NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous College under VTU)
(NAAC Accredited with "A+" Grade, NBA, Accredited)

Syllabus – I Semester M.Tech

STRUCTURAL ENGINEERING

SCHEME AND SYLLABUS

NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

Outcome Based Education Curriculum
2022-2024

Department of Civil Engineering
Nagarjuna College of Engineering & Technology
Mudugurki Village, Venkatagiri Kote Post**,**
Devanahalli Taluk,
Bangalore District-562164

NAGARJUNA
COLLEGE OF ENGINEERING & TECHNOLOGY

An Autonomous College under VTU

DEPARTMENT OF CIVIL ENGINEERING

VISION

To transform the students as leaders in Civil Engineering to achieve professional excellence in the challenging future

MISSION

M1: To provide the Civil Engineering knowledge and skills for students through an excellentacademic environment.

M2: Adopting innovative teaching techniques using modern engineering tools for designing,modeling and analyzing the societal and environmental problems.

M3: Developing Communication skill, leadership qualities through team work and skills for continuing education among the students.

M4: To inculcate moral, ethical and professional values among students to serve the society.

M5: Validate engineering knowledge through innovative research projects to enhance theiremployability and entrepreneurship skills.

Program Educational Objectives (PEOs)

PEO1: Graduates in Civil Engineering will apply the technical knowledge for sustainable societal growth.
PEO2: Graduates of civil Engineering will demonstrate designing, modeling and analyzing skills.
PEO3: Graduates in Civil Engineering will demonstrate good communication skills, dynamic leadership qualities with concern for environmental protection.
PEO4: Civil Engineering graduates will be capable of pursuing higher studies, take up researchand development work blended with ethics and human values.
PEO5: Civil engineering graduates will have the ability to become entrepreneurs thereby switching over from responsive engineering to creative engineering.

Program Outcomes (POs)

PO-1: An ability to independently carry out research /investigation and development work to solve practical problems.
PO-2: An ability to write and present a substantial technical report/document.
PO-3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO-4: Inculcate graduates with qualities of high professional integrity, commitment to societal needs and sustainable development.
PO-5: Use research-based knowledge for innovative projects in Structural engineering.
PO-6: Demonstrate multidisciplinary, individual and teamwork and management principles for entrepreneurship and life-long learning.

Program Specific Outcome (PSO)

PSO-1: Apply the knowledge of Civil Engineering in Sustainable Infrastructure developments.
PSO-2: Identify, analyze and manage Civil Engineering problems with ethical and social responsibilities.
PSO-3: Implementation of relevant codes/ specifications/ guidelines to arrive at comprehensive solutions to address societal needs and exhibit communication and teamwork skills.

TOTAL CREDITS FOR THE COURSE

Sl. No	Semester	Number of Credits
1	First	22
2	Second	18
3	Third	22
4	Fourth	18
	Total Credits	80

First Semester M.Tech – Scheme

Sl. No	Course	Course Code	Course Title	L:T:P (Hrs/week)	Total Credits	Marks (CIE:SEE)	Total Marks
1	BSC	22CSE11	Statistics and Optimization Techniques	3-0-0	3	50:50	100
2	IPCC	22CSE12	Advanced Design of RC Structures	3-0-2	4	50:50	100
3	PCC	22CSE13	Computational Structural Mechanics	3-0-0	3	50:50	100
4	PCC	22CSE14	Structural Dynamics	4-0-0	4	50:50	100
5	PCC	22CSE15	Mechanics of Deformable Bodies	3-0-0	3	50:50	100
6	MCC	22CSE16	Research Methodology & IPR	3-0-0	3	50:50	100
7	PCCL	22CSEL17	Structural Engineering Lab-I	1-0-2	2	50:50	100
8	AUD/ AEC	22AUD/ AEC 18	BOS recommended course (Any NPTEL/SWAYAM)				
Total				**20-0-4**	**22**	**350:350**	**700**

BSC: Basic Science Course
PCC: Professional Core
IPCC: Integrated Professional core Courses
MCC: Mandatory Credit Course
AUD/AEC: Audit Course/Ability Enhancement Course
PCCL: Professional Core Course Lab
L: Lecture
P: Practical
T: Tutorial

Note:

Integrated Professional Core Course (IPCC): These refer to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses): These are prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BOS if prerequisite courses are not required for the programs. Ability Enhancement Courses:

• These courses are prescribed to help students to enhance their skills in fields connected to the field of specialization as well as allied fields that leads to employable skills. Involving in learning such courses is impetus to lifelong learning.

