.	
CYCLE -III	**25 Hrs.**
Finite Element modeling, analysis and design of Reinforced Concrete and Steel Elements.	
	TOTAL:75 Hours

REFERENCES:

1.	Laboratory manuals prepared by Civil Engineering Department, Sona College of
2.	Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2009.
3.	Subramanian N, "Design of Steel Structures", Oxford University Press, New Delhi
4.	Prof. S.K. Bhattacharyya and Dr. D. Maity "Finite Element Analysis" NPTEL Web course, IIT Kharagpur.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR204	Mini Project	0	0	4	2

Course Objective (s): The Purpose of learning this course is to:

- Collect the related articles and identify the problems
- Understand the various techniques for analyse complex structural system
- Give the solution and techniques applying with Engineering Principles

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Identify structural engineering problems reviewing available literature.
CO2	Study different techniques used to analyze complex structural systems.
CO3	Work on the solutions given and present solution by using his/her technique applying engineering principles.

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	3	2	2
CO2	3	3	3	3	3	2	1	2	3	2	2
CO3	3	3	3	3	3	2	1	2	3	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

60 Hours

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.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR512	**Elective** – Design of Offshore Structures	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Understand the wave and its effect on offshore structures
- Familiarize the various types of loads acting on the structures
- Understand the concept of foundation and structural modeling
- Able to analyse the elements of offshore structures
- Able to design the elements of offshore structures

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Describe the wave theories
CO2	Discuss the various forces of offshore structures
CO3	Explain about offshore soil and structure modelling
CO4	Analysis of offshore structures
CO5	Design of offshore structures

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	2	2	2
CO2	3	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	3	3	2	1	2	2	2	2
CO4	3	3	3	3	3	2	1	2	2	2	2
CO5	3	3	3	3	3	2	1	2	2	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

UNIT-I	**Wave Theories**	**9 Hrs.**
Wave generation process, small, finite amplitude and nonlinear wave theories.		
UNIT-II	**Forces of offshore Structures**	**9 Hrs.**
Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.		
UNIT-III	**Offshore Soil and Structure Modelling**	**9 Hrs.**
Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.		
UNIT-IV	**Analysis of Offshore Structures**	**9 Hrs.**
Static method of analysis, foundation analysis and dynamics of offshore structures.		
UNIT-V	**Design of Offshore Structures**	**9 Hrs.**
Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.		
		TOTAL: 45 Hours

REFERENCES:

1.	Reddy.D.V and Swamidas A.S.J., Essential of offshore structures. CRC Press.2013.
2.	Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
3.	API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms Working Stress Design - API Publishing Services, 2005
4.	James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.
5.	Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs,

COURSE CODE	COURSE NAME	L	T	P	C
P19STR514	**Elective** – Formwork Engineering	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Know the requirements and selection of formwork
- Design concept of formworks
- Design the wall and column formworks
- Design the formwork for beams, slabs and other Structures
- Understand the formwork techniques

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Describe the materials and behavior of formwork
CO2	Understand the loads and design of foundation
CO3	Design the formwork for wall and column
CO4	Design of Formwork for beam, slab, bridges and special structures
CO5	Design of Flying Formwork and slip formwork techniques

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	2	2	2
CO2	3	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	3	3	2	1	2	2	2	2
CO4	3	3	3	3	3	2	1	2	2	2	2
CO5	3	3	3	3	3	2	1	2	2	2	2
COs	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

UNIT-I	INTRODUCTION	9 Hrs.

Introduction-Formwork as a temporary structure-requirements for Formwork-selection of Formwork-Classification of Formwork- Formwork Materials-Timber-Plywood-Steel-Aluminium Form-Plastic Forms-other Material-Form Coating and Mould Linings-Form Anchors-Tie System-Spreaders, Spacers-Form Linings Materials.

UNIT-II	FORMWORK DESIGN CONCEPTS & FOUNDATION FORMWORK	9 Hrs.

Loads on Formwork-Dead or Permanent Loads-Imposed Loads-Environmental Loads-Design Basis (Assumption Made in Formwork Design)-Estimating Permissible Stress-Maximum Bending Moment, Shear Force, and Deflection-Formwork for Foundation-Conventional Formwork for Foundation-Foundation Formwork (All Steel)-Foundation Formwork Design-Illustration on Foundation Wall Design.

