ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(Autonomous)

M. Tech - Structural Engineering **AK25 REGULATIONS**

COURSE STRUCTURE & SYLLABI

I-SEMESTER

S. No.	Course codes	Course Name	Category	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P				
1.	25DPC2001	Advanced Structural Analysis	PC	3	0	0	3	40	60	100
2.	25DPC2002	Theory of Elasticity	PC	3	0	0	3	40	60	100
3.	**Program Elective – I**		PE	3	0	0	3	40	60	100
	25DPE2001	Fracture Mechanics								
	25DPE2002	Advanced Concrete Technology								
	25DPE2003	Advanced Mathematical Methods								
4.	**Program Elective – II**		PE	3	0	0	3	40	60	100
	25DPE2004	Advanced Reinforced Concrete Design								
	25DPE2005	Experimental Stress Analysis								
	25DPE2006	Precast And Prefabricated Structures								
5.	25DPC2003	Advanced Concrete Laboratory	PC	0	0	4	2	40	60	100
6.	25DPC2004	Computer Aided Design Laboratory	PC	0	0	4	2	40	60	100
7.	25MBA0110	Research Methodology and IPR	MC	2	0	0	2	40	60	100
8.	25DSE2001	**Skill Enhancement Course** Artificial Intelligence and Applications in Civil Engineering	SE	0	1	2	2	40	60	100
9.	**Audit Course – I**		AC	2	0	0	0	40		40
	25DMC9901	English for Research Paper Writing								
	25DMC2001	Disaster Management								
	25DMC9902	Essence of Indian Traditional Knowledge								
Total							**20**	**360**	**480**	**840**

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II-SEMESTER

S.No.	Course codes	Course Name	Category	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P				
1.	25DPC2005	Structural Dynamics	PC	3	0	0	3	40	60	100
2.	25DPC2006	Stability of Structures	PC	3	0	0	3	40	60	100
3.	**Program Elective – III**		PE	3	0	0	3	40	60	100
	25DPE2007	Finite Element Methods for Structural Engineering								
	25DPE2008	Advanced Steel Structures Design								
	25DPE2009	Theory of Plates and Shells								
4.	**Program Elective – IV**		PE	3	0	0	3	40	60	100
	25DPE2010	Design of Prestressed Concrete								
	25DPE2011	Design of Bridges								
	25DPE2012	Structural Health Monitoring								
5.	25DPC2007	Advanced Structural Engineering Laboratory	PC	0	0	4	2	40	60	100
6.	25DPC2008	Advanced Structural Analysis and Design Laboratory	PC	0	0	4	2	40	60	100
7.	25DMC5801	Quantum Technologies And Applications	MC	2	0	0	2	40		40
8.	25DPC2009	Comprehensive Viva Voce	PC	0	0	0	2	100		100
9.	25DMC2004 25DMC2005 25DMC2006 25DMC2007	Audit Course – II Constitution of India Pedagogy Studies Stress Management by Yoga Personality Development through Life Enlightenment Skills.	AC	2	0	0	0	40		40
Total							20	420	360	780

****Students must undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks that will be evaluated in III semester.**

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M. Tech - Structural Engineering **AK25 REGULATIONS**

III-SEMESTER

S.No.	Course codes	Course Name	Category	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P				
1.	**Program Elective – V**		PE	3	0	0	3	40	60	100
	25DPE2013	Earthquake Resistant Design of Structures								
	25DPE2014	Rehabilitation and Retrofitting of Structures								
	25DPE2015	Building Construction Management								
2.	**Open Elective-I**		OE	3	0	0	3	40	60	100
	25DOE2001	Green Building Technologies								
3.	25DOE2002	Industrial Safety								
4.	25DOE2003	Safety and Construction Practice Regulations								
5.	25DPR2001	Dissertation Phase – I	PR	0	0	20	10	100		100
6.	25DPR2002	Industry Internship		0	0	0	2	100		100
7.	25DPR2003	Co- Curricular Activities		0	0	0	1	-	-	-
Total							19	280	120	400

IV-SEMESTER

S.No.	Corse codes	Course Name	Category	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P				
1.	25DPR2004	Dissertation Phase – II	PR	0	0	32	16	100	100	200
Total							16	100	100	200

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2001	ADVANCED STRUCTURAL ANALYSIS	3	0	0	3

Course Outcomes: After completion of the course, Student will be able to

CO1 Apply matrix method fundamentals and element equation formulation for trusses, beams, and torsion.
CO2 Apply the direct stiffness method to assemble the global stiffness matrix
CO3 Analyze trusses, continuous beams and plane frames using the flexibility method
CO4 Analyze trusses, continuous beams and plane frames using the stiffness method
CO5 Apply special analysis procedures to find structural response quantities

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	Matrix method fundamentals and element equation formulation		For trusses, beams, and torsion	L3
CO2	Apply	The direct stiffness method		To assemble the global stiffness matrix	L3
CO3	Analyze	Trusses, continuous beams and plane frames		Using the flexibility method	L4
CO4	Analyze	Trusses, continuous beams and plane frames		Using the stiffness method	L4
CO5	Apply	Special analysis procedures		To find structural response quantities	L3

UNIT – I

Introduction To Matrix Methods Of Analysis - Statical Indeterminacy And Kinematical Indeterminacy - Degree Of Freedom - Coordinate System - Structure Idealization Stiffness And Flexibility Matrices - Suitability Element Stiffness Equations - Elements Flexibility Equations - Mixed Force - Displacement Equations - For Truss Element, Beam Element And Torsional Element. Transformation Of Coordinates - Element Stiffness Matrix - And Load Vector - Local and Global Coordinates.

UNIT – II

Assembly Of Stiffness Matrix from Element Stiffness Matrix - Direct Stiffness Method - General Procedure - Banded Matrix - Semi Bandwidth - Assembly by Direct Stiffness Matrix Method.

UNIT -III

Analysis Of Plane Truss - Continuous Beams with and Without Settlement - Plane Frame Including Side Sway Single Storey, Single – Bay and Gable Frame by Flexibility Method Using System Approach.

UNIT -IV

Analysis Of Plane Truss - Continuous Beams with and Without Settlement - Plane Frame Including Sides Sway, Grids and Gable Frames by Stiffness Methods, Single Bay – Two Storey, Two Bay Single – Storey.

UNIT -V

Special Analysis Procedures - Static Condensation and Sub Structuring - Initial and Thermal Stresses.

Textbooks:

1. Matrix Analysis Of Frames Structures By William Weaver J.R And James M.Gere, CBS Publications.
2. Advanced Structural Analysis By Ashok.K.Jain, New Channel Brothers.
3. Matrix Method Of S.A By Pandit &Gupta

REFERENCES:

1. Matrix Structural Analysis By Madhu B. Kanchi.
2. Matrix Methods Of Structural Analysis By J.Meek.
3. Structural Analysis By Ghali And Neyveli.
4. Structural Analysis By Devdas Menon, Narosa Publishing Housing Pvt Ltd.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	2
CO2	2	2	2
CO3	3	3	3
CO4	3	3	2
CO5	2	2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/60	20	3	Apply	L3	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
2	12/60	20	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2

						PO3	Thumb Rule	2
3	12/60	20	3	Analyze	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
4	12/60	20	3	Analyze	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
5	12/60	20	3	Apply	L3	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO1 Apply matrix method fundamentals and element equation formulation for trusses, beams, and torsion.
CO1 Action Verb is of BTL3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL3. Using Thumb rule, L3 correlates PO 2 as moderate (2).
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).
CO2 Apply the direct stiffness method to assemble the global stiffness matrix
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).
CO3 Analyze trusses, continuous beams and plane frames using the flexibility method
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).
CO4 Analyze trusses, continuous beams and plane frames using the stiffness method
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).
CO5 Apply special analysis procedures to find structural response quantities
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).

