Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
(Accredited 'A' Grade by NAAC with a score of 3.25)
Hingna Road, Wanadongri, Nagpur - 441 110



Master of Technology SoE & Syllabus 2020 Structural Engineering



#### Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

#### M. Tech. SCHEME OF EXAMINATION 2020 **Deptt. of Civil Engineering** (Structural Engineering)

SoE No. PG-301

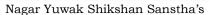
				Con			ontact Hours			% Weightage			ESE
SI. No.	Sem	Course Code	Course Title	T/P	L	т	Р	Total Contact Hrs.	Credits	MSEs*	TA**	ESE	Duration Hours
I SEMESTER													
1	1	CV3901	Theory of Elasticity and Elastic Stability	Т	3	0	0	3	3	30	30	40	3
2	1	CV3902	Structural Dynamics	Т	3	0	0	3	3	30	30	40	3
3	1	CV3903	Lab: Structural Dynamics	Р	0	0	2	2	1	-	60	40	-
4	1	CV3904	Matrix Analysis of Structures	Т	3	0	0	3	3	30	30	40	3
5	1	CV3905	Lab: Matrix Analysis of Structures	Р	0	0	2	2	1	1	60	40	-
6	1	CV3906	Design of Substructures & Foundations	Т	3	0	0	3	3	30	30	40	3
7	1	CV3907	Earthquake and wind effects on Structures	Т	3	0	0	3	3	30	30	40	3
8	1	CV3908	Advanced Concrete Structures	Т	3	0	0	3	3	30	30	40	3
9	1	CV3909	Lab: RCC Design Studio	Р	0	0	2	2	1	-	60	40	-
	•		Total		18	0	6	24	21		•		
			II SEM	FSTF	R								
1	2	CV3915	Finite Element Method	Т	3	0	0	3	3	30	30	40	3
2	2	CV3916	Lab: Finite Element Method	Р	0	0	2	2	1	-	60	40	-
3	2	CV3917	Theory of Plates and Shells	Т	3	0	0	3	3	30	30	40	3
4	2	CV3918	Advanced Steel Structures	Т	3	0	0	3	3	30	30	40	4
5	2	CV3919	Lab: Steel Design Studio	Р	0	0	2	2	1	-	60	40	-
6	2		Professional Elective-I	Т	3	0	0	3	3	30	30	40	3
7	2		Professional Elective-II	Т	3	0	0	3	3	30	30	40	3
8	2		Professional Elective-III	Т	3	0	0	3	3	30	30	40	3
			Total		18	0	4	22	20				
Drof	ossion	al Elective	-1						•				
1	2	CV3920	PE I: New Engineering Materials										
2	2	CV3921	PE I: Prestressed Concrete										
3	2	CV3922	PE I: Smart Structures and Applications										
		al Elective											
2	2	CV3923 CV3924	PE II: RC Tall Buildings PE II: Composite Strucutres										
3	2	CV3925	PE II: RC Bridge Design										
1	ession 2	CV3926	PE III: Plastic Analysis and Design of Structure	:S									
2	2	CV3927	PE III: Seismic Analysis and Design of Structur										
3	2	CV3928	PE III: Design of Industrial Structures										
			III SEN	IESTE	R								
1	3	CV3939	Project Phase-I	Р	0	0	16	16	8	-	100	-	-
			Total		0	0	16	16	8				
	, ,	0)/00/10	IV SEN		_	0	0.4		10		00	40	
	4	CV3940	Project Phase-II  Total	Р	0	0 <b>0</b>	24 <b>24</b>	24 <b>24</b>	12 <b>12</b>	-	60	40	-
1		Total Credits 61											

MSEs\* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous

TA \*\* = for Theory : 20 marks on lecture quizzes, 8 marks on assignments, 2 marks on class performance

TA\*\* = for Practical : MSPA will be 15 marks each

CAN.	Med .	Jan-20	1.00	Applicable for Sem 1 & 2 AY 2020-21	
Chairperson	Dean (Acad. Matters)	Date of Release	Version	& Sem 3 & 4 AY 2021- 22 Onwards	





M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# **I Semester** CV3901 - Theory of Elasticity and Elastic Stability

	COURSE OBJECTIVE	COURSE OUTCOMES
	To impart knowledge of various theories of elasticity and apply them to solve 2D and 3D stress analysis  To demonstrate various theories of bending and	After the completion of the course, the student should be able to  1. Demonstrate the knowledge of fundamental methods of elasticity for 2-D and 3D stress analysis
	torsion and apply them to solve 2D problems To understand the concept of elastic stability of individual elements To apply the concept of elastic stability to beam- column, column and built up column	<ol> <li>Analyze bending and torsional problems and apprise various theories to solve 2-D problems</li> <li>Apply the basic knowledge of elastic stability to various structural elements</li> <li>Explain and solve the problems of beam-column, column and built up column using the concept of elastic stability</li> </ol>
PO	Mapped: 3,4	

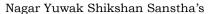
UNIT- I	[07 Hrs.]
Introduction to Two Dimensional Stress Analysis, Types of forces, Components of stresses and strains, Stress-strain relation, Plane stress and plane strain, Strain at a point, Differential equation of	
equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress	
function.	
UNIT- II	[06 Hrs.]
Introduction to Three Dimensional Stress Analysis, Components of stress, Principal stresses, Stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.	
UNIT- III	[06 Hrs.]
Bending of cantilever of narrow rectangular section loaded at end, bending of simply supported beam with uniform load, torsion of non-circular and elliptical cross section.	
UNIT- IV	[07 Hrs.]
Differential equation for beams columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral buckling of beams.	
UNIT- V	[07 Hrs.]
Energy method for elastic bucking of columns, Approximate method, Buckling of Columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with varying cross section.	
UNIT- VI	[06 Hrs.]
Effect of shearing force on critical load, Buckling of built up columns, Buckling of simply supported rectangular plates uniformly compressed in middle plane.	

#### **Text Books**

- 1. Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, 3<sup>rd</sup> Edition, Mc-Graw Hill Book Company, New
- 2. Timoshenko, S.P. and Gere J. M., Theory of Elastic Stability, 2<sup>nd</sup> Edition, Mc-Graw Hill Book Company, New Delhi,1963

- 1. Srinath, L.S., Advanced Mechanics of Solids India, 2<sup>nd</sup> Edition, Tata Mc-Graw Hill Book Company, 2003.
- 2. Ameen, M., Computational Elasticity—Theory of Elasticity, Finite and Boundary Element Methods, 1st Edition, Narosa publication, 2007
- 3. Mikhait Filonenkoborodich, Theory of Elasticity, 1<sup>st</sup> Edition, University press of pacific, 2003

CAN.	May	June 2019	1.00	Applicable for
Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

## **I Semester CV3902 - Structural Dynamics**

COURSE OBJECTIVE		COURSE OUTCOMES
To provide the students clear and understanding of modeling of discrete single and multiple-degree vibratory systems are the free and forced response of these systems.	gle-degree engineering by calculate vibratory system	y knowledge of mathematics, science, and developing the equations of motion for s and solving for the free and forced
2. To provide the students clear and understanding of Calculation of the mode frequencies for the free response of vibratory systems and use modal methods the forced response of these systems.	thorough 2. Ability to identify, having motions vontinuous by having studer structure, in orde	formulate and solve engineering problems arying with time. This will be accomplished at model, analyze and modify a vibratory of to achieve specified requirements. This refersional and ethical responsibilities. This
To provide the students understanding continuous vibratory systems – vibration axial and torsional vibration of bars and bear	modeling will be accompled strings, understanding h	shed by emphasizing the importance of ow structural vibrations may affect safety engineering systems.
4. To provide the student with a basic understance codes related to earthquake loading.	nding of IS 4. An ability to Un loading.	derstand IS codes related to earthquake
PO Mapped: 1,2,3	-	
LIMIT I		[07 Hro 1