• The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
• Registration to Audit /Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
• In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
• The Audit/ Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Note: Mini Project with Seminar: This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analyzing and authenticating, case studies, etc. Students shall present the seminar based on his /her mini-project. CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the program shall be mandatory. The CIE marks awarded for Mini-Project work and Seminar shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course. Internship: All the students shall have to undergo a mandatory internship of 06 weeks during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University Examination after satisfying the internship requirements.

Statistics and Optimization Techniques						
Course Code	**L-T-P (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE11	**3-0-0**	**3**	**50**	**50**	**3 hours**	**40 Hours**

Prerequisites:

Basic understanding of engineering mathematics.

Course Objectives:

The objective of this course is to make students to learn principles of optimization, To implement the optimization Concepts for the structural engineering problems. To evaluate different methods of optimization.

Syllabus

Module – 1 **[8 hours]**

Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques: Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques.

Module – 2 **[8 hours]**

Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming.

Module – 3 **[8 hours]**

Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods.

Module – 4 **[8 hours]**

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different technique.

Module – 5 **[8 hours]**

Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. **Dynamic programming:** Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming.

Course Outcomes:

On completion of this course, students are able to

Achieve Knowledge of design and development of problem solving skills

- Acquainted with the various optimization techniques and their use in civil engineering.
- Use classical optimization techniques and numerical methods of optimization.
- Summarize the Linear, Non-linear and Geometric Programming

• Understands the concept of Dynamic programmin
Text Books: • Spunt,"Optimum Structural Design"- Prentice Hall • S.S. Rao, "Optimization – Theory and Practice"- Wiley Eastern Ltd. • Uri Krisch, "Optimum Structural Design"- McGraw Hill.
Reference Books: • Richard Bronson, "Operation Research"- Schaum"s Outline Series. • Bhavikatti S.S. "Structural optimization using sequential linear programming"- Vikas publishing house.
E-Resources: • https://www.youtube.com/watch?v=wEdZLKMMZ8o&list=PLwdnzlV3ogoXKKb9nABDWYltTDgi37lYD • https://www.youtube.com/watch?v=GMTvoKRfxQw&list=PLGbjwqYC00hsy6XGalOBAphm2tdeLbgK0 • https://www.youtube.com/watch?v=fszNBvdfKrY

PO'S CO'S	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**
C1	3	-	2	-	1	-	3	2	1
C2	3	-	2	-	2	-	3	2	1
C3	3	-	2	-	1	-	3	3	2
C4	3	-	2	-	2	1	2	3	1
C5	3	-	2	-	1	-	3	3	1
C	**3**	**-**	**2**	**-**	**1.4**	**1**	**2.8**	**2.6**	**1.2**

ADVANCED DESIGN OF RC STRUCTURES						
Course Code	**L-T-P (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE12	**3-0-2**	**4**	**50**	**50**	**3 hours**	**50**

Prerequisites:

Engineering Mechanics, Strength of Materials, Structures Analysis, Reinforced Cement Concrete.

Course Objectives:

The objective of this course is to make students to learn principles of Structural Design, To design different types of structures and to detail the structures. To evaluate performance of the structures.

Syllabus

Module – 1

Design of continuous beams with and without redistribution of moments: Introduction, effective span, span /depth ratio, stiffness, loading pattern, moment redistribution, bending moment and shear force co-efficient.

Design of curved beams: -Analysis of bending and torsional moment in circular beams.

[10 hours]

Module – 2

Design of flat slabs: Introduction, proportioning of flat slabs, advantages and limitations of flat slabs, determination of bending moment and shear force, the direct design method, equivalent frame method, slab reinforcement, design of flat slabs.

Design of Waffle and grid floors: Introduction, size of beams and topping, Design of grid floor by Rankine‟s Grashoff method, IS-456:2000 method.

[10 hours]

Module – 3

Design of bunkers: Introduction, Difference between bunkers and silos, Design of rectangular bunker, Design of tension member, Design of circular bunker.

