SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY

M.Tech. CIVIL (STRUCTURAL ENGINEERING)

Choice Based Credit System Syllabus

First Semester

w.e.f. Academic Year 2018-19

SOLAPUR UNIVERSITY, SOLAPUR

FACULTY OF ENGINEERING & TECHNOLOGY
STRUCTURE OF M.Tech. CIVIL (STRUCTURAL ENGINEERING)
Four Semester Course
Choice Based Credit System Syllabus wef 2018 -19
Semester-I

Sr. No.	*Subject*	*Teaching Scheme*				*Credits*				*Evaluation Scheme*				
		L	*T*	*P*	*Total*	*Credits (L)*	*Credits (T)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*ICA-T Marks*	*Total Marks*
1	Advanced structural analysis	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
2	Advanced solid Mechanics	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
3	Structural dynamics	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
4	Elective- I	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
5	Research Methodology and IPR©	3	-	-	3	3	-	-	3	ISE	30	--	-	100
										ESE	70	--	--	
6	Structural design Lab	-		4	4	-	-	2	2	ISE	50	50	--	100
										ESE	--	--	--	
Total		**15**	**4**	**4**	**23**	**15**	**4**	**2**	**21**		**550**	**50**	**100**	**700**

Note : *L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment*
© - This Course is common for M.Tech. (Civil- Structural Engineering) and M.Tech. (Mechanical-Design Engineering)

SOLAPUR UNIVERSITY, SOLAPUR
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STRUCTURE OF M.Tech. CIVIL (STRUCTURAL ENGINEERING)
Four Semester Course
Choice Based Credit System Syllabus wef 2018-19
Semester-II

Sr. No.	*Subject*	*Teaching Scheme*				*Credits*				*Evaluation Scheme*				
		L	*T*	*P*	*Total*	*Credits (L)*	*Credits (T)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*ICA-T Marks*	*Total Marks*
1	FEM in structural Engineering	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
2	Theory of plates and shells	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
3	Seismic design of multistoried buildings	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
4	Elective – II	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
5	Elective – III	3	1	-	4	3	1	-	4	ISE	30	--	25	125
										ESE	70	--	--	
6	Advanced concrete Lab	-	-	2	2	-	-	1	1	ISE		25	--	25
										ESE	--	--	--	
7	Mini project	-	-	2	2	-		2	2	ISE	--	50	--	50
										ESE	--	--	--	
Total		**15**	**5**	**4**	**24**	**15**	**5**	**3**	**23**		**500**	**75**	**125**	**700**

Note : *L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment*

- **List of elective courses for semester I and II -**

Sr. No.	***Elective - I***	***Sr. No.***	***Elective – II***	***Sr. No.***	***Elective – III***
1	Advanced Design of Concrete Structures	1	Design of Prestressed Concrete Structures	1	Theory of Structural Stability
2	Design of Formwork	2	Structural Audits	2	Design of RCC Bridges
3	Advanced Design of Foundation	3	Concrete Composites	3	Advanced Steel Design
4	Structural Optimization	4	Design of Industrial Structures	4	Soil Structure Interaction

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Four Semester Course
Choice Based Credit System Syllabus
Semester-III

Sr. No.	*Subject*	*Teaching Scheme*			*Credits*			*Evaluation Scheme*			
		L	*P*	*Total*	*Credits (L)*	*Credits (P)*	*Total Credits*	*Scheme*	*Theory Marks*	*ICA- P Marks*	*Total Marks*
1	Lab. Practice	-	4	4	-	2	2	ISE	--	50	50
								ESE	--	--	
2	Open Elective Course#	3	-	3	3		3	ISE	30	--	100
								ESE	70	--	
3	Dissertation Phase I : Synopsis Submission Seminar*		@4	4	-	2	2	ISE	--	50	50
								ESE	--	--	
4	Dissertation Phase II : ICA*				-	4	4	ISE	--	100	100
								ESE	--	--	
5	Dissertation Phase II Progress Seminar*				-	4	4	ISE	--	--	100
								ESE	--	100	
Total		**3**	**8**	**11**	**3**	**12**	**15**		**100**	**300**	**400**

L- Lectures, P-Practical, T-Tutorial, ISE- In Semester Evaluation, ESE- End Semester Evaluation, ICA- Internal Continuous Assessment

Note –

- Lab Practice shall include any of the below activities as recommended by Advisor and student shall submit a report after completion of the activity to Advisor along with other details if any. Software / hardware assignments, learning new software, literature survey, filed work, industrial training etc. related to dissertation work.