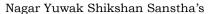
<b>UNIT - I</b> Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped	[07 Hrs.]
single degree freedom systems.	
UNIT - II	[06 Hrs.]
Response of single degree freedom systems to harmonic loading, support motion and transmissibility, Duhamel's integral.	
UNIT - III	[06 Hrs.]
Multiple degree of Freedom system: Vibration of undamped 2 DOF systems; Response of 2 DOF to harmonic excitation, mode superposition, vibration absorber, Free vibration of MDOF (up to 3 DOF) systems, Dynamic response of MDOF (2 DOF) systems-modal superposition method. Energy Principle, Rayleigh's method (2 DOF)	
UNIT - IV	[06 Hrs.]
Dynamic analysis of systems with distributed properties, Approximate design method, Transformation factors.	
UNIT – V	[07 Hrs.]
Response spectra, generation and types of response spectra, Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars / beams. Response of continuous systems to dynamic loads.	
UNIT - VI	[06 Hrs.]
Introduction to vibrations due to earthquake, Study of IS 1893 applicable to Buildings and Water Tanks.	

#### **Text Books:**

- 1. Mario Paz, Structural Dynamics Theory & Application, CBS Publ.; N-Delhi, 1995.
- Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2<sup>nd</sup> Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995

- 1. Clough / Penzien, "Dynamics of Structures", McGraw Hill, 1993
- Humar, J. L., "Dynamics of Structures", Prentice Hall, 1993
- Timoshenko, S., "Advanced Dynamics", McGraw Hill Book Co; NY, 1948
- Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill; NY, 1964
- Damodarasamy and Kavitha," Basics of structural Dyanamics and Aseismic design, Phi Publisher, New Delhi.

TAN.	May .	June 2019	1.00	Applicable for AY 2019-20 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	AT 2019-20 Offwards





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M.Tech. SoE & Syllabi 2020-21 Structural Engineering

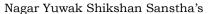
# I Semester CV3903 - Lab : Structural Dynamics

COURSE OBJECTIVE	COURSE OUTCOMES
<ol> <li>To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free response of these systems.</li> <li>To provide the students clear and thorough understanding of damping of systems and their relevance</li> </ol>	<ol> <li>An ability to understand the behavior of vibratory system during cyclic loading.</li> <li>An ability to understand phenomenon like damping and its relevance in actual structural applications.</li> <li>An ability to understand the effect of earthquake phenomenon on water media and subsoil.</li> <li>An ability to understand provision of various Indian</li> </ol>
3. To demonstrate phenomenon of soil liquefaction and mode shapes in water medium	standards for design of structures from seismic safety point of view.
4. To provide the students clear and thorough understanding of IS codes related to earthquake loading for buildings and elevated water tanks	
<b>PO Mapped</b> : 1,2,3	

### **PRACTICALS**

- 1. To study various instruments for imparting dynamic forces.
- 2. To study various instruments for the response of vibrating structure.
- 3. To study the response of a single degree of lumped mass system subjected to base excitation.
- 4. To study the response of a two degree of freedom system building frame subjected to base motion.
- 5. To study the response of a multi degree of lumped mass system.
- 6. Verification of natural frequency of SDOF model under free vibration.
- 7. To study the liquefaction of soil structure.
- 8. To study the Earthquake induced waves in rectangular water tank.
- 9. To calculate horizontal seismic force of building using IS-1893.
- 10. To calculate the lateral forces in water tank due to Earthquake when water tank is empty and water tank is full by IS-1893.

CAN.	May	June 2019	1.00	Applicable for
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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# I Semester CV3904 - Matrix Analysis of Structures

Students will be introduced to  1. Understand basic concepts of stiffness method of matrix analysis.  2. Analyze the structures using stiffness method.  3. Apply software of structural analysis based on this mathematical problem.  Students will be able to  1. Understand the different types of structures apply the matrix stiffness method to model the body of planar trusses, beams, and frames;  3. Analyze any multistoried building using Matrix Start and the defect of the problem.	COURSE OUTCOMES		
this method. methods of structural analysis.  4. Recognize special effects on behavior of structural structural analysis.  5. Implement the method developing their own comprogram to analyze structures.	ethod to model the behavior of frames; ilding using Matrix Stiffness is. In behavior of structures. eloping their own computer		

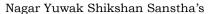
UNIT - I	[07 Hrs.]
Introduction to stiffness and flexibility approach, Stiffness matrix for spring, Bar, torsion, Beam	
(including 3D), Frame and Grid elements, Displacement vectors, Local and Global co-ordinate	
system, Transformation matrices, Global stiffness matrix and load vectors, Assembly of structure	
stiffness matrix with structural load vector, application to spring and bar problems.	
UNIT - II	[06 Hrs.]
Analysis of Plane Truss, Space Truss by Stiffness Method	
UNIT - III	[06 Hrs.]
Analysis of Beam, Plane Frame, Space Frame by Stiffness Method	
UNIT - IV	[07 Hrs.]
Analysis of building systems for horizontal loads, Buildings with and without rigid diaphragm, various mathematical models and introduction to Solution techniques.	
UNIT - V	[06 Hrs.]
Analysis of Plane Grid by Stiffness Method	
UNIT - VI	[07 Hrs.]
Analysis for member loading (self, Temperature & Imposed) Inclined supports, Lack of Fit, Initial joint	<b>_</b>
displacements. Effect of shear deformation, internal member end releases	

#### **Text Books:-**

- 1. Gere, W. and Weaver; J. M., Matrix Method of Structural Analysis 3rd Edition, Van Nostrand Reinhold; New York; 1990
- 2. Meghre A.S.& Deshmukh S.K.; Matrix Method of Structural Analysis, 1<sup>st</sup> edition, Charotar publishing house, Anand, 2003
- 3. Kanchi, M. B., Matrix Method of Structural Analysis, 2nd Edition; John Willey & Sons, 1999
- 4. Godbole P., Sonparote R., Dhote S. Matrix Methods of Structural Analysis, PHI Learning Pvt. Ltd. 2014

- 1. Cheng, F.Y., M. Dekke; Matrix Analysis of Structural Dynamics, NY 2000
- 2. Bathe, K.J., Finite Element Procedures, 2nd Edition Springer,; 2002
- Cook, R.D Concepts and Applications of Finite Element Analysis, et. al, John Willey &Sons; NY 1995
- 4. Martin; H.C., Introduction to Matrix Method of Structural Analysis, McGraw Hill Book Co. 1966
- 5. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991
- 6. Kassimali A., Matrix Analysis of Structures SI Version, Cengage Learning, 2011
- Livesley R. K. Matrix Methods of Structural Analysis: Pergamon International Library of Science, Technology, Engineering and Social Studies, Elsevier, 2013
- 8. McGuire W. Gallaghar R. H. & Zimian R. D., Matrix Structure Analysis. John Willey Publication
- 9. Przemieniecki J. S., Theory of Matrix Structural Analysis, Dover Publication Inc. New York

TOTAL.	Met.	June 2019	1.00	Applicable for AY 2019-20 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	





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M.Tech. SoE & Syllabi 2020-21

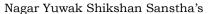
## Structural Engineering

# I Semester CV3905 - Lab : Matrix Analysis of Structures

COURSE OBJECTIVE	COURSE OUTCOMES
Students will be introduced to	Students will be able to
<ol> <li>Develop models of various structures in the software package, and apply the required properties, boundary conditions and forces in the developed models.</li> </ol>	truss, plane frame neglecting axial deformation, plane frame considering axial deformation, plane
Analysize various structural elements by stiffness method of structural analysis.	grids. 3. Recognize special effects on behavior structures.
Execute computer program using standard software package without any error.	
4. Compare results between manual analysis and software package analysis.	
<b>PO Mapped</b> : 1,3,4	

- 1. Analyze a continuous beam with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 2. Analyze a continuous beam with sinking of support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 3. Analyze a plane truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method. Conclude it from both the result.
- 4. Analyze a plane truss subjected to inclined roller support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 5. Analyze a plane truss subjected to temperature effect and lack of fit with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 6. Analyze a space truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 7. Analyze a plane frame with maximum three degree of Kinematic Indeterminacy, using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 8. Analyze a plane grid using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
- 9. Analyze a multi storied frame structure subjected to horizontal forces using software package.