Design of silos-Silos for storage of cement.

[10 hours]

Module – 4

Design of chimneys: Introduction, Design factors, stresses due to self-weight and wind load. Stresses in horizontal reinforcement, temperature stresses, combined effect of self-weight, wind load and temperature stress in hoop reinforcement, Design of chimneys.

[10 hours]

Module – 5

Design of miscellaneous RC structures:

Shear walls-classification of shear walls, loads in shear walls, design of rectangular and flanged shear walls**.**

Deep beams-Introduction, parameters influencing design, minimum thickness, design of deep

beams, checking for local failure.

Folded plates-General features, types, analysis of folded plates, structural behavior of folded plates, methods.

[10 hours]

Experiments:

1. Analysis and design of beams by using software (STAADPRO)
2. Analysis and design of slabs by using software (STAADPRO)
3. Analysis and design of bunkers and silos by using software (STAADPRO)
4. Analysis and design of chimney by using software (STAADPRO)
5. Analysis and design of folded plates by using software (STAADPRO)

Course Outcomes:

On completion of this course, students are able to

- Achieve Knowledge of design and development of problem solving skills.
- Understand the principles of Structural Design and structural performance.
- Design and develop analytical skills.
- Summarize the principles of Structural Design and detailing

Text Books:

- Krishna Raju. N., "Advanced Reinforced Concrete Design", CBS Publishers & Distributors
- Pillai S. U. and Menon D., "Reinforced Concrete Design", Tata McGraw-Hill, 3rd Ed, 1999
- Relevant IS Code Books
- Shah.H.J, "Reinforced Concrete", Vol-1 and Vol-2, Charotar, 8th Edition – 2009 and 6th Edition – 2012 respectively.

Reference Books:

- P.C.Varghese, "Advanced Reinforced Concrete Design", Prentice-Hall of India, New Delhi, 2005.
- N.Krishna raju, "Advanced Reinforced Concrete Design".
- S S Bavikatti, "Advanced Reinforced Concrete Design".
- A Park and Paulay, "Reinforced and Prestressed Concrete"2000.
- Lin TY and Burns N H, "Reinforced Concrete Design".
- Kong KF and Evans T H "Design of Prestressed Concrete Structures

E-Resources

- **https://nptel.ac.in/courses/105/106/105106176/**

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	1	-	3	2	-	1	3	2	2
C2	2	-	3	1	-	1	2	3	2
C3	2	-	3	1	-	-	2	3	2
C4	2	-	3	1	-	1	2	3	2
C	**1.75**	**-**	**3**	**1.25**	**-**	**0.75**	**2.25**	**2.75**	**2**

COMPUTATIONAL STRUCTURAL MECHANICS						
Course Code	**L-T-P (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE13	**3-2-0**	**4**	**50**	**50**	**3 hours**	**40**

Prerequisites:

Structural Analysis, Matrix Method.

Course Objectives:

The objective of this course is to understand the principles of Structural Analysis, numerical methods, and analyze the structural members using flexibility and stiffness matrix method.

Syllabus

Module – 1 **[8 hours]**

Introduction: Static and Kinematic indeterminacy, numerical problems on static and kinematic indeterminacy. Concepts of stiffness and flexibility. Energy concepts. Principle of minimum potential energy and minimum complementary energy. Flexibility and Stiffness matrices for truss, beam and Portal Frame.

Module – 2 **[8 hours]**

Analysis using Flexibility method: Flexibility matrix for continuous beams, plane trusses and rigid plane frames. Analysis of continuous beams, plane trusses and rigid plane frames by flexibility method (having not more than 3 coordinates – 3x3 flexibility matrix.

Module – 3 **[8 hours]**

Analysis using Stiffness Method: Stiffness matrix for continuous beams, plane trusses and rigid plane frames. Analysis of continuous beams, plane trusses and rigid plane frames by stiffness method (having not more than 3 coordinates – 3x3 stiffness matrix).

Module – 4 **[8 hours]**

Effects of temperature change and lack of fit: Flexibility method of analysis-continuous beams, plane trusses and rigid plane frames by the flexibility method which are subjected to the effect of temperature change, continuous beams, plane trusses and rigid plane frames by the flexibility method which are subjected to the effect of lack of fit (having not more than 3 coordinates – 3x3 flexibility matrix).