- *- For all activities related to dissertation Phase I (synopsis submission seminar and progress seminar) student must interact regularly every week with the advisor.
- # - This course is common for all branches of Technology (i.e. for all M.Tech. Programs)
- Synopsis submission seminar shall cover detailed synopsis of the proposed work. Student shall submit synopsis of the dissertation work only after delivering this seminar.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any
- @ Indicates contact hours of students for interaction with advisor.
- Details of modes of assessment of seminar and dissertation shall be as specified in 7(III) of PG Engineering Ordinance of Solapur University, Solapur

- **List of open Elective Courses-**

Sr.	***Subject***
1	Business Analytics
2	Operation Research
3	Cost Management of Engineering Projects
4	Non conventional Energy

- New Open Elective Courses may be added as and when required

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Four Semester Course
Choice Based Credit System Syllabus
Semester-IV

Sr. No.	***Subject***	***Teaching Scheme***			***Credits***			***Evaluation Scheme***		
		L	***P***	***Total***	***Credits (L)***	***Credits (P)***	***Total Credits***	***Scheme***	***ICA- P Marks***	***Total Marks***
1	Dissertation Phase III : Progress Seminar #	-	4@	4	-	3	3	ISE	100	100
2	Dissertation Phase IV: Final presentation and submission of report #	-	2@	2	-	6	6	--	200	200
3	Dissertation Viva – Voce	-	-	-	-	6	6	ESE	200	200
Total		**-**	**6**	**6**	**--**	**15**	**15**	**-**	**500**	**500**

Note –

- #- For all activities related to dissertation Phase III & IV student must interact regularly every week with the advisor.
- Progress seminar shall be delivered capturing details of the work done by student for dissertation
- Student shall deliver all seminars using modern presentation tools. A hard copy of the report shall be submitted to the Department before delivering the seminar. A PDF copy of the report must be submitted to the advisor along with other details if any.
- Student must submit a hard copy of Project Report to the department
- @ indicates contact hours of the student for interaction with the advisor
- Details of modes of assessment of seminar and dissertation shall be as specified in 7 (III) of PG Engineering Ordinance of Solapur University, Solapur.

Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ADVANCED STRUCTURAL ANALYSIS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course outcome:

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

1. Draw ILD for indeterminate structures
2. Analyze the beams curved in plan
3. Analyze the structure resting on elastic foundation
4. Analyze the skeleton structures using stiffness method

Course content

Unit no.	Details	Teaching Hours
	Section-I	
1	**Influence Line Diagrams for Indeterminate Structures:** Continuous beams, portal frames and two hinged arches. Muller-Breslau's Principle and Moment Distribution Method.	8
2	**Beams curved in plane:** Determinate and indeterminate beams curved in plan.	5
3	**Beams on elastic foundations:** Analysis of infinite, Semi- infinite and finite beams	8
	Section-II	
4	**Beam columns:** Concept of geometric and material non linearity, Governing differential equation, Analysis of beam-columns subjected to different loadings and support conditions, Stiffness and carry-over factors for beam-columns, fixed end	6

	actions due to various loads.	
5	**Stiffness method of structural analysis:** Analysis of continuous beams, trusses and plane frames by structure oriented stiffness approach.	10
6	**Member oriented stiffness Method:** stiffness matrices of beam, truss, plane frame, grid, pin and rigid jointed space frame elements on member axes. Transformation of matrices on structure axes. Over-all joint stiffness matrix and nodal load vector, assembly rules, Calculation of member end forces, Bandwidth.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:

1. Structural Analysis by Negi and Jangid.
2. Analysis of structure by Vazirani and Ratwani, Vol. II
3. Advanced Theory of Structures by Vazirani and Ratwani.
4. Theory of Elastic Stability by Timoshenko and Gere.
5. Matrix Analysis of Framed structures by Gere and Weaver.
6. Structural Analysis – A Matrix approach by Pandit and Gupta.
7. Mechanics of Structures Vol. I, II and III by Junnarkar and Shah.
8. Basic structural Analysis by C. S. Reddy.

Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

ADVANCED SOLID MECHANICS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

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

1. Identify and Solve problems of elasticity understanding the basic concepts
2. Apply numerical methods to solve continuum problems.
3. Identify and Solve problems of plasticity understanding the basic concepts.

Course content

Unit No	Details	Teaching Hours
	Section- I	
1	Introduction to Elasticity: Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.	6
2	Three-Dimensional Problems of Elasticity: Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components, Equations of Equilibrium, Stress- Strain relations, Strain Displacement and Compatibility Relations.	10

3	Two-Dimensional Problems of Elasticity: Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.	6
	Section- II	
4	**Torsion of Prismatic Bars:** Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.	8
5	**Plastic Deformation :**Strain Hardening, Idealized Stress- Strain curve, Yield Criterion, Von Mises Yield Criterion	7
6	**Plastic Deformation:** Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	7

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Theory of Elasticity: Timoshenko S. and Goodier J. N., McGraw Hill, 1961.
2. Elasticity: Sadd M.H., Elsevier,2005.
3. Engineering Solid Mechanics: Ragab A.R., Bayoumi S.E., CRC Press, 1999.
4. Computational Elasticity: Ameen M., Narosa, 2005.
5. Solid Mechanics: Kazimi S. M. A., Tata McGraw Hill, 1994.
6. Advanced Mechanics of Solids: Srinath L.S., Tata McGraw Hill, 2000.
7. Introduction to Mechanics of Solids by Venkatraman & Patel
8. Theory of Plasticity by Chakraborty

Solapur University, Solapur

M.Tech. Civil (Structural Engineering) - I

STRUCTURAL DYNAMICS

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

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

1. Analyze dynamic response of SDOF system using fundamental theory and equation of motion
2. Analyze dynamic response of MDOF system using fundamental theory and equation of motion
3. Analyze beams in flexure by applying the theory of free and forced vibration

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Course content

Unit No	Details	Teaching hours
	Section-I	
1	Single-Degree-of-Freedom System, Analysis models, Equations of motion, Free vibration, Damping, Types of Damping, Response to harmonic loading, Resonance, Support motion, Transmissibility, Vibration isolation	9
2	SDOF systems subjected to periodic and impulsive loading, and other different loading conditions, introduction to frequency-Domain Analysis.	7
3	SDOF system subjected to general dynamic loading, Numerical evaluation of SDOF –Duhamal's Integral, Application to simple loading cases	6
	Section-II	
4	MDOF System, Selection of DOFs, Formulation of Equation of motion, Structure matrices, Static condensation, Free vibrations, Frequencies and	8

	Mode Shapes, Determination of natural frequencies and mode shapes, Orthogonality conditions.	
5	Discrete systems, Fundamental mode analysis, Rayleigh method, Dunkerly's Method, Response of MDOF systems to dynamic loading, Mode superposition Method,	8
6	Distributed Parameter Systems, Partial differential equations of motion, free and forced vibrations, Application to beams in flexure.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Dynamics of structures - R.W. Clough and J. Penxiene, McGraw-Hill Pub.
2. Structural Dynamics – Roy Craig, John-Wiley & Sons
3. Dynamics of Structures – Theory & Application to Earthquake Engineering- A.K. Chopra , Prentice Hall Publications
4. Dynamics of Structures – Mukhopadhyay
5. Structural Dynamics – Mario Paz
6. Elements of Earthquake Engineering by Jaikrishna, A.R. Chandrashekharan, Brijesh Chandra, Standard Publishers & Distributors.

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M.Tech. Civil (Structural Engineering)-I

ELECTIVE- I: ADVANCED DESIGN OF CONCRETE STRUCTURES

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

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

1. Analyze and Design various special types of slabs
2. Analyze and Design Combined Footing and Raft foundation
3. Analyze and Design Overhead water tanks.
4. Design of Deep beam, Corbel, Chimneys , **S**ilos and Bunkers

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Course content

Unit no.	Details	Contact Hours
	Section-I	
1	Analysis and Design of Flat slab, Grid Slab and Circular slab.	8
2	Analysis and Design of Combined Footing and Raft foundation	6
3	Design of miscellaneous structures: Design of Deep Beam and Corbel, Design of Shear Walls.	8
	Section-II	
4	Analysis and Design of Overhead water tank- Rectangular and Circular with flat bottom, Design of staging for wind and seismic loads.	8
5	Design of RCC Chimneys- Design factors, stresses due to self	6

	weight and wind load, Temperature stresses	
6	Design of silos and bunkers – classification, Square bunkers and circular bunkers, Silos- Lateral pressure, Airy's theory, Shallow Bins, Deep Bins	8