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I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2002	**THEORY OF ELASTICITY**	**3**	**0**	**0**	**3**

Course Outcomes: After completion of the course, Student will be able to

CO1 Apply the fundamental concepts of plane stress and plane strain analysis
CO2 Apply two-dimensional stress and strain analysis methods in rectangular coordinates
CO3 Analyze two-dimensional problems in polar coordinates to determine stress and strain distributions
CO4 Apply the three-dimensional stress and strain systems
CO5 Analyze torsional behavior of prismatic bars with different cross-sections

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	The fundamental concepts of plane stress and plane strain analysis			L3
CO2	Apply	Two-dimensional stress and strain analysis methods	In rectangular coordinates		L3
CO3	Analyze	Two-dimensional problems in polar coordinates		To determine stress and strain distributions	L4
CO4	Apply	The three-dimensional stress and strain systems			L3
CO5	Analyze	Torsional behavior of prismatic bars	With different cross-sections		L4

UNIT – I

INTRODUCTION TO PLANE STRESS and PLANE STRAIN ANALYSIS:

Elasticity –Notation for Forces and Stresses-Components of Stresses –Components of Strain – Hooke's Law. Plane Stress-Plane Strain-Differential Equations of Equilibrium- Boundary Conditions- Compatibility Equations-Stress Function-Boundary Conditions.

UNIT – II

TWO DIMENSIONAL PROBLEMS in RECTANGULAR COORDINATES:

Solution by Polynomials-Saint Venant's Principle-Determination of Displacements-Bending of Simple Beams-Application of Fourier Series for Two Dimensional Problems - Gravity Loading.

UNIT -III

TWO DIMENSIONAL PROBLEMS in POLAR COORDINATES:

General Equation in Polar Co-Ordinates - Stress Distribution Symmetrical About an Axis – Pure Bending of Curved Bars- Strain Components in Polar Coordinates-Displacements for Symmetrical Stress Distributions-Simple Symmetric and Asymmetric Problems-General Solution of Two-Dimensional Problem in Polar Coordinates-Application of The General Solution of Two-Dimensional Problem in Polar Coordinates-Application of The General Solution in Polar Coordinates.

UNIT -IV

ANALYSIS Of STRESS And STRAIN In THREE DIMENSIONS: Principle Stress - Ellipsoid and Stress-Director Surface-Determination of Principle Stresses- Maximum Shear Stresses-Homogeneous Deformation- Principle Axis of Strain Rotation.

General Theorems: Balance Laws - Differential Equations of Equilibrium- Conditions of Compatibility - Determination of Displacement-Equations of Equilibrium in Terms of Displacements - Principle of Superposition-Uniqueness of Solution –The Reciprocal Theorem.

UNIT -V

TORSION Of PRISMATIC BARS:

Torsion of Prismatic Bars- Elliptical Cross Section-Other Elementary Solutions-Membrane Analogy-Torsion of Rectangular Bars-Solution of Torsional Problems by Energy Method-Use of Soap Films In Solving Torsional Problems-Hydra Dynamical Analogies-Torsion of Shafts, Tubes and Bars.

Textbooks:

1. Theory Of Elasticity and Plasticity by Timoshenko, S., MC Graw Hill Book Company.
2. Advanced Strength of Materials by Papoov, MC Graw Hill Book Company.
3. Theory Of Elasticity and Plasticity by Sadhu Singh. Khanna Publishers.

REFERENCES:

1. Plasticity For Structural Engineers- Chen, W.F. And Han, D.J., Springer – Verlag, New York.
2. Plasticity Theory, Lubliner, J., Mac Millan Publishing Co., New York.
3. Foundations of Solid Mechanics By Y.C.Fung, PHI Publications.
4. Advanced Mechanics of Solids by L.S. Srinath, Tata MC Graw Hill Book Company.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	
CO2	2	2	
CO3	3	3	
CO4	2	2	
CO5	3	3	

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/62	19	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
2	12/62	19	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
3	12/62	20	3	Analyze	L4	PO1 PO2	Thumb Rule Thumb Rule	3 3
4	13/62	21	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
5	13/62	21	3	Analyze	L4	PO1 PO2	Thumb Rule Thumb Rule	3 3

JUSTIFICATION STATEMENTS:

CO1 Apply the fundamental concepts of plane stress and plane strain analysis
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

CO2 Apply two-dimensional stress and strain analysis methods in rectangular coordinates
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

CO3 Analyze two-dimensional problems in polar coordinates to determine stress and strain distributions
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as moderate (2).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as moderate (2).

CO4 Apply the three-dimensional stress and strain systems
CO4 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO4 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).
CO4 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).

CO5 Analyze torsional behavior of prismatic bars with different cross-sections
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2001	FRACTURE MECHANICS	3	0	0	3

Course Outcomes: After completion of the course, Student will be able to

CO1 Apply the basic problems and concepts of fracture mechanics
CO2 Analyse the elastic crack-tip stress fields using Airy stress function and complex stress functions
CO3 Apply different approaches to determine the shape and effect of the plastic zone under plane stress and plane strain conditions.
CO4 Apply the energy-based principles of crack growth using standard testing methods
CO5 Apply the fracture assessment methods to determine stress intensity factors

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	The basic problems and concepts of fracture mechanics			L3
CO2	Analyse	The elastic crack-tip stress fields	Using Airy stress function and complex stress functions		L4
CO3	Apply	Different approaches to determine the shape and effect of the plastic zone	Under plane stress and plane strain conditions		L3
CO4	Apply	The energy-based principles of crack growth	Using standard testing methods		L3
CO5	Apply	The fracture assessment methods to determine stress intensity factors			L3

UNIT – I Summary of Basic Problems and Concepts:
Introduction - A Crack in A Structure - The Stress at A Crack Tip - The Griffith Criterion the Crack Opening Displacement Criterion - Crack Propagation - Closure

UNIT – II The Elastic Crack – Tip Stress Field:
The Airy Stress Function - Complex Stress Functions - Solution to Crack Problems - The Effect of Finite Size - Special Cases - Elliptical Cracks - Some Useful Expressions

UNIT -III The Crack Tip Plastic Zone:
The Irwin Plastic Zone Correction - The Dugdale Approach - The Shape of The Plastic Zone - Plane Stress Versus Plane Strain - Plastic Constraint Factor - The Thickness Effect

UNIT -IV

The Energy Principle:

The Energy Release Rate - The Criterion for Crack Growth - The Crack Resistance (R Curve) - Compliance, The J Integral (Definitions Only)

Plane Strain Fracture Toughness:

The Standard Test - Size Requirements - Non-Linearity – Applicability

Plane Stress and Transitional Behavior:

Introduction - An Engineering Concept of Plane Stress - The R Curve Concept

UNIT -V

The Crack Opening Displacement Criterion:

Fracture Beyond General Yield - The Crack Tip Opening Displacement - The Possible Use of The CTOD Criterion

Determination of Stress Intensity Factors:

Introduction - Analytical and Numerical Methods - Finite Element Methods, Experimental Methods (An Ariel Views Only)

Textbooks:

1. Elementary Engineering Fracture Mechanics -David Broek, Battelle, Columbus Laboratories, Columbus, Ohieo, USA
2. Fracture and Fatigue Control in Structures- John M.Barsom, Stanley T.Rolfe, Ross H.Forney
3. Rock and other Quasi-brittle materials - Surender P Shah , Stuart E Swartz,Wiley 1995.