TOTAL.	Most.	June 2019	1.00	Applicable for
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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# **I Semester** CV3906 - Design of Substructures and Foundations

	COURSE OBJECTIVE	COURSE OUTCOMES
1.	To provide the students knowledge of different types of foundation structures.	1. Students will be able to identify the type of foundations to be used for various site
2.	To provide the students knowledge of different types of loading	conditions
	applied on foundation structures.	2. Students will be able to analyze and design
3.	To provide the students knowledge of different methods used for	different types of foundation structures.
	the analysis of foundation structures.	3. Students will be able to draw RCC detailing
4.	To provide the students, knowledge of different codal provisions	and to prepare working drawing.
	applicable to advanced design of foundation structures.	4. Students will be able to understand the
5.	To provide the students knowledge of design of deep foundation	importance of various codes used for different
	systems, machine foundations etc.	types of foundation structures.
PC	Mapped: 1,3,4,6	

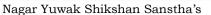
UNIT – I Introduction to soil structure interaction, Bearing Capacity of Foundations, Theories, In-situ tests; Settlement Analysis, factors affecting settlement, control of excessive settlements; Soil classification, Geotechnical design parameters. Design of different isolated footings including eccentrically loaded footings.	[07Hrs.]
UNIT – II	[06 Hrs.]
Design of combined footing and design of raft foundation.	
UNIT – III	[07 Hrs.]
Analysis and design of pile foundation, Function and Classification of piles, Static point and skin resistance capacity of a Pile, pile load tests, Pile settlements, design of RCC piles, Various pile group patterns, Efficiency of Pile in group, Negative skin friction, Pile Cap design, Under reamed pile foundation, Introduction to design of well foundation. IS 2911 Part I to Part V	
UNIT – IV	[06 Hrs.]
Introduction to machine foundations and its practical considerations for construction IS code of practice, introduction to analysis and design of simple machine foundation. Theory of sub grade reaction, beam on elastic foundation.	
UNIT – V	[06 Hrs.]
Ground improvements: Various methods, sand drains, stone columns, stabilization, grouting, reinforced earth, geotextiles, diaphragm walls, Reinforced earth retaining walls, skin walls.	
UNIT – VI	[07 Hrs.]
Analysis and design of Cantilever, counter fort and basement retaining walls and abutments.	

#### **Text Books**

- 1. Sawmi Saran, "Analysis and Design of Substructures", , Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
- Kurain N. P," Design of foundation systems- Principles and Practice", Narosa Publishing house, New Delhi, 2005. Poulose H.G. and Davis E.H.," Pile foundation Analysis and Design", John-Wiley Sons, NY, 1980.
- Karuna Moy Ghosh, "Foundation Design in practice", PHI Learning Pvt. Ltd, New Delhi 2012
- P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.

- J. E. Bowles, "Foundation Analysis and Design", Tata McGraw Hill New York
- Kurain N.P," Modern Foundations: Introduction to Advance Techniques", Tata McGraw Hill, 1982 Winterkorn H.F. and Fang H.Y. Ed., "Foundation Engineering Hand Book", Van-Nostrand Reynold, 1975
- Bowles J.E., "Foundation Analysis and Design" (4th Ed.), Mc.Graw -Hill, NY, 1996
- Sreenivasalu&Varadarajan, "Handbook of Machine Foundations", Tata McGraw Hill
- Hetenyi, M. "Beam on Elastic Foundation", University of Michigan Press, 1946.
- Swami Saran, "Soil Dynamics and machine Foundations", Galgotia Publications (P)Ltd, New Delhi, 1999.

CAN.	April	June 2019	1.00	Applicable for
Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards
		VCCE_CE_6		





M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# **I Semester** CV3907 - Earthquake and Wind Effects on Structures

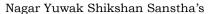
COURSE OBJECTIVES	COURSE OUTCOMES
After completion of syllabus students will able to	1. An ability to apply the knowledge of geological
Understand basic concepts of earthquake engineering	feature, plate tectonics in understanding occurrence of earthquake.
2. Understand behavior of structural components under earthquake and wind loading	2. An ability to understand causes and sources of earthquake damages and possible response of
3. Understand concepts of earthquake resistance design	structure and system to earthquake.  3. An ability to understand characteristics of wind and
4. Understand various standers & specification related to earthquake and wind effects on structures	its static and dynamic effects on structures 4. An ability to understand relevant I.S. codes and philosophy in design of earthquake& Wind
5. Understand Wind Characteristics and concept of Mathematical Modeling.	resistant structure
<b>PO Mapped :</b> 1,3,4,5	

UNIT – I Origin of earthquake, Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake (magnitude, & intensity of earthquake), Measurement of earthquake (accelerograph, accelogram recording and analysis of earthquake records), determination of magnitude, epicenter distances, Seismicity of the world.	[07 Hrs.]
UNIT- II Causes or sources of earthquake damage, damage due to ground failure, History of past Earthquakes, generation of response spectrum from available earthquake records, Earthquake design spectrum and inelastic spectrum. Evolution of seismic risk.	[07 Hrs.]
UNIT – III Concepts of earthquake resistance design, Design philosophy, and four virtues of earthquake resistance design (stiffness, strength, ductility and configuration). Introduction to capacity design concept, Study of IS: 1893, Study of IS: 13920 for analysis and ductile design of RCC structures.	[06 Hrs.]
<b>UNIT – IV</b> Wind Characteristics: Historical Wind Speed Data, Wind Speed Map of India, Cyclones and Tornadoes.	[05 Hrs.]
UNIT-V Static Wind effects and Building Codes with particular reference to IS – 875 (Part III).	[07 Hrs.]
UNIT-VI Dynamic Wind Effects: Wind Induced Vibrations, , Analysis for dynamic wind loads, Vibration Control and Structural Health Monitoring.	[07 Hrs.]