UNIT-III	WALL & COLUMN FORMWORK	9 Hrs.

Wall Formwork - Conventional Wall Formwork-Proprietary Wall Formwork System - Large Area Wall Forms-Climbing Formwork Wall Formwork - Climbing Formwork - Different types of Climbing formwork – Doka climbing Formwork - Wall Form Design - Illustration of Wall Formwork Design Using Plywood and H-16 Beams - Column Formwork - Conventional Column Formwork - Proprietary Column Formwork - Column Formwork System - Doka form

work system - PERI Column Formwork - Disposable Column Formwork - All Metal Column Formwork-Achieving Formwork Economy in Column Construction-Design For Column Formwork-Illustration of Column Formwork Design-Example		
UNIT-IV	**SLAB AND BEAM FORMWORK**	**9 Hrs.**
Traditional Slab and Beam Formwork-Slab and Beam Formwork Solutions offered by L&T - Beam and Slab Formwork Solution by PERI and Mivan - achieving Economy In Slab Construction - Design of Slab and Beam Construction - Illustration of Slab and Beam Formwork Design - Illustration of Proprietary Slab Formworkb-Formwork Arrangement for Caissons - Formwork For Piers And Pier Caps-Bridge Superstructures - Formwork for Bridge Railing / Parapets / Edge Beams - Cases Temporary Support Structures of Bridges.		
UNIT-V	**FLYING FORMWORK**	**9 Hrs.**
Some Examples of Flying Formwork - Flying Formwork Cycle - Advantages and Limitation of Flying Formwork -Design Issues In Flying Forms - Safety Issues in Flying Forms - Table Forms - Tunnel Formwork System -Column Mounted Shoring System - Gang Forms – Slipform - Vertical Slipform - Horizontal Slipform -Types of Slipform - Functions of Varies Slipform Components - Assembly, Sliding and Dismantling of Slipform - Slipform Design Issues - Some Cases in Slipform - Safety Operation during Slipform Erection - Productivity Issues in Slipform Construction. Failure of formworks.		
		TOTAL: 45Hours
REFERENCES:		
1.	Kumar Neeraj Jha, "Formwork for concrete structures" Tata Mcgraw Hill Education	
2.	Peurifoy R.L., Oberlender G.D., " Formwork For Concrete Structures", McGraw Hill, New York, 1996.	

COURSE CODE	COURSE NAME	L	T	P	C
P19GE702	Audit Course – Stress Management by Yoga	2	0	0	0

Course Objective (s): The Purpose of learning this course is to:

- Understand the benefits of Yoga and thus ensure social well being
- Perform and study breathing related asanas
- Perform yoga to ensure mental physical health of mankind
- Understand role of women in yoga and create self destructive habits
- Implement yoga for moral health

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Develop physical and mental health thus improves social health
CO2	Increase immunity power of the body and prevent diseases
CO3	Accelerate memory power
CO4	Achieve the set goal with confidence and determination
CO5	Improve stability of mind, pleasing personality and work with awakened wisdom

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**P**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO**	**PO10**	**PO11**
CO1	3	3	3	1	2	1	-	-	-	2	3
CO2	2	3	3	1	2	-	-	-	-	2	3
CO3	2	3	3	-	2	1	-	-	-	3	3
CO4	3	3	3	1	2	1	-	-	-	2	2
CO5	2	3	3	-	2	1	-	-	-	3	3
COs	**3**	**3**	**3**	**-**	**2**	**1**	**-**	**-**	**-**	**3**	**2**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium)

UNIT-I	**12 Hrs.**

Yoga –Introduction – astanga yoga – 8 parts – Yam and Niyam etc.-Do's and Don'ts in life- Benefits of Yoga and Asana-Yoga Exercise and benefits- Pranayama yoga – Nadi suthi, Practice and Spinal Scaleance Practice

UNIT-II	**12**

Neuromuscular Breathing exercise and practice -magarasa yoga , 14 points Acupressure techniques and practice - Body relaxation practice and its benefits – Raja Yoga. 1.Agna - explanation and practice – Activation of pituritary – Raja Yoga. 2. Santhi Yoga – Practice – Balancing of physical and mental power.