REFERENCES:

1. Analysis of Concrete Structures by fracture mechanics, Elfgren L, Routledge,1990
2. Fracture Mechanics- Applications to concrete, Victor C.Li and Z P Bazant , ACI SP118
3. Fracture Mechanics , CT Suri and Zh jin , Elsevier Academic Press,2012

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	
CO2	3	3	
CO3	2	2	
CO4	2	2	
CO5	2	2	

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/62	19	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2

2	12/62	19	3	Analyse	L4	PO1 PO2	Thumb Rule Thumb Rule	3 3
3	12/62	20	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
4	13/62	21	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
5	13/62	21	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2

JUSTIFICATION STATEMENTS:

CO1 Apply the basic problems and concepts of fracture mechanics
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

CO2 Analyze the elastic crack-tip stress fields using Airy stress function and complex stress functions
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).

CO3 Apply different approaches to determine the shape and effect of the plastic zone under plane stress and plane strain conditions.
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

CO4 Apply the energy-based principles of crack growth using standard testing methods
CO4 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO4 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 2 as moderate (2).

CO5 Apply the fracture assessment methods to determine stress intensity factors
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2002	ADVANCED CONCRETE TECHNOLOGY	3	0	0	3

Course Outcomes: After completion of the course, Student will be able to

CO1 Understand the properties and types of cements and aggregates used in concrete
CO2 Understand the fresh and hardened properties of concrete
CO3 Design concrete mix as per IS, ACI codes for economical, durable concrete and also understand types, properties and applications of special concretes
CO4 Understand the engineering properties and special applications of concrete.
CO5 Understand the Rheology and durability of concrete

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	The properties and types	Of cement and aggregates	in concrete	L2
CO2	Understand	the fresh and hardened properties		of concrete	L2
CO3	Design and Understand	concrete mix as per IS, ACI, types, properties and applications	for economical, durable	Concrete & Special Concrete	L6 L2
CO4	Understand	the engineering properties and special applications		of concrete	L2
CO5	Understand	The rheology and durability		Of Concrete	L2

UNIT – I:

INGREDIENTS OF CONCRETE

Cements And Admixtures: Portland Cement – Chemical Composition - Hydration, Setting and Fineness's of Cement – Structures of Hydrated Cement – Mechanical Strength of Cement Gel - Water Held in Hydrate Cement Paste – Heat of Hydration of Cement – Influence of Compound Composition on Properties of Cement – Tests on Physical Properties of Cement – I.S. Specifications – Different Types of Cements – Admixtures.

Aggregates: Classification of Aggregate – Particle Shape and Texture – Bond Strength and Other Mechanical Properties of Aggregate: Specific Gravity, Bulk Density, Porosity, Absorption and Moisture in Aggregate – Soundness of Aggregate – Alkali Aggregate Reaction– Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Partical Grading – Gap Graded Aggregate – Maximum Aggregate Size

UNIT -II

Fresh Concrete: Workability – Factors Affecting Workability – Measurement of Workability by Different Tests – Effect of Time and Temperature on Workability – Segregation and Bleeding – Mixing and Vibration of Concrete – Quality of Mixing Water.
Hardened Concrete: Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water in Mix – Nature of Strength Of Concrete – Strength in Tension And Compression- Griffith's Hypothesis – Factors affecting Strength – Autogeneous Healing –Relation between Compression and Tensile Strength – Curing and Maturity of Concrete Influence of Temperature on Strength – Steam Curing – Testing of Hardened Concrete – Compression Tests – Tension Tests – Factors affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.

UNIT -III
Mix Design: Factors in the Choice of Mix Proportions – Quality Control of Concrete – Statistical Methods - Proportioning of Concrete Mixes by Various Methods – Fineness Modulus, Trial and Error, Mix Density, ACI and IS Code Methods – High Strength Concrete Mix Design – Self Compacting Concrete Mix Design according to IS Code.
Special Concretes: Light Weight Concretes - Cellular Concrete - No Fines Concrete – High Density Concrete – High Strength Concrete – Polymer Concrete – Self Compacting Concrete - Underwater Concreting Method

UNIT -IV
Elasticity, Shrinkage and Creep: Modulus of Elasticity – Dynamic Modulus of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Drying Shrinkage - Mechanism of Shrinkage – Factors affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep of Concrete – Factors influencing Creep – Relation Between Creep and Time – Nature of Creep – Effect of Creep.

UNIT V

Rheology of Concrete: Viscoelasticity – Basic rheological models **-** Tests on Cement paste – Tests on concrete – Bingham constants

Durability of Concrete: Durability concept, pore structure and transport processes, Permeability of concrete, reinforcement corrosion, fire resistance, frost damage, sulphate attack, Acid attack, alkali silica reaction, delayed ettringite formation, methods of providing durable concrete, short-term tests to assess long-term behavior.

TEXTBOOKS:

1. Concrete: Micro Structure, Properties And Materials – P.K.Mehta And J.M.Monteiro, Mc-Graw Hill Publishers
2. Concrete Technology By M.S.Shetty. – S.Chand &Co. ; 2004
3. Concrete Technology By A.R. Santha Kumar, Oxford University Press, New Delhi

REFERENCES:

1. Concrete Technology By A.M.Neville – Pearson Publication (Year of Publication need to mention)
2. Design Of Concrete Mix By Krishna Raju, CBS Pubilishers.
3. Concrete Technology By M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
4. Non-Destructive Test And Evaluation Of Materials By J.Prasad &C.G.K. Nair , Tata Mcgraw Hill Publishers, New Delhi

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	2
CO2	2	2	2
CO3	3	3	2
CO4	2	2	2
CO5	2	2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
2	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
3	12/60	20	3	Design Understand	L6 L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
4	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
5	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO1 Understand the properties and types of cements and aggregates used in concrete
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).

CO2 Understand the fresh and hardened properties of concrete
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).

CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as moderate (2).

CO3 Design concrete mix as per IS, ACI codes for economical, durable concrete and also understand types, properties and applications of special concretes
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).

CO4 Understand the engineering properties and special applications of concrete.
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).

CO5 Understand the Rheology and durability of concrete
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2003	**ADVANCED MATHEMATICAL METHODS**	**3**	**0**	**0**	**3**

Course Outcomes: After completion of the course, Student will be able to

CO1: Analyze the solutions of various functionals in Calculus of variation.
CO2: Apply the numerical methods for solving ordinary differential equations to find eigen values and eigen vectors
CO3: Apply the numerical techniques to solve elliptical equations models of partial differential equations
CO4: Apply the numerical techniques to solve parabolic equations models of partial differential equations
CO5: Analyze the concepts of finite element methods for 1-D and 2-D problems

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1	Analyze	the solutions of various functionals	in Calculus of variation.		**L4**
2	Apply	the numerical methods for solving ordinary differential equations	to find eigen values and eigen vectors.		**L3**
3	Apply	the numerical techniques	to solve elliptical equations models of partial differential equations.		**L3**
4	Apply	the numerical techniques	to solve parabolic equations models of partial differential equations.		**L3**
5	Analyze	the concepts of finite element methods	for 1-D and 2-D problems.		**L4**