#### **Text Books:**

- 1. Kramer, S.L, "Geotechnical Earthquake Engineering", Prentice Hall, New Jersey, 1996.
- 2. Arya A. S., "Introduction to earthquake engineering structures".
- 3. C. Scruton, "An Introduction to Wind Effects on Structures", Oxford University Press, Oxford, UK., 1981

CAN.	May .	June 2019	1.00	Applicable for
Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21
Structural Engineering

# I Semester CV3907 - Earthquake and Wind Effects on Structures

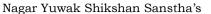
### Reference books

- 1. Murthy, C.V.R, "Earthquake tips", IIT Kanpur documents.
- 2. Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2<sup>nd</sup> Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995
- 3. Dowrick, D.J, "Earthquake Resistant Design for Engineers and Architects", 2nd Edition; 1987
- 4. Peter Sachs, "Wind Forces in Engineering", Pergamon Press. Oxford UK, 1972
- 5. Lawson T. V., "Wind Effects on Buildings", Applied Science Publishers, London, UK, 1980
- 6. Emil Simiu and R. H. Scanlan, "Wind Effects on Structures An Introduction to Wind Engineering", John Wiley and Sons, New York., 1986
- 7. Cook, N. J., The designer's guide to wind loading of building structures. Part 1 Background, damage survey, wind data and structural classification. Building Research Establishment, Butterworths, U. K., 1985
- 8. Cook, N. J., Designer's guide to wind loading of building structures. Part 2: Static structures. Building Research Establishment, Butterworths, U. K., 1990
- 9. Simiu, E., Scanlan, R. H. Wind Effects on Structures: fundamentals and applications to design. 3rd Edition., John Wiley & Sons, New York, 1996.
- 10. Dyrbye, C., Hansen, S. O., Wind loads on structures., John Wiley, New York, 1997

#### Reference IS codes:

IS 1893-2016 Part I Earthquake criteria IS 13920-2016 ductile detailing

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21

### **Structural Engineering**

# I Semester CV3908 - Advanced Concrete Structures

COURSE OBJECTIVES	COURSE OUTCOMES
After completion of syllabus students will able to	1. An Ability to know provisions of relevant IS codes / IRC
get the knowledge about the design of	code required for design of advanced concrete structures
<ol> <li>Bridges.</li> </ol>	such as water tank, bridges ,multistoried building
<ol><li>Water tanks.</li></ol>	2. An ability to design advanced concrete structures such as
<ol><li>Multistoried buildings.</li></ol>	water tank , bridge and culvert
4. Silos & Bunkers.	3. An ability to understand the various methods of design of multistoried buildings, retaining wall.
	4. An ability to draw RCC detailing of structures.
<b>PO Mapped</b> : 1,3,4,5	

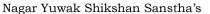
<b>UNIT – I</b> Analysis and design of Multistoried buildings, calculation of loads, Approximate analysis, Preliminary sizing,	[07 Hrs.]
UNIT – II Design of circular water tanks resting on ground.	[06 Hrs.]
UNIT – III  Analysis and Design of Elevated water tank including design of supporting system	[07 Hrs.]
UNIT – IV Study of different types of IRC loading and IRC Recommendations	[06 Hrs.]
UNIT – V Analysis, Design & Detailing of bridges and Culverts. IRC Recommendations	[07 Hrs.]
UNIT – VI Analysis and design of, Silos, and Bunkers.	[06 Hrs.]

### **Text Books:**

- 1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition 2006
- 2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
- 3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

- 1. Johnson and Victor, "Essentials of Bridge Engineering" Oxford and IBH publisher, 1980
- 2. Jain O.P. and Jai Krishna, Plain and Reinforced concrete structures-Volume -II, Nemchand and brothers,
- 3. Chattergee, B K, "Theory and design of Concrete Shells" Oxford and IBH publisher, 1978
- 4. Chen, W.F. and Duan, L. "Bridge engineering Handbook"

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M.Tech. SoE & Syllabi 2020-21

## **Structural Engineering**

# I Semester CV3909 - Lab : RCC Design Studio

	COURSE OBJECTIVES		COURSE OUTCOMES
1.	To provide the students clear & thorough	1.	An Ability to know provisions of relevant IS codes /
	understanding of IS code related to reinforced		IRC code required for design of advanced concrete
	concrete structures.		structures such as water tank, bridges ,multistoried
2.	To provide the students clear & thorough		building
	understanding of reinforcement of essential parts of	2.	An ability to design advanced concrete structures
	R. C. structures as per SP 34.		such as water tank, bridge and culvert
3.	To provide the knowledge to understand the	3.	An ability to understand the various methods of
	comparison of results between manual analysis &		design of multistoried buildings.
	design and software analysis & design of simple	4.	An ability to draw RCC detailing of structures
	member of R. C. structure.		
PO	<b>Mapped :</b> 1,3,4,5,		

### **PRACTICALS**

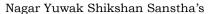
- 1. Review of IS 456, IS 962 Basics of Limit State Design (Beams, Columns, Slabs ) Design of Multistoried buildings
- 2. Design for axial force, flexural, shear and combined effects Slabs (one way & two way) and slabs on grades. Preliminary sizing, modeling, designing & detailing of R. C. C. structures
- 3. Design of Bunker/ Design of Bridge (Any One)

#### **Reference Books:**

- 1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, I<sup>st</sup> edition 2006
- 2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2<sup>nd</sup> edition-2005.

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards	

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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

## **II Semester CV3915 - Finite Element Method**

	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To provide the student with knowledge and analysis skills in applying basic laws and steps used in	1.	An ability to derive element matrix equation by different methods by applying basic laws in
2.	solving the problem by finite element method.  To provide the student the knowledge of various interpolation functions and elements to solve simple problems by finite element method.		structural analysis.  An ability to apply the knowledge of finite element method to solve simple problems.  An ability to extend the knowledge of finite
3.	To provide the student the knowledge of is oparametric transformation.		element method to solve complex problems using various elements.
4.	To provide students the knowledge of mathematical modelling techniques.	4.	An ability to understand solution and modeling techniques used in finite element method.
5.	To develop the student's skills in applying FEM solution steps by using software.		-
PC	Mapped: 3,4		

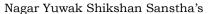
UNIT – I	[06 Hrs.]
Principles and discretization, Elements stiffness formulation based on direct and, variational techniques, Rayleigh Ritz Method for Bar and Beam analysis.	
UNIT – II	[07 Hrs.]
Shape functions, Finite Element Formulation using Cartesian Coordinates, Application to 1D problems, Convergence criteria.	
UNIT – III	[06 Hrs.]
Triangular and Rectangular element formulation using Cartesian Coordinates, Application to 2D stress analysis.	[oo mon
UNIT – IV	[07 Hrs.]
Natural coordinates, Isoparametric elements, Application to 1D Problems, Isoparametric elements for two-dimensional stress analysis.	[or mon
UNIT – V	[07 Hrs.]
Shape Functions for three Dimensional Stress analysis, Axi-symmetric Stress Analysis.	[0.000]
UNIT – VI	[06 Hrs.]
Modelling techniques and solution techniques, Computer Implementation of FEM Procedure for 1D & 2D problems, Numerical integration.	
	1

#### **Text Books:**

- 1. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991
- 2. Rajasekaran S, Finite Element Analysis in Engineering Design, S. Chand &Co. Ltd. New Delhi, 1999.

- 1. Zienkiewicz O.C. and Taylor R.L., The Finite Element Method (Volume -I), 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1989
- 2. Cook R. D., Concepts and Applications of Finite Element Analysis, 3<sup>rd</sup> Edition, Wiley India Text books, Wiley India Pvt. Limited, New Delhi, 1989.
- 3. Krishnamurthi C.S., Finite Element Analysis: Theory and Programming, 2<sup>nd</sup> Edition, Tata McGraw Hill Publishing Company Limited, 1994, Reprint 2005.
- 4. Bathe K. J., Finite Element Procedure, Prentice-hall of India, New Delhi, 1997.

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21

# Structural Engineering

## **II Semester** CV3916 - Lab: Finite Element Method

	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To provide the students the academic environment to conduct a structural analysis using finite element software	1.	An ability to identify the information required to conduct a structural analysis using finite element software
2.	To motivate the students to use the modern tools and software.	2.	An ability to interpret the solutions obtained from finite element analyses.
	To provide the students the basic skills in using commercial finite element software and effective presentation of their analysis results.		An ability to have basic skills in using commercial finite element software and effective presentation of their analysis results.
4.	To provide the students the knowledge of finite element method for the analysis of structural engineering problems and their solution.	4.	An ability to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained.