UNIT-III	**12**

Raja yoga – 3. Sagasrathara yoga – practice - Activation of dormanant brain cells – kayakalpa Theory - Kayakalpa – practice – yogic exercise to improve physical and mental health and practice – Asanas –explanation –Practice – benefits.

UNIT-IV	**12**

Sun namaskar – 12 Poses – explanation and practice - yoga – Asana –padmasana, vajrasana, chakrasana, vinachasans etc., Stress management with yoga – Role of women and yoga

Equality, non-violence, Humanity, Self-Control – Food and Yoga Aware of self-destructive habits Avoid fault thinking (thought analysis – practice) – Yoga free Anger (Neutralization of anger) & Practice.		
UNIT-V		**12**
Moralisation of Desire & Practice - Punctuality – Love – kindness – Compassion Eradication of worries –practices in Geetha – Sense of duty – Devotion, Self-Reliance, Confidence, Concentration, truthfulness, Cleanliness.		
		TOTAL:60 Hours

REFERENCES:

1.	"Yogic Asanas for Group Training Par-I" Janardan Swami Yigabhyasi Mandal,
2.	"Rajayoga or Conquering theInternal Nature" by Swami Vivekananda Advaita Ashram (Publication Department), Kolkatta

P19GE702 **Stress Management by Yoga**

2 0 0 0

Course Outcomes:

At the end of completion of this course, students will be able to

1. Develop physical and mental health thus improving social health
2. Increase immunity power of the body and prevent diseases
3. Accelerate memory power
4. Achieve the set goal with confidence and determination
5. Improve stability of mind, pleasing personality and work with awakened wisdom

UNIT – I **6**

Yoga-Introduction - Astanga Yoga- 8 parts-Yam and Niyam etc.- Do`s and Don'ts in life- Benefits of Yoga and Asana- Yoga Exercise- and benefits- Pranayam Yoga- Nadi suthi, Practice and Spinal Sclearance Practice- Regularization of breathing techniques and its effects-Practice and kapalapathy practice.

UNIT – II **6**

Neuromuscular breathing exercise and Practice- Magarasa Yoga, 14 points Acupressure techniques and practice- Body relaxation practice and its benefits- Raja Yoga- 1.Agna – explanation and practice- Activation of Pituitary- Raja Yoga- 2. Santhi Yoga-Practice- Balancing of physical and mental power.

UNIT – III **6**

Raja Yoga- 3. Sagasrathara yoga –practice- Activation of dormant brain cells-Kayakalpa-theory- Kayakalpa –practice-Yogic exercise to improve physical and mental health and practice-Asanas –explanation-Practice-benefits

UNIT –IV **6**

Sun namaskar- 12 poses-explanation and practice-Yoga –Asana-Padmasana, vajrasana,chakrasana, viruchasana etc-Stress management with Yoga-Role of women and Yoga

Equality, nonviolence, Humanity, Self- control- Food and yoga Aware of self-destructive habits

Avoid fault thinking (thought analysis-Practice)-Yoga Free from ANGER (Neutralization of anger)& practice

UNIT – V **6**

Moralisation of Desire & practice- Punctuality-Love-Kindness-Compassion Eradication of worries-Practice -Personality development, positive thinking-Good characters to lead a moral life

How to clear the polluted mind- Benefits of blessing- Five- fold culture –explanation- Karma Yoga Practice In Geetha- Sense of duty-Devotion, self- reliance, confidence, concentration, truthfulness, cleanliness.

Reference Books

1. 'Yogic Asanas for Group Tarining-Part-I" Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Total: 30 hours

Dr. M. Renuga
BoS – Chairperson,
Science & Humanities
HOD / H&L

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME III Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Theory							
1	P19STR301	Design of Steel Concrete Composite Structures	3	0	0	3	45
2	P19STR525	**Professional Elective-** Internet of Things of Civil Engineering	3	0	0	3	45
3	P19END601	**Open Elective-** Product Design and Manufacturing	3	0	0	3	45
	P19ISE601	**Open Elective-** Transport Safety					
	P19PSE601	**Open Elective-** Smart Grid Technologies					
Practical							
4	P19STR302	Technical Seminar	0	0	2	1	30
5	P19STR303	Practical Training	0	0	4	2	60
6	P19STR304	Project Phase – I	0	0	16	8	240
					Total Credits	**20**	