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

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1. Reinforced concrete, Limit state Design by Ashok K. Jain, New Chand and Bros. Roorkee.
2. Advanced Reinforced Concrete Design by P.C. Varghese- Prentice Hall of India.
3. Advanced Reinforced Concrete Design by N. Krishnaraju- CBS Publishers & Distributors.
4. Reinforced Concrete Structures Vol.1 & Vol.2 by Jain and Jaikrishna.
5. Reinforced Concrete Structures Vol.1 & Vol.2 by B. C. Punmia, A. K. Jain, Arun K. Jain.
6. Advanced Reinforced Concrete Design by Bhavikatti S.S.

Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ELECTIVE- I: DESIGN OF FORMWORK

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,
1. Select proper formwork, accessories and material
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures
4. Design the flying formwork

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction to formwork** Types of formwork, Requirement of formwork , Selection of formwork, Trenchless technology	6
2	**Formwork materials** Timber, Plywood, Steel, Aluminum, Plastic, and Accessories. Types of supports, Horizontal and Vertical Formwork Supports,	8
3	**Formwork Design** Concepts, Formwork Systems and Design for Foundations, Walls, Columns Slab and Beams	8
	Section-II	

4	**Formwork Design for Special Structures**: Shells, Domes, Folded Plates, Overhead Water Tanks, Tower, Bridges.	9
5	**Flying Formwork**: Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues – Pre- and Post-Award.	6
6	Causes and Case studies in Formwork Failure, Formwork Issues in Multi- Story Building Construction.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Formwork for Concrete Structures, Peurify, McGraw Hill Publication India
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS

Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ELECTIVE - I: ADVANCED DESIGN OF FOUNDATION

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

At the end of the course, student will be able to,
1. Evaluate Bearing capacity of soil by various theories
2. Design wall footing, strap footing, combined footing
3. Design Pile foundation for the given loading and site conditions
4. Design simple Machine foundation

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	Theories of failure of soil, Determination of ultimate bearing capacity, Dynamic bearing capacity. Different methods of design of shallow foundations for axial and eccentric load.	8
2	Design of wall footing, strap footing, combined footing, (Rectangular & Trapezoidal)	8
3	Raft foundation, different types, Design considerations and various methods of analysis of raft.	5
	Section-II	
4	Determination of load carrying capacity of single pile, rock socketing, Negative skin friction, Design of axially loaded piles, design of pile groups and pile cap, under-reamed piles.	8

5	Analysis and design of drilled piers and well foundation.	7
6	Dynamic response of soil, criteria for satisfactory machine foundation, framed and massive foundation, Analysis and design of simple machine foundations using I. S. Code. Vibration isolation.	6

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:-

1. Winterkorn H. F. and Fang H. Y. ,"Foundation Engineering Hand Book"-Van Nostand Reinhold Company,1975
2. Bowles J.E.," Foundation Analysis and Design"-McGraw Hill Book Company,1968.
3. "Vibration Analysis and Design of Foundations for Machines and Turbines"-Major A. Collets Holding Ltd.,1962.
4. Kany M. ,"Design of Raft Foundations" Elithelm Earnest and Sohn.1974.
5. Goodman, L. J.and Karol, R. H.,", Theory and Practice of Foundation Engineering",McMillion,1968.
6. "Soil Dynamics," Shamsher Prakashan, McGraw Hill Book Co.
7. D. D. Barkar, "Dynamics of Bases & Foundation."

Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

ELECTIVE- I: STRUCTURAL OPTIMIZATION

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits
Tutorial: 1 hour per week, 1 Credit

Examination Scheme:
ESE: 70 marks (duration: 4 Hours)
ISE: 30 marks
ICA: 25 marks

Course Outcomes: -

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

1. Use variational principle for optimization
2. Apply optimization techniques to structural steel and concrete members
3. Apply Linear and non linear optimization technique