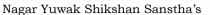
# **PO Mapped : 2,3,4**

#### Minimum Six practical based on theory syllabus

- 1. Analysis of 2D truss
- 2. Analysis of Bar subjected to various loading conditions
- 3. Analysis of beam subjected to various loading conditions
- 4. Analysis of Plane Stress problem (Plate, Plate with hole) using triangular & Quadrilateral element
- 5. Analysis of Plain Strain problem (Retaining wall, Culvert) using triangular & Quadrilateral element
- 6. Analysis of Axisymmetric problem (Cylinder, foundation) using triangular & Quadrilateral element
- 7. Analysis of 3D beams (Cantilever and Simply Supported) subjected to various loading conditions

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards	
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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# **II Semester** CV3917 - Theory of Plates and Shells

COURSE OBJECTIVES	COURSE OUTCOMES
<ol> <li>To impart knowledge of plate and shell behavior under different loading and boundary conditions.</li> <li>To demonstrate use of classical, approximate and numerical methods to solve plate and shell problems.</li> </ol>	
PO Mapped: 3,4	

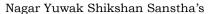
<b>UNIT – I</b> Development of governing differential equations by Kirchoff's theory with reference to thin rectangular plates with various boundary conditions. Symmetrical bending of laterally loaded circular plates with different boundary conditions.	[07 Hrs.]
UNIT- II Study of Simply supported plates under different loadings. Navier's solution. Introduction to Levis solution.	[06 Hrs.]
UNIT – III Application of finite difference method to plate problem.	[06 Hrs.]
UNIT – IV Classification of Shells. Membrane theory of cylindrical shells with different directrix such as circular, cycloidal, catenary, and parabolic.	[07 Hrs.]
UNIT – V Bending theory of cylindrical shells, Finster walder, Schorer's, and D-K-J theory.	[06 Hrs.]
UNIT – VI Approximate analysis of cylindrical shells by beam method.	[07 Hrs.]

#### **Text Books**

- 1. Timoshenko S.P and Krieger S.W, Theory of Plates and Shells, 2<sup>nd</sup> Edition, McGraw-Hill Book Company, New Delhi, 1970.
- 2. Chadrashekhara K, Theory of Plates, 1st Edition, Universities Press (India) Ltd, Hyderabad, 2001.
- 3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

- 1. Ramachandran S., Thin Shells (Theory and Problems) 1st Edition, Universities Press (India) Ltd, Hyderabad
- Szilard R., Theory and Analysis of Plates, Prentice Hall Publication, 1974.
   Philipee G Ciarlet, Mathematical elasticity Vol.II: Theory of plates, 1<sup>st</sup> Edition, Elsevier Science B V, 1997

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21

### **Structural Engineering**

# II Semester CV3918 - Advanced Steel Structures

COURSE OBJECTIVE	COURSE OUTCOMES			
After completion of syllabus students will able	1. An ability to understand the configuration			
1. To understand basic principles of reliability-based	(component of structures, civil\structural			
design on steel structures	engineering drawing etc.) of the structure.			
2. To understand the effect of natural phenomenon	2. An ability to understand the effect of natural			
(wind and or earthquake), for structural engineering	phenomenon (wind and earthquake), in structural			
applications	engineering applications			
· · · · · · · · · · · · · · · · · · ·				
and design of advanced steel structures like,	structures by applying the provision of Indian			
Industrial Structure, Storage Tank, Truss Bridge	Standard Code			
and Tower				
PO Mapped: 1,6				

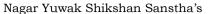
UNIT – I	[07 Hrs.]
Design of roof truss of industrial structure.	
UNIT- II	[06 Hrs.]
Design of gantry girder, plate girder of industrial Structure.	
UNIT – III	[07 Hrs.]
Design of elevated storage tank.	
UNIT – IV	[06 Hrs.]
Design of staging of elevated storage tank.	
UNIT – V	[07 Hrs.]
Design of Truss Bridges.	
UNIT – VI	[06 Hrs.]
Design of Chimney.	-

#### **Text Books:**

- 1. Arya A.S and Ajmani J.L. Design of Steel Structures, Nemchand & bross, Roorkee
- 2. Duggal S.K., Design of Steel Structures, Mc Graw Hill publication, 2007
- 3. Dayaratnam P., Design of Steel Structures, Wheeler Publications, Allahabad, 1992
- 4. N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, ISBN 978-81-204-1741-0, Fourth edition, 2010.

- 1. Ram Chandra Design of Steel structures Vol-I & Vol-II Std. book house / Rajsons Publication Pvt. Ltd.,, Delhi, 2006
- 2. Gaylords, E.H. & Gaylords, C. N., Design of Steel Structures, Blackwell, 1994.
- 3. Ghosh, "Analysis and Design practice of Steel Structure", (Forthcoming), Phi Publisher, New Delhi

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M.Tech. SoE & Syllabi 2020-21

## **Structural Engineering**

## II Semester CV3919 - Lab: Steel Design Studio

COURSE OBJECTIVE	COURSE OUTCOMES
After completion of syllabus students will able  1. To provide basic knowledge of steel structural	An ability to apply the basic knowledge of structural steel.
design and apply its principles to design steel structures.	
2. To analyze and design the steel structures using software.	<ul><li>by applying appropriate loads.</li><li>3. An ability to present the analysis and design results in</li></ul>
3. To present the analysis and design results in schematic way of the desired structure	schematic way of the desired structure
PO Mapped: 1,6	

# SN Solve Any Four

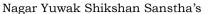
- 1 Analyze and design the beam for TWO-point load moving on it.
- 2 Analyze and design the beam for THREE-point load moving on it.
- 3 Analyze and design the members of the roof truss of industrial structure.
- 4 Analysis and design of building structure for gravity load
- 5 Analysis and design of building structure for gravity &wind load.
- 6 Analysis and design of truss bridge.

#### Text Books:

- 1. Arya A.S and Ajmani J.L. "Design of Steel Structures", Nem Chand & Bros, Roorkee.
- 2. Duggal S.K., "Design of Steel Structures", Mc Graw Hill publication, 2007
- 3. Dayaratnam P., "Design of Steel Structures", Wheeler Publications, Allahabad, 1992.
- 4. N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, ISBN 978-81-204-1741-0, Fourth edition, 2010.

- 1. Ram Chandra, "Design of Steel structures", Vol-I & Vol-II, Std. Book House, Raj Sons Publication Pvt. Ltd., Delhi, 2006
- 2. Gaylords, E.H. & Gaylords, C. N., "Design of Steel Structures", Blackwell, 1994.
- 3. Ghosh, "Analysis and Design practice of Steel Structure", Phi Publisher, New Delhi

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

# **II Semester CV3920 - PE-I : New Engineering Materials**

COURSE OBJECTIVE			COURSE OUTCOMES
1.	To understand various civil engineering materials	1.	An ability to introduce different high quality
2.	To understand various methods of testing of		materials for civil engineering applications.
	materials	2.	An ability to use engineering materials for better
3.	3. To understand and use various codes related to the		and durable Civil Engineering Structures.
	civil engineering materials		
РО	Mapped: 1,2		

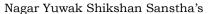
UNIT-I Steel fiber reinforced concrete, Properties, Aspect ratio, strength and durability.	[06 Hrs.]
UNIT-II Fiber reinforced plastics, other types of fibers and their applications.	[07 Hrs.]
UNIT-III Light weight concrete, foam concrete, fly ash concrete, workability, durability, and application.	[06 Hrs.]
UNIT-IV High-grade concrete, high strength performance concrete, trimix concrete.	[07 Hrs.]
UNIT-V New engineering materials like light weight steel profile, aluminum profile, pressed steel sections.	[06 Hrs.]
UNIT-VI Introduction to steel concrete composite including infill, encased section, properties of shear connectors, use of IS: 11384, IRC 22.	[07 Hrs.]