Approved by

Chairperson, Civil Engineering BOS	**Member Secretary, Academic Council**	**Chairperson, Academic Council & Principal**
Dr.R.Malathy	**Dr.R.Shivakumar**	**Dr.S.R.R.Senthil Kumar**

Copy to:-

HOD/Civil, Third Semester ME STR Students and Staff, COE

COURSE CODE	COURSE NAME	L	T	P	C
P19STR301	Design of Steel-Concrete Composite Structures	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

- Understand the steel - concrete composite construction and Construction issues in design.
- Design of various composite member
- Design of various connectors
- Understand the design concepts and behaviour of box girder bridges
- Understand the various behaviour of steel - concrete composite structures through case studies

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Understand the steel-concrete composite actions (K1)
CO2	Design of composite members (K3)
CO3	Design of connections in composite structures (K3)
CO4	Behaviour of box girder bridges (K4)
CO5	Seismic behaviour of composite structures (K5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	2	1	2	2	2	2
CO2	3	3	3	3	3	2	1	2	2	2	2
CO3	3	3	3	3	3	2	1	2	2	2	2
CO4	3	3	3	3	3	2	1	2	2	2	2
CO5	3	3	3	3	3	2	1	2	2	2	2
CO (Avg)	3	3	3	3	3	2	1	2	2	2	2

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	INTRODUCTION	9 Hrs.

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

UNIT-II	DESIGN OF COMPOSITE MEMBERS	9 Hrs.

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

UNIT-III	DESIGN OF CONNECTIONS	9 Hrs.

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

UNIT-IV	COMPOSITE BOX GIRDER BRIDGES	9 Hrs.

Introduction - behaviour of box girder bridges - design concepts

UNIT-V	CASE STUDIES	9 Hrs.

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

TOTAL: 45 Hours

REFERENCES:

1.	Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2.	Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.
3.	Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

COURSE CODE	COURSE NAME	L	T	P	C
P19STR302	**Technical Seminar**	**0**	**0**	**2**	**1**

Course Objective (s): The Purpose of learning this course is to:

- Improve the presentation skill and answer the questions in a brief manner within the stipulated time

Course Outcome (s) (COs): At the end of this course, the students will be able to:

- Know the way of presentation about their understanding/concepts in a clear manner (K2)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	3	1	2	2	3	2
CO2	3	3	3	3	3	3	1	2	2	3	2
CO3	3	3	3	3	3	3	1	2	2	3	2
CO4	3	3	3	3	3	3	1	2	2	3	2
CO5	3	3	3	3	3	3	1	2	2	3	2
CO (Avg)	3	3	3	3	3	3	1	2	2	3	2

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

TOTAL: 30 Hours

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

COURSE CODE	COURSE NAME	L	T	P	C
P19STR303	**Practical Training**	**0**	**0**	**4**	**2**

Course Objective (s): The Purpose of learning this course is to:

- Trained in tackling a practical field/industry-orientated problem related to Structural Engineering.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

- Develop skills in facing and solving the field problems (K5)

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	3	1	2	2	3	2
CO2	3	3	3	3	3	3	1	2	2	3	2
CO3	3	3	3	3	3	3	1	2	2	3	2
CO4	3	3	3	3	3	3	1	2	2	3	2
CO5	3	3	3	3	3	3	1	2	2	3	2
CO (Avg)	3	3	3	3	3	3	1	2	2	3	2

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

TOTAL: 60 Hours

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

COURSE CODE	COURSE NAME	L	T	P	C
P19STR304	**Project Phase – I**	**0**	**0**	**16**	**8**

Course Objective (s): The Purpose of learning this course is to:

- Express his/her findings in the project in sequenced manner and defend their ideas

Course Outcome (s) (COs): At the end of this course, the students will be able to:

- The students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	3	3	3	3	1	2	2	3	2
CO2	3	3	3	3	3	3	1	2	2	3	2
CO3	3	3	3	3	3	3	1	2	2	3	2
CO4	3	3	3	3	3	3	1	2	2	3	2
CO5	3	3	3	3	3	3	1	2	2	3	2
CO (Avg)	3	3	3	3	3	3	1	2	2	3	2