Module – 5 **[8 hours]**

Numerical methods: Solution techniques including numerical problems for simultaneous equation developed in slope deflection method and other methods of structural analysis for beam and frames. Numerical problems on Gauss elimination and Numerical problems on Cholesky method.

Course Outcomes:

On completion of this course, students are able to

- Achieve Knowledge of design and development of problem solving skills.
- Understand the principles of Structural Analysis
- Design and develop analytical skills.
- Summarize the Solution techniques.

- Understand the concepts of structural behavior.

Text Books:

- S.Rajasekaran, "Computational Structural Mechanics", PHI, New Delhi, 2001.
- K.Jain "Advanced Structural Analysis with Computer Application" Nemchand and Brothers, Roorkee, India, 2005.
- F.W.Beaufait et al., "Computer methods of Structural Analysis", Prentice Hall, 1970.

Reference Books:

- W.Weaver and J.H.Gere, "Matrix Analysis of Framed Structures", Van Nastran, 1980.
- H.KardeStuncer, "Elementary Matrix Analysis of Structures", McGraw Hill 1974.
- M.F.Rubinstein "Matrix Computer Methods of Structural Analysis "Prentice – Hall., 2010.

E-Resources

- https://vtu.ac.in/pdf/cbcs/pg/2018/msesyll.pdf

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	3	2	-	-	-	-	-	3	-
C2	3	3	2	-	-	-	-	3	-
C3	3	2	-	-	-	-	-	3	-
C4	3	2	-	-	-	-	-	3	-
C5	3	3	-	-	-	-	-	3	-
C	**3**	**2**	**2**	-	-	-	-	**3**	-

Structural Dynamics						
Course Code	**L-T-P (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE14	**4-0-0**	**4**	**50**	**50**	**3 hours**	**50 Hours**

Prerequisites:

Basic understanding of structural analysis and knowledge of engineering mathematics.

Course Objectives:

The students will be able to learn the basic principles of structural dynamics, and implement principles of structural dynamics through different methods and to apply the same for free and forced vibration of structures to evaluate dynamic characteristics of structure. Also they will be able to study the different dynamic analysis procedures for calculating the response of structures to design structures against wind, earthquake and other dynamic loads.

Syllabus

Module – 1 **[10 hours]**

Introduction: Introduction to Dynamic problems in Civil Engineering, Concept of degrees of freedom, D-Alembert‟s principle, principle of virtual displacement and energy principles Dynamics of Single-degree-of-freedom systems: Mathematical models of Single-degree-of-freedom systems system, Free vibration response of damped and un damped systems. Methods of evaluation of damping.

Module – 2 **[10 hours]**

Response of Single-degree-of-freedom systems to harmonic loading (rotation unbalance, reciprocating unbalance) including support motion, vibration isolation, transmissibility, Numerical methods applied to Single-degree-of-freedom systems -Duhamel integral, principle of vibration-measuring instruments-seismometer and accelerometer.

Module – 3 **[10 hours]**

Dynamics of Multi-degree freedom systems: Mathematical models of multi-degree-of-freedom systems, Shear building concept, free vibration of undamped multi-degree-of-freedom systems - Natural frequencies and mode shapes-orthogonality property of modes.

Module – 4 **[10 hours]**

Response of Shear buildings for harmonic loading without damping using normal mode approach. Response of Shear buildings for forced vibration for harmonic loading with damping using normal mode approach, condition of damping uncoupling.

Module – 5 **[10 hours]**

Approximate methods: Rayleigh‟s method Dunkarley‟s method, Stodola‟s method. Dynamics of Continuous systems: Free longitudinal vibration of bars, flexural vibration of beams with different end conditions. Stiffness matrix, mass matrix (lumped and consistent); equations of motion for the discretized beam in matrix form.