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	Objective optimization, problem formulation, problem types, constrained and unconstrained problems, implications of risk & uncertainly mathematical programming, general problems of linear and non linear programming.	7
2	Linear Programming-Standard linear programming form, definitions and theorem, simplex method-Algorithm canonical form, improving the basis, identifying an optimal solution, locating initial basic feasible solution, examples.	7
3	Application of Linear Programming-Problems on structural design trusses, plastic analysis of frame, weight minimization, transportation problem, duality, decomposition, parametric linear programming, integer linear programming examples.	7

Section-II		
4	Non-linear optimization-classical optimization techniques-differential calculus-Language multipliers, Newtons Raphson approximation, Kuhn Tucker conditions, examples.	7
5	Geometric programming- Calculus viewpoint, polynomials, orthogonality conditions, degree of difficulty, geometric inequality, primal-dual relations, inequality constraints, examples.	7
6	Search techniques-altering, one dimensional or sectioning search, transforming non linear problem into linear cutting –plane method, logarithmic transformation, graphical optimization , examples. Examples on minimum route problem, minimum cost, minimum weight, optimum design of R.C.C. sections, Structural design-frame, trusses.	7

Internal Continuous Assessment (ICA)

ICA shall be based upon Problems/ tutorials based on topics in the curriculum.

References:

1. Foundation of Optimization by Wilde & Beighter
2. Optimization Theory & Applications by S.S. Rao
3. Optimization in Structures by Hemp.
4. Mechanical foundation for design by Stark and Nicholls, Mc Graw Hill

Solapur University, Solapur

M. Tech. Civil (Structural Engineering) - I

RESEARCH METHODOLOGY AND IPR

Teaching Scheme:
Lectures: 3 hours per week, 3 Credits

Examination Assessment Scheme:
ESE: 70 marks (Duration: 3 Hours)
ISE: 30 marks

Course Outcomes: -

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

1. Propose and distinguish appropriate research designs and methodologies for a specific research project.
2. Develop skills in literature review, qualitative and quantitative data analysis and presentation.
3. Describe the importance of Computers, Information Technology in research and also highlight the significance of ideas, concept, and creativity in research.
4. Illustrate the importance of Intellectual Property Rights in growth of individuals & nation.
5. Exhibit knowledge about IPR protection, providing an incentive to inventors for further research work leading to creation of new and better products.

Course content

Unit No.	Details	Teaching hours
	Section-I	
1	**Introduction:** Defining Research, Scientific Enquiry, Hypothesis, Scientific Method, Types of Research, Research Process and steps in it. Research Proposals – Types, contents, sponsor agent's requirements, Ethical, Training, Cooperation and Legal aspects.	6
2	**Research Design:** Meaning, Need, Concepts related to it, categories; Literature Survey and Review, Dimensions and issues of Research Design, Research Design Process – Selection of type of research, Measurement and measurement techniques ,Selection	6

	of Sample, Selection of Data Collection Procedures, Selection of Methods of Analysis, Errors in Research.	
3	**Research Problem:** Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	6
Section-II		
4	**Nature of Intellectual Property:** Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	8
5	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	5
6	**New Developments in IPR:** Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR	5

References:

1. Krishnaswamy, K.N., Sivakumar, Appa Iyer & Mathirajan M., (2006) - Management Research Methodology: Integration of Principles, Methods & Techniques (New Delhi, Pearson Education)
2. Montgomery, Douglas C. (2004) – Design & Analysis of Experiments, (New York, John Wiley & Sons)
3. Kothari, C.K. (2004) – Research Methodology, Methods & Techniques, (New Delhi, New Age International Ltd. Publishers).
4. Prabuddha Ganguli, IPR: Unleashing the Knowledge Economy, published by Tata McGraw Hill 2001.
5. John W Cresswell, (2009)-Research Design: Qualitative, Quantitative and Mixed Methods Approaches, (Sage Publications Pvt Ltd. 3rd Edition.)
6. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

7. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.

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M.Tech. Civil (Structural Engineering) - I

STRUCTURAL DESIGN LAB

Lab work: - 4 hours per week, 2 Credits

Examination Scheme:
ISE: 50 marks
ICA: 50 marks

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

1. Design and Detail all the Structural Components of Frame Buildings.
2. Design and Detail complete Multi-Storey Frame Buildings.

Course content	Teaching hours
Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes and relevant application software.	4

Internal Continuous Assessment (ICA)

ICA shall be based upon the Term work consisting Analysis and Design calculations of the poblem. The student shall give the presentation at the end of semester based on his / her termwork. The supervisor shall assess the term work and presentation