UNIT – I	**Calculus of Variation**	
Calculus of Variation – Functionals – Euler's Equation - Solution of Euler's Equation –Isoperimetric problems – several dependent variables – Functionals involving higher Order derivatives – Hamilton's principle – Lagrange's Equations.		
UNIT - II	**Numerical Solution of ordinary Differential Equations & Eigen values and Eigen vectors**	
Numerical Methods- Eigen values and Eigen vectors – general method – power Method, spectral method. Numerical Solution of ordinary Differential Equations - Taylor Series Method, Picard's method, Euler's		

method modified Euler's method & R.K. Method.		
UNIT - III	**Numerical solution of partial differential equations**	
Numerical solution of partial differential equations –elliptical equations standard five Points formula, Diagonal five point formula –Solution of Laplace equation by Leibmann's iteration method, Poisson's equation and its applications.		
UNIT - IV	**Numerical Solution of Partial Differential Equations**	
Numerical Solution of Partial Differential Equations – Parabolic Equations Bender –Schmidt Method-Bender - Schmidt Recurrence Equation, Crank-Nicholson Difference Method.		
UNIT - V	**Finite Element Method**	
Finite Element Method – Weighted residual methods, least square method, Gelarkin's method – Finite Elements – Interpolating over the whole Domain – one dimensional case, two dimensional case – Application to Boundary value Problems.		
Textbooks:		
1. Higher Engineering Mathematics By B.S. Grewal Khanna Publishers. 2. Numerical Methods For Engineers By Steven C.Chapra And Raymond P.Canale – Mc Graw Hill Book Company.		
Reference Books:		
1. Applied Numerical Analysis By Curtis. F.Gerald- Addeson Wesely Publishing Company. 2. C-Language And Numerical Methods By C-Xavier. New Age International Publishers. 3. Computational Methods For Partial Differential Equations By M.K.Jain, SKR Lyengar, R.K.Jain.		
Online Learning Resources: 1. Calc_Var.dvi 2. homepage.divms.uiowa.edu/~atkinson/papers/NAODE_Book.pdf 3. NumerPDEs_Lecture.pdf 4. Introduction to the Finite Element Method 5. ME280A.pdf		

Mapping of COs to POs

CO	PO1	PO2	PO3
1		3	
2	3		
3	3		
4	3		
5		3	

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Analyze	L4	PO2	Analyze	3

2				Apply	L3	PO1	Apply	3
3				Apply	L3	PO1	Apply	3
4				Apply	L3	PO1	Apply	3
5				Analyze	L4	PO2	Analyze	3

JUSTIFICATION STATEMENTS:

CO1: Analyze the solutions of various functionals in Calculus of variation.
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO1 Action Verb is equal to PO2 verb Therefore correlation is high (3).
CO2: Apply the numerical methods for solving ordinary differential equations to find eigen values and eigen vectors.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO3: Apply the numerical techniques to solve elliptical equations models of partial differential equations.
Action Verb: Apply **(L3)**
PO1 Verb: Apply (L3)
CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO4: Apply the numerical techniques to solve parabolic equations models of partial differential equations.
Action Verb: Apply **(L3)**
PO2 Verb: Apply (L3)
CO4 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO5: Analyze the concepts of finite element methods for 1-D and 2-D problems.
Action Verb: Analyze **(L4)**
PO2 Verb: Analyze (L4)
CO5 Action verb is equal to PO2 verb; therefore the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2004	**Advanced Reinforced Concrete Design**	**3**	**0**	**0**	**3**

Course Outcomes: After completion of the course, Student will be able to

CO1 Analyse the deflections of Reinforced Concrete Beams and Slabs by understanding their behaviour.
CO2 Design the Deep Beams and estimation of crack width in concrete structures
CO3 Design the Flat Slabs according to ACI standards
CO4 Design the plain concrete and shear wall according to loading conditions
CO5 Analyse the effects of high temperatures on reinforced concrete members under fire

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Analyse	the deflections of Reinforced Concrete Beams and Slabs		by understanding their behaviour.	L4
CO2	Design	the Deep Beams and estimation of crack width		in concrete structures	L6
CO3	Design	the Flat Slabs		according to ACI standards	L6
CO4	Design	the plain concrete and shear wall		according to loading conditions	L6
CO5	Analyse	the effects of high temperatures	under fire	on reinforced concrete members	L4

UNIT I DEFLECTION OF REINFORCED CONCRETE BEAMS AND SLABS:

Introduction -Short-Term Deflection of Beams and Slabs -Deflection Due to Imposed Loads - Short- Term Deflection of Beams Due to Applied Loads- Calculation of Deflection by IS 456 - Calculation of Deflection by BS 8110 - Deflection Calculation by Eurocode – ACI Simplified Method - Deflection of Continuous Beams by IS 456 - Deflection of Cantilevers - Deflection of Slabs - Redistribution of Moments

UNIT II ESTIMATION OF CRACK WIDTH IN REINFORCED CONCRETE MEMBERS:

Introduction - Factors Affecting Crack Width in Beams - Mechanism of Flexural Cracking Calculation of Crack Widths - Simple Empirical Method - Estimation of Crack width In - Beams - Shrinkage and Thermal Cracking.

DEEP BEAMS: Introduction - Minimum Thickness - Steps of Designing Deep Beams - Design by IS 456 - Design According to British Practice - ACI Procedure for Design of Deep Beams - Checking for Local Failures - Detailing of Deep Beams.

UNIT-III SHEAR IN FLAT SLABS AND FLAT PLATES:

Introduction - Checking for One-Way (Wide Beam) Shear - Two-Way (Punching) Shear Permissible Punching Shear - Shear Due To Unbalanced Moment (Torsional Moments) Calculation of J Values - Strengthening of Column Areas for Moment Transfer by Torsion Which Produces Shear - Shear Reinforcement Design - Effect of Openings in Flat Slabs - Recent Revisions in ACI 318 - Shear in Two – Way Slabs with Beams.

UNIT-IV DESIGN OF PLAIN CONCRETE WALLS AND SHEAR WALLS:

Introduction - Braced and Unbraced Walls - Slenderness of Walls- Eccentricities of Vertical Loads at Right Angles to Wall - Empirical Design Method for Plane Concrete Walls Carrying Axial Load - Design of Walls for In-Plane Horizontal Forces - Rules for Detailing of Steel in Concrete Walls

DESIGN OF SHEAR WALLS: Introduction - Classification of Shear Walls - Classification According To behavior - Loads in Shear Walls - Design of Rectangular and Flanged Shear Walls - Derivation of Formula for Moment of Resistance of Rectangular Shear Walls

UNIT-V DESIGN OF REINFORCED CONCRETE MEMBERS FOR FIRE RESISTANCE:

Introduction - ISO 834 Standard Heating Conditions- Grading or Classification - Effect of High Temperature on Steel and Concrete - Effect of High Temperatures on Different Types of Structural Members - Fire Resistance by Structural Detailing from Tabulated Data - Analytical Determination of The Ultimate Bending Moment Capacity of Reinforced Concrete Beams Under Fire - Other Considerations

CORRELATION OF COS WITH THE POS

	PO1	**PO2**	**PO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	**Course Outcomes**	**Program**		**Level of**

	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL	Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Correlation (0-3)
1				Analyze	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
2				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
3				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
4				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
5				Analyze	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1 Analyze the deflections of Reinforced Concrete Beams and Slabs by understanding their behavior.

CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO1 as High (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO2 as High (3)
CO1 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO3 as High (3)

CO2 Design the Deep Beams and estimation of crack width in concrete structures

CO2 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO1 as High (3)
CO2 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO2 as High (3)
CO2 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO3 as High (3)

CO3 Design the Flat Slabs according to ACI standards

CO3 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO1 as High (3)
CO3 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO2 as High (3)
CO3 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO3 as High (3)

CO4 Design the plain concrete and shear wall according to loading conditions

CO4 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO1 as High (3)
CO4 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO2 as High (3)
CO4 Action verb Create is of BTL 6. Using Thumb rule, L6 correlates PO3 as High (3)

CO5 Analyse the effects of high temperatures on reinforced concrete members under fire

CO5 Action verb Create is of BTL 4. Using Thumb rule, L6 correlates PO1 as High (3)
CO5 Action verb Create is of BTL 4. Using Thumb rule, L6 correlates PO2 as High (3)
CO5 Action verb Create is of BTL 4. Using Thumb rule, L6 correlates PO3 as High (3)

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2005	**EXPERIMENTAL STRESS ANALYSIS**	**3**	**0**	**0**	**3**

Course Outcomes: After completion of the course, Student will be able to

CO1 Understand the principles, merits and applications of experimental stress analysis and differentiate various methods for simplifying structural problems.
CO2 Apply the concepts of strain measurement using different types of strain gauges
CO3 Analyse strain data using strain rosettes through non-destructive testing methods
CO4 Understand the theory of photoelasticity, stress-optic law, polariscope arrangements, and fringe sharpening techniques.
CO5 Apply two-dimensional photoelasticity techniques to interpret fringe patterns

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	The principles, merits, and applications of experimental stress analysis and differentiate various methods		For simplifying structural problems	L3
CO2	Apply	The concepts of strain measurement	Using different types of strain gauges		L3
CO3	Analyse	Strain data using strain rosettes	Through non-destructive testing methods		L4
CO4	Apply	The theory of photoelasticity, stress-optic law, polariscope arrangements, and fringe sharpening techniques			L3
CO5	Apply	The two-dimensional photoelasticity techniques		To interpret fringe patterns	L3

UNIT – I PRINCIPLES of EXPERIMENTAL APPROACH

Merits of Experimental Analysis Introduction, Uses of Experimental Stress Analysis Advantages of Experimental Stress Analysis, Different Methods –Simplification of Problems.

UNIT – II STRAIN MEASUREMENT USING STRAIN GAUGES:
Definition of Strain and Its Relation of Experimental Determinations Properties of Strain-Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction To Electrical Strain Gauges - Inductance Strain Gauges – LVDT – Resistance Strain Gauges – Various Types –Gauge Factor – Materials of Adhesion Base.
UNIT -III STRAIN ROSSETTES and NON – DESTRUCTIVE TESTING of CONCRETE: Introduction – The Three Elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity Method –Application To Concrete. Hammer Test – Application To Concrete.
UNIT -IV
THEORY OF PHOTOELASTICITY:
Introduction –Temporary Double Refraction – The Stress Optic Law –Effects of Stressed Model in A Polariscope for Various Arrangements – Fringe Sharpening. Brewster's Stress Optic Law.
UNIT -V
TWO-DIMENSIONAL PHOTOELASTICITY:
Introduction – Isochromatic Fringe Patterns- Isoclinic Fringe Patterns Passage of Light Through Plane Polariscope and Circular Polariscope Isoclinic Fringe Patterns – Compensation Techniques – Calibration Methods – Separation Methods – Scaling Model to Prototype Stresses – Materials for Photoelasticity- Properties of Photo elastic Materials.

Textbooks:

1. Experimental Stress Analysis by J.W.Dally and W.F.Riley, College House Enterprises
2. Experimental Stress Analysis by Dr.Sadhu Singh.Khanna Publishers
3. Abdul Mubeen, "Experimental Stress Analysis", DhanpatRai and Sons, 2001.

REFERENCES:

1. Experimental Stress Analysis by U.C.Jindal, Pearson Pubilications.
2. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers.
3. Moire Fringes in Strain Analysis, PS Theocaris, Pergammon Press, 2002.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	
CO2	2	2	
CO3	3	3	
CO4	2	2	
CO5	2	2	

CO-PO MAPPING JUSTIFICATION:

	Course Outcomes	Program		Level of

Unit No	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL	Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Correlation (0-3)
1	12/60	20	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
2	12/60	20	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2
3	12/60	20	3	Analyze	L4	PO1 PO2	Thumb Rule Thumb Rule	3 3
4	12/60	20	3	Apply	L2	PO1 PO2	Thumb Rule Thumb Rule	2 2 2
5	12/60	20	3	Apply	L3	PO1 PO2	Thumb Rule Thumb Rule	2 2

JUSTIFICATION STATEMENTS:

CO1 Apply the principles, merits and applications of experimental stress analysis and differentiate various methods for simplifying structural problems
CO1 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 2 as moderate (2).

CO2 Apply the concepts of strain measurement using different types of strain gauges
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

CO3 Analyze strain data using strain rosettes through non-destructive testing methods
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).

CO4 Apply the theory of photoelasticity, stress-optic law, polariscope arrangements, and fringe sharpening techniques
CO4 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO4 Action Verb is of BTL 3. Using Thumb rule, L2 correlates PO 2 as moderate (2).

CO5 Apply two-dimensional photoelasticity techniques to interpret fringe patterns
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2006	**PRECAST AND PREFABRICATED STRUCTURES**	**3**	**0**	**0**	**3**

Course Outcomes: After completion of the course, Student will be able to

CO1 Understand the principles and methods of prefabrication
CO2 Analyse the behaviour and design of prefabricated load-carrying members
CO3 Apply knowledge of structural and non-structural joints for precast elements
CO4 Understand production and hoisting technologies for precast components
CO5 Design precast units for buildings and industrial structures for progressive collapse and abnormal load conditions

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	The principles and methods of prefabrication			L2
CO2	Analyse	The behaviour and design of prefabricated load-carrying members			L4
CO3	Apply	Knowledge of structural and non-structural joints		For precast elements	L3
CO4	Understand	Production and hoisting technologies		For precast components	L2
CO5	Design	Precast units for buildings and industrial structures	For progressive collapse and abnormal load conditions		L4

UNIT – I

Need for prefabrication – General Principles of Prefabrication - Comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization–Materials–Modular coordination–Systems–Production –Transportation–Erection.

UNIT – II

Prefabricated Load Carrying Members-Planning for components of prefabricated structures, disuniting of structures, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses, beams, columns, symmetric frames. Behaviour of

structural components – Large panel constructions – Construction of roof and floor slabs–Wall panels–Columns–Shear walls.

UNIT -III

Joints - Joints for different structural connections, effective sealing of joints for water proofing, provisions for non-structural fastenings, expansion joints in precast construction.

UNIT -IV

Production Technology - Choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

UNIT -V

Applications - Designing and detailing of precast UNIT for factory structures, purlins, principal rafters, roof trusses, lattice girders, gable frames, singe span single storied simple frames, single storied buildings, slabs, beams and columns. Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

Textbooks:

1. CBRI, Building materials and components, India,1990
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994
3. Koncz T., Manual of precast concrete construction, Vols. I, II and III, Bauverlag,GMBH, 1971.

REFERENCES:

1. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
2. A Text Book of Shell Analysis–Bairagi, K,Khanna Publisher, New Delhi.
3. Mokk. L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	2	2	2
CO2	3	3	3
CO3	2	2	2
CO4	2	2	2
CO5	3	3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
2	12/60	20	3	Analyse	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
3	12/60	20	3	Apply	L3	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
4	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 2
5	12/60	20	3	Design	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1 Understand the principles and methods of prefabrication
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).