#### Text books:

- 1. Neville A. M., Properties of Concrete, Pearson Education Limited.
- Rafat Siddequi, Special Concretes, Galgotia Publications.
- M Gambhir, Concrete Technology, Tata Mcgraw Hill Education Private Limited.

- 1. Mehta P, Concrete Technology, Tata Mcgraw Hill Education Private Limited.
- 2. Shetty M. S, Concrete Technology, S. Chand Publisher.

CAN.	Mal	June 2019	1.00	Applicable for
Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

## **II Semester** CV3921 - PE-I: Prestressed Concrete

	COURSE OBJECTIVES		COURSE OUTCOMES
1.	To understand the basic concepts of prestressed concrete.	1.	Students will be able to apply basic concepts of prestressed concrete in construction industry.
3.	To study various devices used for Prestressing.  To analyze and design the basic structural members in Prestressed concrete  To analyze and design the special structures like	<ol> <li>2.</li> <li>3.</li> </ol>	Students will be able to identify, formulate and solve engineering problems pertaining to prestressed concrete.  Students will be able to Understand IS codes
	Prestressed Concrete Pipes, Liquid Storage Tanks and Ring Beams	4.	related to prestressed concrete. Students will be able to design special prestressed concrete structures.
PC	Mapped: 1,3,4,6		

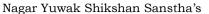
UNIT-I	[06 Hrs.]
Introduction to prestressed concrete, types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads.	
<b>UNIT-II</b> IS1343 – 2012 codal provisions, Limit state of collapse and serviceability for analysis and design of rectangular, I and box sections for flexure and shear, control of deflection.	[07 Hrs.]
UNIT-III	[07 Hrs.]
Transmission of pre-stress in pre-tensioned members; Anchorage zone stresses for post-tensioned members.	
Introduction to statically indeterminate structures, redundant reactions, linear transformation and concordancy.	
UNIT-IV	[06 Hrs.]
Analysis and design of continuous beams, Choice of cable profile.	
UNIT-V Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage, deflection effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations	[07 Hrs.]
UNIT-VI	[06 Hrs.]
Analysis and design of prestressed concrete slabs – one way and two way Introduction to prestressed concrete pipes, tanks, flat slabs, grids, railway sleepers (No numerical problems).	

#### **Text Books:**

- 1. N. Krishnaraju, Prestressed Concrete, 3rd edition, Tata McGraw Hill Publishing Co., 2004
- 2. S.K. Mallick and A.P.Gupta, Prestressed concrete, Oxford and IBH Publishing Co., New Delhi.
- 3. Praveen Nagarajan, "Prestressed Concrete Design", PEARSON Publishing Co., Delhi, 2013
- 4. K.U.Muthu, Azmi Ibrahim, Maganti Janardhana, M. Vijayananad, "Prestressed Concrete", PHI Learning Pvt. Ltd., Delhi 2016

- 1. Lin, T.Y. and Burns, N.H., Design of Prestressed Concrete Structures, , 3rd edition, John Wiley &Son's, 2004
- 2. IS: 1343 2012, Code of Practice of Prestressed Concrete, Indian Standards Institution.
- 3. Guyon Y., Prestressed Concrete vol.I and II, Contractors Record Ltd., London.
- Abels P.W., An Introduction to Prestressed Concrete, Vol.I and II', Concrete Publications Ltd., London.
   DayaratnamP., Prestressed Concrete Structures, , 5<sup>th</sup> edition, Oxford & IBH, 1996

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M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

# **II Semester** CV3922 - PE-I Smart Structures and Applications

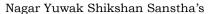
COURSE OBJECTIVE	COURSE OUTCOMES
To understand smart system	An ability to understand passive and active
To understand characteristics and behavior of	systems.
smart materials	2. An ability to understand the characteristics and
3. To understand control system and its applications	behavior of smart materials
4. To understand techniques of base isolation	<ol><li>An ability to understand control system and its applications</li></ol>
	An ability to understand techniques of base isolation

**PO Mapped** : 3,4

UNIT-I	[07 Hrs.]
Introduction to smart structures, application, smart systems –Components of smart systems, different	_
types smart materials – characteristics and behavior of smart materials – modeling of smart	
*	
materials.	
UNIT-II	[06 Hrs.]
Introduction of sensors and actuators., features and - characteristics of sensors-types of sensor and	_
actuators- electronic, thermal and hydraulic type actuators, characteristics of sensors and actuators.	
adduction of contorner, and my drawno type adductors, or large or contorner and adductors.	
IIAUT III	[07]
UNIT-III	[07 Hrs.]
Overview of structural health monitoring ,smart application to new and existing buildings ,Advantages	
and limitations	
UNIT-IV	[06 Hrs.]
Theory of Vibration Isolation: Principle of base isolation, Methods, Techniques	[0010.]
Theory of vibration isolation. Trinospic of base isolation, inclineds, recrimques	
UNIT-V	[07 Hrs.]
Energy dissipation devices; introduction ,Methods, principals	[01 111 01]
Energy dissipation devices, introduction, inicinous, principals	
UNIT-VI	[06 Hrs.]
	[30 111 31]
Types of energy dissipation devices; Metallic yield dampers, friction dampers, viscoelastic dampers,	
tuned mass dampers.	

- 1. Srinivasan, A.V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University
- 2. Yoseph Bar Cohen, Smart Structures and Materials 2003, The International Society for Optical Engineering 2003.
- 3. Brian Culshaw, Smart Structures and Materials, Artech House, Boston, 1996.
- 4. M.V.Gandhi and B.S.thompson, Smart Materials and Structures, Chapman and Hall 1992

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M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

# II Semester CV3923 – PE-II : RC Tall Buildings

COURSE OBJECTIVE	COURSE OUTCOMES
<ol> <li>To understand earthquake load acting on a building and design the building for above loading by providing shear walls</li> <li>To understand various aspects of high rise buildings such as the effect of torsion, soft storey effect, p- delta effect and drift index.</li> <li>To understand detailing of RCC members for ductile behavior as IS Code provisions</li> </ol>	<ol> <li>The students will be able to describe fundamental concept, principle and application of earthquake engineering.</li> <li>The students will be able to analyze and design RCC structures with ductile detailing as per Indian standards.</li> <li>The students will be able to apply technical design principles and techniques such as P-delta effect, soil structure interaction for a design of high rise structures.</li> <li>The students will be able to apply various provisions for earthquake resistance design of structures as per Indian standards.</li> </ol>
<b>PO Mapped :</b> 1,2,3,4,6	

<b>UNIT-I</b> Earthquake & wind load calculations along with dead load and live loads and their Combinations as per IS code.	[06 Hrs.]
UNIT-II Introduction to Frame – shear wall buildings, Mathematical modeling of buildings with different Structural systems. Analysis & Design of shear walled buildings with ductile detailing as per IS 13920-2016	[06 Hrs.]
<b>UNIT-III</b> Special aspects in Multi- Story buildings like effect of torsion, flexible first storey, P- delta effect, Soil – Structure Interaction on building response, drift limitations.	[07 Hrs.]
UNIT-IV Ductility of reinforced members subjected to flexure. Design of braced columns using codal provisions.	[06 Hrs.]
<b>UNIT-V</b> Analysis and Design of multi-storeyed buildings with bracings & masonry in fills, Beam – column jointed for ductile behaviors.	[07 Hrs.]
UNIT-VI Introduction to Diaphragm. Seismic Design of Floor Diaphragm.	[06 Hrs.]