Course Outcomes:

On completion of this course, students are able to

- Understand the principles of Structural Dynamics
- Have the Knowledge of vibration analysis of structures with different degrees of freedom
- Solve problems on single degree of freedom system

• Summarize the solution techniques for dynamics of Multi-degree freedom systems • Understand the concepts of damping in structures.
Text Books: • Structural Dynamics- Mario Paz: CBS publishers. • Structural Dynamics- Clough & Penzien: TMH • Vibrations, structural dynamics- M. Mukhopadhaya : Oxford IBH
Reference Books: • Dynamics of Structures – Theory and Application to Earthquake Engineering"- 2nd ed., Anil K. Chopra, Pearson Education. • Earthquake Resistant Design of Building Structures, Vinod Hosur, WILEY (india) • Vibration Problems in Engineering Timoshenko, S, Van-Nostrand Co
E-Resources • **https://nptel.ac.in/courses/105/106/105106151/**

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	-	-	3	-	2	1	3	2	1
C2	-	2	-	-	3	1	3	3	2
C3	-	-	3	-	2	1	2	3	1
C4	-	1	3	-	2	1	2	3	2
C5	-	-	2	-	3	1	2	3	2
C	**-**	**1.5**	**2.75**	**-**	**2.4**	**1**	**2.4**	**2.8**	**1.6**

Mechanics of Deformable Bodies						
Course Code	**L-T-P (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE15	**4-0-0**	**3**	**50**	**50**	**3 hours**	**40**

Prerequisites:

Strength of Materials and Engineering Mathematics.

Course Objectives:

To enable the students to gain the knowledge on principles of Analysis of Stress and Strain which makes them able to predict the stress-strain behaviour of continuum. Expose the students for the evaluation of the stress and strain parameters and their inter relations of the continuum.

Syllabus

Module – 1 **[8 hours]**

Theory of Elasticity: Introduction: Definition of stress and strain and strain at a point, components of stress and strain at point of Cartesian and polar co-ordinates. Constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.

Module – 2 **[8 hours]**

Transformation of stress: Principal stresses and principal directions, invariants of stress, hydrostatic and deviatory stress, Cauchy‟s formula to find - Normal stress, Shearing stress and resultant stress and Tangential stress, Concepts of maximum shear stress.

Module – 3 **[8 hours]**

Transformation of strain: Measurement of strains – Strain Rosettes, Principal strains and principal directions, magnitude of principal stress, orientation of principal planes, invariants of strain, spherical and deviatoric strains, Concepts of maximum shear strain, Numericals on displacement components and displacement field.

Module – 4 **[8 hours]**

Plane stress and plane strain: Airy‟s stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axi-symmetric problems, stress concentration due to the presence of a circular hole in plates.

Module – 5 **[8 hours]**

Theory of Plasticity: Stress – strain diagram in simple tension, perfectly elastic, Rigid – Perfectly plastic, Linear work –hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, yield conditions, stress – space representation of yield criteria through Westergard stress space, Tresca and Von-Mises criteria of yielding.

Course Outcomes:

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

- Achieve Knowledge of design and development of problem solving skills.
- Understand the principles of stress-strain behavior of continuum.
- Design and develop analytical skills.
- Describe the continuum in 2 and 3- dimensions.
- Understand the concepts of elasticity and plasticity.

Text Books:

- Srinath L.S., Advanced Mechanics of Solids , 10th print, Tata McGraw Hill, New Delhi, 1994.
- Verma P.D.S, "Theory of Elasticity", Vikas Publishing Pvt. Ltd., 1997.
- Chenn W.P and Hendry D.J, "Plasticity for Structural Engineers ", Springer Verlag., 1988.

Reference Books:

- Valliappan C, "Continuum Mechanics Fundamentals", Oxford IBH Publishing Co. Ltd., 1982.
- Sadhu Singh, "Applied Stress Analysis", 1st Edition, Khanna Publishers., 2014.
- Timoshenko &Goodier, "Theory of Elasticity", 3rd Edition, McGraw Hill New York 1970.

E-Resources

- https://nptel.ac.in/courses/112/107/112107146/

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	3	-	2	-	1	-	-	3	-
C2	3	-	1	-	2	-	-	3	-
C3	3	-	1	-	2	-	-	3	-
C4	3	-	1	-	2	-	-	3	-
C5	2	-	1	-	3	-	-	3	-
C	**2.8**	**-**	**1.2**	**-**	**2**	**-**	**-**	**3**	**-**

Research Methodology & IPR						
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSE16	**3-0-0-0**	**3**	**50**	**50**	**3 hours**	**40**

Prerequisites:

Basic Knowledge about Research

Course Objectives:

The students will be able to:

- Understand research problem formulation
- Analyze research related information.
- Understand the preparation of a research project thesis report
- Understand that when IPR would take such important place in growth of individuals & nation.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D.