CO2 Analyze the behavior and design of prefabricated load-carrying members
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3).
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).

CO3 Apply knowledge of structural and non-structural joints for precast elements
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as moderate (2).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).

CO4 Understand production and hoisting technologies for precast components
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).

CO5 Design precast units for buildings and industrial structures for progressive collapse and abnormal load conditions
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO5 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2003	**ADVANCED CONCRETE LABORATORY**	**0**	**0**	**4**	**2**

Course Outcomes: After completion of the course, Student will be able to

CO1 Evaluate the fresh and Hardened concrete properties of different grades for conventional concrete specimens
CO2 Evaluate the fresh and hardened concrete properties for high strength grades of concrete
CO3 Evaluate the fresh and hardened properties of self compacting concrete
CO4 Analyze the admixtures effect on fresh properties of concrete
CO5 Evaluate the strength of specimen by NDT methods

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Evaluate	The fresh and Hardened properties of different grades		For conventional concrete specimens	L5
CO2	Evaluate	The fresh and hardened concete properties	For high strength grades	Of concrete	L5
CO3	Evaluate	The fresh and hardened concete properties		of self compacting concrete	L5
CO4	Analyze	The admixtures effect on fresh properties		Of concrete	L4
CO5	Evaluate	The strength of specimen	By NDT methods		L5

List of Experiments:

1. Mix Design and Casting of Conventional Concrete Specimens [M30, M40 & M50] (CO1)
– Fresh properties (workability –slump/vee bee/compaction)
–Hardened properties (Cubes, cylinders, beams)
2. Mix Design and Casting High-Strength Concrete Specimens [M60, M70 & M80] (CO2)

– Fresh properties (workability –slump/vee bee/compaction)
–Hardened properties (Cubes, cylinders, beams).

3. Mix Design and Casting of Self-Compacting - – Cubes, beams, cylinders. (CO3)
– Fresh properties (workability –Flow table test, V-funnel test, L-box ratio)
–Hardened properties (Cubes, cylinders, beams).

4. Effect of Admixtures on Fresh Concrete Properties – Workability, flow, and setting behavior (CO4)
5. Non-Destructive testing- Rebound hammer and Ultra sonic pulse velocity test (CO5)

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Evaluate	L5	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
2				Evaluate	L5	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

3				Evaluate	L5	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
4				Analyze	L4	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
5				Evaluate	L5	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1 Evaluate the fresh and Hardened concrete properties of different grades for conventional concrete specimens.
CO1 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 1 as high (3).
CO1 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 2 as high (3).
CO1 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 3 as high (3).

CO2 Evaluate the fresh and hardened concrete properties for high strength grades of concrete.
CO2 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 2 as high (3).
CO2 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 3 as high (3).

CO3 Evaluate the fresh and hardened properties of self compacting concrete
CO3 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 5. Using Thumb rule, L5 correlates PO 3 as high (3).

CO4 Analyze the admixtures effect on fresh properties of concrete
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 2 as high (3)
CO4 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO 3 as high (3).

CO5 Evaluate the strength of specimen by NDT methods
CO5 Action Verb is of BTL 4. Using Thumb rule, L5 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 4. Using Thumb rule, L5 correlates PO 2 as high (3)
CO5 Action Verb is of BTL 4. Using Thumb rule, L5 correlates PO 3 as high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2004	Computer Aided Design Laboratory	0	0	4	2

Course Outcomes: After completion of the course, Student will be able to

CO1: Design the determinate and indeterminate beams using Excel templates.
CO2: Design of one-way and two-way slabs, plane and space frames under various loading conditions.
CO3: Design of multi-storeyed buildings under various loading conditions.
CO4: Design of roof trusses, rectangular and circular water tanks, and foundations using spreadsheet-based calculations.
CO5: Design of different types of staircases with accurate consideration of loads and geometry.

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Design	the determinate and indeterminate beams	using Excel templates		L6
CO2	Design	of one-way and two-way slabs, plane and space frames	under various loading conditions		L6
CO3	Design	of multi-storeyed buildings	under various loading conditions		L6
CO4	Design	of roof trusses, rectangular and circular water tanks, and foundations	using spreadsheet-based calculations		L6
CO5	Design	of different types of staircases	with accurate consideration of loads and geometry		L6

List of Experiments:

1. Analysis and design of determinate beams with Excel template development-CO1
2. Analysis and design of indeterminate beams with Excel template development-CO1
3. Analysis and design of One way slab beams with Excel template development-CO2
4. Analysis and design of Two way slab beams with Excel template development-CO2
5. Analysis and design of plane frames with Excel template development-CO2

6. Analysis and design of space frames with Excel template development-CO2
7. Analysis and design of a multi-storeyed building subjected to dead load, live load, and wind load-CO3
8. Analysis and design of a multi-storeyed building subjected to dead load, live load, and earthquake load-CO3
9. Analysis and design of King roof trusses including wind load calculation using Excel spreadsheets-CO4
10. Analysis and design of Queen roof trusses including wind load calculation using Excel spreadsheets-CO4
11. Analysis and design of rectangular water tanks with Excel template development-CO4
12. Analysis and design of circular water tanks with Excel template development-CO4
13. Analysis and design of footings and column foundations with Excel template development-CO4
14. Analysis and design of open well type staircases with Excel template development-CO5
15. Analysis and design of dog-legged type staircases with Excel template development-CO5

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
2				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

3				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
4				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3
5				Design	L6	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 3 3

JUSTIFICATION STATEMENTS:

CO1 Design the determinate and indeterminate beams using Excel templates
CO1 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 1 as high (3).
CO1 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 2 as high (3).
CO1 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 3 as high (3).

CO2 Design of one-way and two-way slabs, plane and space frames under various loading conditions
CO2 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 2 as high (3).
CO2 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 3 as high (3).

CO3 Design of multi-storeyed buildings under various loading conditions
CO3 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 1 as high (3).
CO3 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 3 as high (3).

CO4 Design of roof trusses, rectangular and circular water tanks, and foundations using spreadsheet-based calculations
CO4 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 2 as high (3).
CO4 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 3 as high (3).

CO5 Design of different types of staircases with accurate consideration of loads and geometry.
CO5 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 1 as high (3).
CO5 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 2 as high (3).
CO5 Action Verb is of BTL 6. Using Thumb rule, L6 correlates PO 3 as high (3).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

Year: I **Semester: I** **Branch of Study: M.Tech**

Subject code: 25MBA0110	Subject Name: Research Methodology and Intellectual Property Rights	L T P 2 0 0	Credits 2

Course Outcomes: After studying the course, student will be able to :

CO1: Understand various research approaches for different research goals to identify suitable methodologies.

CO2: Analyse various sources and tools and technologies to collect the data.

CO3: Apply statistical methods for analysing data and understand the guidelines for report writing.

CO4: Analyse the safeguarding of business secrets by using various types of Intellectual Property Rights

CO5: Understand the procedure for filling and grant of patent to protect the innovative ideas of the business.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	various research approaches for different research goals.		to identify suitable methodologies	L2
CO2	Analyse	various sources and tools and technologies		to collect the data	L4
CO3	Apply Understand	statistical methods for analysing data the guidelines for report writing			L3 L2
CO4	Analyse	the safeguarding of business secrets	by using various types of Intellectual Property Rights		L4
CO5	Understand	the procedure for filling and grant of patent		to protect the innovative ideas of the business	L2

UNIT – I: FUNDAMENTALS OF RESEARCH METHODOLOGY

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences.