#### **Text Books:**

- 1. Agrawal P. & Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4th Edition, 2007.
- 2. Verghese P.C., Advance Reinforced Concrete Design, Prentice hall of India, New Delhi, 2001
- 3. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford university Press second edition 2013
- 4. Reinforced concrete design of Tall building by Bungale s. Taranah. 1<sup>st</sup> Edition Kindle Edition.

- 1. Park, R. &Paulay, T., Reinforced Concrete Structures, John Willey & Sons; 2nd Edition, 1975
- 2. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition, 1999
- 3. FarzadNaeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
- 4. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

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M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

# **II Semester** CV3924 - PE-II: Composite Structures

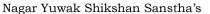
	COURSE OBJECTIVE		COURSE OUTCOMES
	To provide the student knowledge of basic concepts and characteristics of Composite materials  To provide the student the knowledge of behavior of	1.	Students will be able to understand basic concepts and characteristics of Composite materials.
	lamina To provide the student with knowledge of various failure theories	2.	
4.	To provide students the knowledge of analysis of laminated plates under bending and vibration.	4.	failure theories. Students will be able to analyse laminated plates under bending and vibration.
PC	Mapped: 1,3,4,6		<u> </u>
Inti	IIT-I roduction: definition, Classification and characteristics itations, Current Status and Future Prospects: Basic C		,

UNIT-I	[07 Hrs.]
Introduction: definition, Classification and characteristics of Composite materials, advantages and limitations. Current Status and Future Prospects; Basic Concepts and characteristics: Homogeneity	
and Heterogeneity, Isotropy, Orthotropy and Anisotropy;	
UNIT-II	[06 Hrs.]
Characteristics and configurations of lamina, laminate, micromechanics and macro-mechanics. Constituent materials and properties; Elastic behavior of unidirectional lamina: Anisotropic, separately	
orthotropic and transversely isotropic materials,	
UNIT-III	[07 Hrs.]
stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters, Strength of unidirectional lamina.	
UNIT-IV	[07 Hrs.]
Macro-mechanical failure theories- Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu)	
UNIT-V	[06 Hrs.]
Elastic Behavior of multidirectional laminates: Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties.	
UNIT-VI	[06 Hrs.]
Bending and vibration of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, especially orthotropic, anti-symmetric cross-ply laminates. Recent advances: Functionally graded materials, Smart materials.	•
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### **Text / Reference Books:**

- 1. R.M. Jones, Mechanics of Composite materials, Taylor and Francis, 1999.
- 2. M. Daniel and O. Ishai, Engineering mechanics of Composite materials, Oxford university press, 1999
- 3. P.K. Mallick, Fiber-reinforced Composites, Marcel Dekker Inc, 1988.
- 4. D. Hull and T.W. Clyne, An introduction to composite materials, Cambridge university press, Second Edition, 1996.
- 5. J.N. Reddy, Mechanics of laminated composite plates and shells-Theory and Analysis, CRC Press, BocaRaton, Second Edition, 2003.

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M.Tech. SoE & Syllabi 2020-21

## **Structural Engineering**

# II Semester CV3925 – PE-II: RC Bridge Design

	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To provide the students clear and through understanding of various types of bridges and	1.	An ability to identify the types of bridge to be used for various site and loading conditions.
	loadings.	2.	An ability to understand applicability of IRC codes
2.	To provide the students the knowledge of design		related to bridges.
	philosophy for bridges and its components.	3.	An ability to analyze and design slab bridges and
3.	To provide understanding of earthquake behavior		its components.
	and design philosophy for retaining wall and		
	abutments.		
PO	<b>Mapped :</b> 1,2,3		

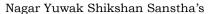
UNIT – I	[07 Hrs.]
Types of RC bridge superstructure and introduction to their design, choice of type of bridges.	
UNIT – II	[08 Hrs.]
IRC Loads, Analysis of IRC Loads, Impact factors, Other loads to be considered in Bridge Design.	
UNIT – III	[07 Hrs.]
Reinforced concrete solid bridge, Effective width method, Dispersion length.	
UNIT – IV	[08 Hrs.]
Seismic design philosophy for Bridges, Capacity design concept. Behavior Retaining wall.	
UNIT – V	[08 Hrs.]
Abutments, Stability Analysis of Abutments, Piers, Analysis of Piers.	
UNIT – VI	[08 Hrs.]
Bearings, Forces on Bearings, Types of Bearings, Basis for Selection of Bearings.	

#### **Text Books:**

- 1. N. Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
- 2. D. Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
- 3. Jagdeesh R. and Jairam M., "Design of bridges", PHI Publication New Delhi, 2<sup>nd</sup> edition,

- 1. IRC: 5 -1970, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.
- 2. IRC 006, Standard Specifications and Code of Practice for Road Bridges, Section II Loads and Stresses (Fourth Revision), 2014.
- 3. Chen, W.F. and Duan, L., Bridge Engineering Handbook, CRC Press, 1999
- 4. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 1962.
- 5. Hambly, E.C., Bridge deck behaviour, Chapman and Hall, London
- 6. O'Brien E.J. and Keogh D.L., Bridge deck analysis, E& FN Spon, New York

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards





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M.Tech. SoE & Syllabi 2020-21

### **Structural Engineering**

# II Semester CV3926 – PE-III : Plastic Analysis & Design of Steel Structure

COURSE OBJECTIVE	COURSE OUTCOMES
After completion of syllabus students will able to Understand behavior of steel structural members beyond yield point, understand the theories of plastic analysis and will be able to design steel structures considering plastic design approaches	<ol> <li>An ability to understand behavior of steel structure elements beyond yield point loading and basic concepts of plastic analysis.</li> <li>An ability to understand techniques for estimation of collapse loads on steel structures</li> <li>To understand the effects of axial and shear forces on</li> </ol>
PO Mapped : 3,4	plastic moment of resistance 4. To understand philosophies of plastic design of steel structural elements

UNIT I: Plastic behavior, review curves of structural steel, plastic moments, shape factors, load factors, plastic hinge, types of collapse, collapse mechanism, collapse load factor, step by step method.	[07 Hrs.]
UNIT II: Upper and lower bound, uniqueness theorem, principle of virtual work, statical method, minimum and maximum theorems, Determination of collapse load factor for beams and portal frames.	[07 Hrs.]
UNIT III:  Methods of release of restrains, load interaction diagrams, method of inequalities.	[06 Hrs.]
UNIT IV: Plastic Moment distribution applied to continuous beams & portal frames (Max. two bays single storey)	[06 Hrs.]
UNIT V: Effect of Axial force & Shear force on Plastic moment of resistance, Design of simply supported and continuous beams.	[07 Hrs.]
UNIT VI:  Design of portal frames up to single storey – two bays. Minimum weight design.	[06 Hrs.]