Syllabus

Module – 1 **[8 hours]**

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Module – 2 **[8 hours]**

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Module – 3 **[8 hours]**

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Module – 4 **[8 hours]**

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes,

Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Module – 5 **[8 hours]**

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers‟ Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organization (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO

Course Outcomes:

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

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Text Books:

- Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.
- Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 2011.
- Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013

Reference Books:

- Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
- Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

E-Resources

- https://www.youtube.com/watch?v=E2gGF1rburw
- https://www.youtube.com/watch?v=5fvpsqPWZac&list=PLyqSpQzTE6M8PuzP1p2hNPXgpbOBhFgja

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	-	2	-	-	3	1	1	3	-
C2	1	1	-	-	3	2	-	3	-
C3	-	1	3	-	2	1	-	3	-
C4	-	3	1	2	2	-	-	3	-
C5	-	1	2	-	3	2	-	3	-
C	1	1.6	**2**	2	2.6	1.5	**1**	**3**	-

STRUCTURAL ENGINEERING LAB - I						
Course Code	**L-T-P-S (Hrs/week)**	**Credits**	**CIE Marks**	**SEE Marks**	**SEE Duration**	**Total Lecture Hours**
22CSEL17	**0-0-4-0**	**2**	**50**	**50**	**3 hours**	**30**

Prerequisites:

Concrete Technology, Special Concrete and Concrete Lab.

Course Objectives:

The students will be able to:

- Apprehend the principles of concrete mix design as per Indian standards.
- Acquire the knowledge on behavior of concrete in fresh and hardened state.
- Provide an exposure to modern techniques to test rate of corrosion and Non-Destructive testing methods.
- Evaluate dynamic behavior of multi-story building.

Syllabus

1. **Conventional concrete Mix Design** – OPC / PPC / PSC, Fresh property, Mechanical properties and Durability properties - RCPT, water absorption and chemical attack atdifferent ages.
2. **High performance concrete and High Strength Concrete Mix design** – Fresh property, Mechanical properties and Durability properties - RCPT, water absorption and chemical attack at different ages.
3. Accelerated corrosion test by impressed voltage.
4. Corrosion damage measurement by Open Circuit Potential method.
5. In situ testing of concrete structures by Rebound Hammer and Ultrasonic Pulse Velocity.
6. Experiments on vibration of multi-story frame models for Natural frequency and modes.

Course Outcomes:

On completion of this course, students are able to

- Achieve the knowledge of mix design.
- Develop of experimenting skills.
- Study the concept of natural frequency and modes.

Reference Books:

- Indian Standard code for concrete mix design 10262: 2019.
- Indian Standard code for plain and reinforced concrete 456: 2000.
- Indian Standard code methods of tests for strength of concrete 516: 1959.
- Standard Test Method for Electrical Indication of Concrete‟s Ability to Resist Chloride Ion Penetration ASTM C 1202 – 19.
- Indian Standard code for high strength steel bars 1786: 2008.
- Indian Standard code non-destructive testing of concrete (Ultrasonic Pulse Velocity) - methods of test IS 13311 (Part 1): 1992.
- Indian Standard code non-destructive testing of concrete (Rebound Hammer) - methods of test IS 13311 (Part 2): 1992.
- Neville A.M. “Properties of Concrete”- 5 th Ed., Pearson Education Ltd., 2011.

E-Resources

- https://civilenggascent.com/is-10262-2019-pdf/
- http://www.spongeiron.in/standards/is.1786.2008.pdf
- https://www.iitk.ac.in/ce/test/IS-codes/is.13311.1.1992.pdf
- https://www.iitk.ac.in/ce/test/IS-codes/is.13311.2.1992.pdf

PO'S CO'S	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
C1	3	-	2	-	1	-	-	3	1
C2	1	-	3	2	3	-	1	3	-
C3	1	-	2		3	1	-	3	-
C4	-	-	-	-	-	-	-	-	-
C5	-	-	-	-	-	-	-	-	-
C	**1.66**	**-**	**2.33**	**2**	**2.33**	**1**	**1**	**3**	**1**