Correlation Level: 1: Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

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

COURSE CODE	COURSE NAME	L	T	P	C
P19STR525	Internet of Things of Civil Engineering	3	0	0	3

Course Objective (s): The Purpose of learning this course is to:

1. Understand the basic components in the architecture of IoT.
2. Enable to know the basic concept of WoT.
3. Understand the working principle of the Sensors used in IoT.
4. Acquire the knowledge in Application of IoT in Smart Cities.
5. Understand the role of IoT in Environmental monitoring.

Course Outcome (s) (COs): At the end of this course, the students will be able to:

CO1	Explain the basic concept and pillars of IoT**(K1)**
CO2	Demonstrate the pillars and the architecture of the webof things**(K2)**
CO3	Apply the suitability of IoT sensors for various applications in Civil Engineering**(K3)**
CO4	Understand the IoT tools for smart city applications**(K4)**
CO5	Monitor the environment using IoT architecture and related concepts**(K5)**

Knowledge Level: K1 – Remember: K2 – Understand: K3 – Apply: K4 – Analyze: K5 – Evaluate:

CO – PO Mapping

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3		2	3	2	2	1	2	2	3
CO2	2	2	1	2	3	2	2	2	2	2	3
CO3	1	2	1	2	3	2	2	2	2	2	3
CO4	1	1	1	2	3	2	2	2	2	2	3
CO5	1	1	1	2	3	2	2	2	2	2	3
CO	**1**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**

Correlation Level: 1:Slight (Low) 2:Moderate (Medium) 3:Substantial (High)

UNIT-I	**INTRODUCTION**	**10 Hours**

Definition and functional Requirements-Motivation-Architecture-Web3.0 View of IoT-Ubiquitous IoTapplictions-Four pillars of IoT-DNA of IoT-The Toolkit approach for End-user participation in the Internet of Things .Middleware for IoT: Overview-Communication middleware for IoT-IoT Information Security

UNIT-II	**WEB OF THINGS**	**10 Hours**

Web of things versus Internet of things-Two pillars of the web-Architecture Standardization for WoT--Unified Multitier WoTArchitecture.Cloud of Things:Grid/SOA and cloud computing –Mobile Cloud computing-The cloud of things.

UNIT-III	**IOT SENSORS**	**9 Hours**

Introduction –Detectable phenomena-conversion methods-commonly measured quantiuties-Physiocal Principles-Selection of sensor-Need for sensor –role of sensor. Types of sensor: Requirements, Advantages, disadvantages and application-Pressures sensor-Temperature sensor-Humidity sensor-chemical sensor-Accelerometer and gyroscope.

UNIT-IV	**SMART CITY APPLICATION**	**8 Hours**

Smart transportation –Intelligent parking-Autonomous Vehicle network. Smart buildings –Energy aware-inter building Navigation. Environmental sensing-Sustainable cities-City insights. Health monitoring of structures-Case studies.

UNIT-V	**ENVIRONMENTAL MONITORING**	**8 Hours**

Water management –Process –application.Airpollution-Methods-advantages.Water monitoring-quality standards.Indication of calamities-alert systems-applications.Smart irrigation-case study.Micro climate monitoring.

TOTAL: 45 Hours

REFERENCES:	
1.	The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou – CRC Press – 2012
2.	Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles-(Eds.) – Springer – 2011
3.	The Internet of Things: Applications to the Smart Grid and Building Automation by - Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley -2012
4.	Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

Sona College of Technology, Salem
(An Autonomous Institution)
Courses of Study for ME IV Semester under Regulations 2019
Civil Engineering
Branch: Structural Engineering

S. No	Course Code	Course Title	Lecture	Tutorial	Practical	Credit	Total Contact Hours
Practical							
1	P19STR401	Project Phase – II	0	0	28	14	420
					Total Credits	**14**	

Approved by

Chairperson, Civil Engineering BOS
Dr.R.Malathy

Member Secretary, Academic Council
Dr.R.Shivakumar

Chairperson, Academic Council & Principal
Dr.S.R.R.Senthil Kumar

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