### Text Book:

- 1. Steel Skeleton, J. F. Baker, Volume II, Cambridge University Press 196
- 2. B.G. Neal Plastic Method of Structural Analysis, Chapman & Hall

#### **Reference Books:**

- 1. "Limit state Design of Steel Structures", S K Duggal , McGraw Hill education, 2010
- 2. "Limit State Design of Steel Structures", Dr. M R Shiyekar, PHI Publication, 3rd Print
- 3. A.S. Arya and J.L. Ajmani Design of Steel Structures, Nemchand& Bros., Roorke
- 4. Ramchandra Design of Steel Structures Vol II, Standard Book House, Delhi
- 5. L.S. Beedle Plastic Design of Steel Frames, John Willey & Sons
- 6. Structural design in steel by SalwarAlamRaz New Age International Publishers 15/44
- 7. Steel Designers Manual ELBS

#### **General Reading Suggested:**

- 1. Codes: IS: 800 2007 Code of Practice for General Construction in Steel Hand books
- 2. SP: 6 (6) 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures
- 3. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1993) Bureau of Indian Standards.
- 4. NPTEL
- 5. Teaching Resource for Structural Steel Design INSDAG Kolkatta

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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

# II Semester CV3927 – PE-III : Seismic Analysis and Design of Structures

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide the students clear and through	1. An ability to apply basic concepts Earthquake
understanding of the basic concepts of earthquake	resistant design in construction industry.
resistance design.	2. An ability to identify, formulate and solve
2. To provide the students clear and through	engineering problems pertaining to earthquake
understanding of analysis and design aspects of RCC	effects on structures.
and steel members subjected to earthquake loads.	3. An ability to understand IS codes related to
3. To provide the students clear and through	static as well as dynamic analysis of high rise
understanding of detailing of RCC and steel members	buildings.
for ductile behavior.	4. An ability to design special structures
4. To provide the students clear and through	subjected to more effective earthquake forces.
understanding of various Indian codes related to	
earthquake engineering.	
PO Mapped: 3.4	

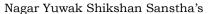
<b>UNIT - I</b> Performance of RC buildings, behavior of RC buildings in past earthquakes, influence of unsymmetry, infill walls, foundations, soft story, confinement of concrete.	[07 Hrs.]
UNIT - II  Review of IS 1893:2016 Part I -Capacity Based Design concept - Design for Strong column & weak beam, Design of Beam-Column Joints.	[06 Hrs.]
UNIT - III Behavior and failures of RC beam and recommendation for it -capacity design of RC Beam.	[06 Hrs.]
UNIT - IV Analysis & Design of shear walled buildings with ductile detailing as per IS 13920-2016.	[06 Hrs.]
UNIT - V Performance of steel structures in past earthquakes-Seismic behavior of steel structures - design philosophy for steel structures, Basics of Steel Design.	[07 Hrs.]
UNIT - VI Capacity design concept, Ductility of steel buildings- Stability considerations.	[07 Hrs.]

#### **Text Books:**

- 1. Agrawal P. & ,Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4<sup>th</sup> Edition, 2007.
- 2. Agrawal P. &, Shrikhande M., Earthquake Resistant Design of Structures, PHI Publisher, New Delhi.
- 3. Bruneau, M.; Uang, C.M.; & Whittaker, A Ductile Design of Steel Structures McGraw Hill.
- 4. Mazzolani, F.M.; &Piluso Theory and Design of Seismic Resistant Steel Frames E&FN Spon

- 1. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition,
- 2. Farzad Naeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
- 3. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

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M.Tech. SoE & Syllabi 2020-21

### Structural Engineering

## **II Semester** CV3928 - PE-III: Design of Industrial Structures

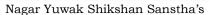
	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To afford the knowledge of various aspects of industrial structures, analysis of loads on industrial structure.	1.	An expertise to understand planning of industrial structures.
2.	To convey the knowledge of analysis and design of large span structures.	2.	The capability to analyse large span structures.
3.	To drill the importance of prefabricated and precast structures as applied to concrete, RCC and structural steel	3.	An expertise to understand stability of silos and bunkers under dynamic loads.
4.	To deliver the knowledge of stability of silos and bunkers under dynamic loads.	4.	The skill to analyse and design foundations for industrial structures.
5.	To provide the knowledge of analysis and design of foundations for industrial structures		
PC	<b>Mapped</b> : 1,6		

UNIT-I: PLANNING OF INDUSTRIAL STRUCTURES: Classification of industries and local regulations - Factors affecting planning - General Aspects - Civil Engineering Aspects - Light and Ventilation.	[06 Hrs.]
UNIT-II: ANALYSIS OF LOADS Analysis of dead load; imposed load and wind load on industrial structure, Introduction to earthquake forces.	[07 Hrs.]
UNIT-III PRE-ENGINEERED AND PRECAST STRUCTURES Prefabricated construction; necessity, advantages, disadvantages, prefabricates classification; foundation, columns, beams, roof and floor panels, wall panels, box prefabricates, erection and assembly.	[06 Hrs.]
UNIT-IV: LARGE SPAN STRUCTURES IN INDUSTRIES Cable roofs, types of cable roofs, Analysis of a cable subjected to concentrated loads and uniformly distributed load, Overview of deep beams, Virrendel Girder, Castellated Girders	[07 Hrs.]
UNIT-V SILOS AND BUNKERS Concept of Angle of Repose, Pressure distribution, Dynamic loads, Stability of bunkers, Foundations.	[06 Hrs.]
UNIT-VI: FOUNDATIONS FOR INDUSTRIAL STRUCTURES Machine foundations, General requirements, Design criteria, General analysis, Design of a block foundation for vertical compressor, Vibration Isolation, Foundations for Chimney and Microwave Towers.	[07 Hrs.]

### Text books:

- Srinivasula P., "Hand Book of Machine Foundation", Tata Mc. Graw Hill Publications, New Delhi. First Edition, 2000
- Ramchandra, "Design of Steel Structures", Standard Book House, New Delhi Seventh Edition, 2000
- Raghupati M., "Design of Steel Structures", Tata Mc. Graw Hill Publication, Delhi First Edition, 2003
- Dayaratnam P.< "Design of Steel Structures", Wheelr's Publishers, Allahabad1995 4.
- AnandArya&Ajmani J. L., "Design of Steel Structures", Nemchand& Bros., Roorkee, U.P., India, Forth Edition, 2004 5.
- Lambert F.W., "The Theory & Practical Design of Bunkers", British Constructional Steelwork Association Ltd., London, UK2000
- Hass, A.M., "Precast Concrete, Design and Applications", Taylor & Francis, UK. 7.
- Phillips, W.R. and Sheppard, D.A., "Plant cast, Precast and Prestressed Concrete", McGraw Hill, New York.

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	AY 2019-20 Onwards
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M.Tech. SoE & Syllabi 2020-21

## **Structural Engineering**

## **III Semester** CV3939 - Project Phase-I

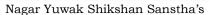
	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering	1. 2.	An ability to understand the advances in structural engineering.  An ability to understand the use of modern tools.
2.		3.	An ability to work independently and in a team for effective communication
3.	To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	4.	An ability to understand the importance of lifelong learning.
PC	Mapped: 1,2,3,4,5,6,		

#### Contents:

- 1. Literature review on current topic related to the structural engineering.
- 2. Preparation and presentation of progress seminars on topic selected for dissertation.
- 3. Submission of project report including introduction, literature review, objective and scope of investigation and pilot studies carried out during the semester.

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M.Tech. SoE & Syllabi 2020-21

## Structural Engineering

# **IV Semester** CV3940 - Project Phase-II

	COURSE OBJECTIVE		COURSE OUTCOMES
1.	To provide the students the academic environment to	1.	An ability to understand the advances in
	carry out literature survey of advanced topics in	_	structural engineering.
	structural engineering.	2.	
2.	To provide the students the understanding of real world		engineering problems.
	structural engineering problems and their solution.	3.	
3.	To motivate the students to use the modern tools and		lifelong learning and the use of modern tools.
	software.	4.	An ability to work independently and in a team
4.	To provide the students the understanding of various		for effective communication.
	aspects like effective communication skills, working		
	independently and in a team and the importance of		
	lifelong learning etc. to carry out project.		
PO	Mapped: 1,2,3,4,5,6,	•	

### Contents:

- 1. The of detailed study of a work including collection and analysis of data, determining solution, design, scientific research on topic selected for dissertation.
- 2. Preparation and presentation of progress seminars on topic selected for dissertation.
- 3. Submission of project report on the entire studies carried out during the semester

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YCCE-CE-26