UNIT – II: DATA COLLECTION AND SOURCES

Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection**.**

UNIT – III: DATA ANALYSIS AND REPORTING

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals.

UNIT – IV: UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT – V: PATENTS

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents**.**

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, *Research Methodology: An introduction for Science & Engineering students*, Juta and Company Ltd, 2004
2. Catherine J. Holland, *Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*, Entrepreneur Press, 2007.
1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education 11e (2012).
2. Ranjit Kumar , *Research Methodology: A Step-by-Step Guide for Beginners.* . David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
3. Deborah E. Bouchoux , *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 6th Edition,* Cengage 2024.
4. Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, *The Craft of Research*, 5th Edition, University of Chicago Press, 2024
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
6. Peter Elbow, *Writing With Power*, Oxford University Press, 1998.

Online Resources (Free & Authentic)

- Coursera / edX – Research Methodology and Data Analysis courses
- Springer Link & Science Direct – Latest journals on research design and statistics
- Google Scholar – Free access to research papers
- NCBI Bookshelf – Open-access research methodology resources
- Khan Academy (Statistics & Probability) – For fundamentals of hypothesis testing, regression, and ANOVA.

Course Title	Course Outcomes COs	Programme outcomes (Pos)		
		PO1	PO2	PO3
Research Methodology and Intellectual Property Rights	CO1	2		
	CO2	3		
	CO3	2	2	
	CO4	3		
	CO5	2		

CORRELATION MATRIX

Unit	CO	Progra	PO(s):ActionVerb	Level of

No.	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	m Outcome (PO)	and BTL	Correlation (0-3)
1	14	22.5	3	CO1: Understand	L2	PO1	Thumb Rule	2
2	12	19.4	2	CO2: Analyze	L4	PO1	Thumb Rule	3
3	12	19.4	2	CO3: Apply Understand	L3 L2	PO1 PO2	Thumb Rule Thumb Rule	2 2
4	14	22.6	3	CO4: Analyze	L4	PO1	Thumb Rule	3
5	10	16.1	2	CO5: Understand	L2	PO1	Thumb Rule	2
total	**62**	**100**						

Justification statements:

CO1: Understand various research approaches for different research goals to identify suitable methodologies.
Action Verb: Understand (L2)
PO1: Thumb rule
As using thumb rule, L2 correlates with PO1, Therefore the correlation is medium (2)

CO2: Analyse various sources and tools and technologies to collect the data.
Action Verb: Analyze (L4)
PO1: Thumb rule
As using thumb rule, correlates with PO1, Therefore the correlation is High (3)

CO3: Apply statistical methods for analysing data and understand the guidelines for report writing.
Action Verb : Apply (L3)
PO1: Thumb rule
As using thumb rule, correlates with PO1, Therefore the correlation is medium (2)
Action Verb: Understand (L2)
PO2: Thumb rule
As using thumb rule, L2 correlates with PO2, Therefore the correlation is medium (2)

CO4: Analyse the safeguarding of business secrets by using various types of Intellectual Property Rights.
Action Verb : Analyze (L4)
PO1: Thumb rule
As using thumb rule, correlates with PO1. Therefore the correlation is High (3)

CO5: Understand the procedure for filling and grant of patent to protect the innovative ideas of the business.
Action Verb : Understand(L2)
PO1: Thumb rule

As using thumb rule, correlates with PO1. Therefore the correlation is medium (2)

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DSE2001	**ARTIFICIAL INTELLIGENCE AND APPLICATIONS IN CIVIL ENGINEERING**	**0**	**1**	**2**	**2**

Course Outcomes: After completion of the course, Student will be able to

CO1 Understand the concepts, history and branches of Artificial Intelligence with relevance to civil engineering applications.
CO2 Apply machine learning models and algorithms to solve civil engineering problems.
CO3 Apply artificial neural network and deep learning models for infrastructure and structural engineering applications
CO4 Understand fuzzy logic and expert systems to handle uncertainty in engineering decision-making
CO5 Understand prompt engineering techniques to effectively use AI tools in civil engineering

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	The concepts, history and branches of Artificial Intelligence		With relevance to civil engineering applications	L2
CO2	Apply	Machine learning models and algorithms		To solve civil engineering problems	L3
CO3	Apply	Artificial neural network and deep learning models		For infrastructure and structural engineering applications	L3
CO4	Understand	Fuzzy logic and expert systems		To handle uncertainty in engineering decision-making	L2
CO5	Understand	Prompt engineering techniques		To effectively use AI tools in civil engineering	L2

UNIT – I

Introduction To AI: Introduction to AI, Definition of AI, Historical Evolution of AI, AI Types, Brief Introduction to The Branches of AI, Machine Learning, Natural Language Processing, Computer Vision, Robotics, Expert Systems, Artificial Neural Networks, Evolutionary Computation, Cognitive Computing, And Swarm Intelligence.

UNIT – II

Machine Learning: Introduction to Machine learning-Different Kinds Of Machine Learning, Supervised, Unsupervised, Applications of Different ML Techniques and applications In Civil Engineering.

UNIT -III

Artificial Neural Networks (ANN): Introduction, Biological Noron, Motivation, Appropriate Problems In ANN Learning**, Perceptron's**, The Representational Power of Perceptions, Multilayer Networks, Back Propagation. Applications Of Neural Networks In Highway/ Infrastructure Construction Management And Other Civil Engineering Domains.

UNIT -IV

Uncertainty and Ambiguity, Fuzzy Logic, Linguistic Variables, Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Expert Systems, Fuzzification, Defuzzification, Fuzzy Rules, Fuzzy Inferences. Fuzzy Inference System, Illustrative Examples of Engineering Applications of Fuzzy Logic With Specific Reference to Civil Engineering.

UNIT -V

Introduction to Prompt Engineering: What is Prompt Engineering? A simple introduction to the art of crafting effective instructions (prompts) for Large Language Models (LLMs). Understanding prompts as the way to communicate with and control AI tools. Using LLMs to enhance productivity, automate routine tasks, and aid in problem-solving. The core principles of writing good prompts. • **Clarity and Specificity**: The importance of giving clear, detailed instructions. • **Providing Context**: How to give the AI background information for better results. • **Assigning a Persona**: Telling the AI to "act as" a specific professional (e.g., a structural engineer, a project manager). • **Iterative Refinement**: The process of improving prompts based on AI responses. Practical Applications in Civil Engineering. **Ethical Considerations in AI**: Discussing bias, accountability, and societal impact

TEXTBOOKS:

1. Afaq Ahmad, Nikos D. Langaros, Vagelis Pleveris – **Artificial Intelligence and Machine learning Techniques for Civil Engineers** IGI Global
2. Pijush Samui, Dwarakadas Pralhaddas Kothari, **Artificial Intelligence in Civil Engineering** Lambert Academic Publishing
3. **Introduction to Artificial Intelligence and Machine Learning** by Munesh Chandra Trivedi and Ankit Srivastava, Khanna Publishing House

REFERENCES:

1. Phillip D Wassermann **Neural Computing Theory and Practice**
2. S. Rajasekharan, G A Vijayalakshmi Pai Neural Networks, **Fuzzy Logic And Genetic Algorithms And Its Applications,** PHI Learning
3. **Web Resource**: https://www.kaggle.com/whitepaper-prompt-engineering

CORRELATION OF COS WITH THE POS

	PO1	**PO2**	**PO3**
CO1	3	2	2
CO2	2	3	2
CO3	2	3	2
CO4	3	2	2
CO5	2	2	3

CO-PO MAPPING JUSTIFICATION:

	Course Outcomes	**Program**		**Level of**

Unit No	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL	Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO3)	Correlation (0-3)
1	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 2 2
2	12/60	20	3	Apply	L3	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 3 2
3	12/60	20	3	Apply	L3	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 3 2
4	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	3 2 2
5	12/60	20	3	Understand	L2	PO1 PO2 PO3	Thumb Rule Thumb Rule Thumb Rule	2 2 3

JUSTIFICATION STATEMENTS:

CO1 Understand the concepts, history and branches of Artificial Intelligence with relevance to civil engineering applications
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as high (3).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2)
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).
CO2 Apply machine learning models and algorithms to solve civil engineering problems
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).
CO3 Apply artificial neural network and deep learning models for infrastructure and structural engineering applications
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as moderate (2).
CO4 Understand fuzzy logic and expert systems to handle uncertainty in engineering decision-making
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as high (3).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as moderate (2).
CO5 Understand prompt engineering techniques to effectively use AI tools in civil engineering
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 2 as moderate (2)
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 3 as high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I Year I Semester

Subject Code	Subject Name	L	T	P	CREDITS
25DMC9901	ENGLISH FOR RESEARCH PAPER WRITING	2	0	0	0

Course Outcomes: After completion of the course, Student will be able to

CO1	Understand the key language aspects and structural elements of academic writing in research papers.
CO2	Apply note-making techniques to organize information from academic and research texts.
CO3	Apply correct use of voice, subject–verb agreement, and modifiers to improve sentence accuracy
CO4	Apply editing strategies to improve clarity, coherence, structure, grammar, and spelling in academic writing
CO5	Analyze plagiarism, ethical issues, and fair-use practices using digital tools and awareness strategies.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	The key language aspects and structural elements of academic writing	in research papers		L2
2	Apply	Note-making techniques to organize information		From academic and research texts	L3
3	Apply	Correct use of voice, subject–verb agreement, and modifiers to improve sentence accuracy			L3
4	Apply	Editing strategies to improve clarity, coherence, structure, grammar, and spelling	in academic writing		L3
5	Analyze	Plagiarism, ethical issues, and fair-use practices.		Using digital tools and awareness strategies	L4

UNIT - I Fundamentals of Academic English

Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Word order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings

UNIT - II Reading Skills for Researchers

Reading Academic Texts - Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analyzing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes

UNIT - III Grammar Refinement for Research Writing

Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active- Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences

UNIT - IV Mastery in Refining Written Content/Editing Skills

Effective Revisions - Restructuring Paragraph - Editing vs Proofreading, Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors - Critical and Creative Phases of Writing

UNIT - V Technology and Language for Research

Digital Literacy and Critical Evaluation of Online Content - Technology and Role of AI in Research Writing – Assistance in Generating Citations and References - Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices

TEXTBOOKS:

1. Bailey. S. A*cademic Writing: A Handbook for International Students.* London and New York: Routledge, 2015.
2. Adrian Wallwork, *English for Writing Research Papers*, Springer New York Dordrecht Heidelberg London, 2011.

REFERENCE BOOKS:

1. 1.Craswell, G. *Writing for Academic Success,* Sage Publications, 2004.
2. 2.Peter Elbow, *Writing With Power, E-book*, Oxford University Press, 2007
3. Oshima, A. & Hogue, A. *Writing Academic English*, Addison-Wesley, New York, 2005
4. Swales, J. & C. Feak, Academic Writing for Graduate Students: Essential Skills and Tasks. Michigan University Press, 2012.
5. 5.Goldbort R.*Writing for Science*, Yale University Press (available on Google Books), 2006
6. 6. Day R.*How to Write and Publish a Scientific Paper*, Cambridge University Press, 2006

Online Learning Resources:

1. 1.https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge04/
2. 2.https://onlinecourses.swayam2.ac.in/ntr24_ed15/preview
3. 3.. "Writing in the Sciences" – Stanford University (MOOC on Coursera)
   https://www.coursera.org/learn/sciwrite
4. Academic Phrasebank – University of Manchester
5. http://www.phrasebank.manchester.ac.uk
6. 5. OWL (Online Writing Lab) – Purdue University, https://owl.purdue.edu
7. *(Resources on APA/MLA formats, grammar, structure, paraphrasing)*
7. Zotero or Mendeley (Reference Management Tools) – Useful for managing citations and sources.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	3	3	
CO2	3	3	
CO3	2	3	
CO4	2	3	
CO5	2	3	

JUSTIFICATION STATEMENTS:

CO1 Understand the key language aspects and structural elements of academic writing in research papers.
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as high (3).
CO1 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3)

CO2 Apply note-making techniques to organize information from academic and research textsCO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 1 as high (3).
CO2 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3)

CO3 Apply correct use of voice, subject–verb agreement, and modifiers to improve sentence accuracy
CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).

CO4 Apply editing strategies to improve clarity, coherence, structure, grammar, and spelling in academic writing
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO4 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).

CO5 Analyze plagiarism, ethical issues, and fair-use practices using digital tools and awareness strategies.
CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DMC2001	DISASTER MANAGEMENT	2	0	0	0

Course Outcomes: After completion of the course, Student will be able to

CO1 understand hazards and disasters, their classifications based on type and nature and their impacts on people
CO2 Understand map disaster-prone areas in India and epidemiological consequences of disasters.
CO3 Understand disaster preparedness through monitoring and risk evaluation
CO4 Understand disaster risk, its reduction, assessment techniques, global cooperation and survival strategies
CO5 Understand disaster mitigation concepts, strategies, trends and related programs in India

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	Hazards and disasters, their classifications		Based on type and nature and their impacts on people	L2
CO2	Understand	Map disaster-prone areas in India		Epidemiological consequences of disasters	L2
CO3	Understand	Disaster preparedness	Through monitoring and risk evaluation		L2
CO4	Understand	Disaster risk, its reduction, assessment techniques, global cooperation and survival strategies			L2
CO5	Understand	Disaster mitigation concepts, strategies, trends and related programs		In India	L2

UNIT – I Introduction

Disaster - Definition, Factors and Significance - Difference Between Hazard and Disaster - Natural and Man-made Disasters - Difference, Nature, Types and Magnitude - Disaster Prone Areas in India - Study of Seismic Zones - Areas Prone to Floods and Droughts,

Landslides and Avalanches - Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami - Post-Disaster Diseases and Epidemics.

UNIT – II Repercussions of Disasters and Hazards

Economic Damage - Loss of Human and Animal Life - Destruction of Ecosystem - Natural Disasters - Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster - Nuclear Reactor Meltdown - Industrial Accidents - Oil Slick sand Spills - Outbreaks of Disease and Epidemics War and Conflicts

UNIT -III Disaster Preparedness and Management

Preparedness - Monitoring of Phenomena - Triggering a Disasteror Hazard - Evaluation of Risk-Application of Remote Sensing - Data from Meteorological and Other Agencies - Media Reports-Governmental and Community Preparedness

UNIT -IV Risk Assessment

Disaster Risk -Concept and Elements, Disaster Risk Reduction - Global and National Disaster Risk Situation -Techniques of Risk Assessment – Global Co-Operation in Risk Assessment and Warning - People's participation in Risk Assessment – Strategies for Survival

UNIT -V Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation - EmergingTrends in Mitigation - Structural Mitigation and Non- Structural Mitigation - Programs of Disaster Mitigation in India

TEXTBOOKS:

1. Gupta, H. K. Disaster Management. Universities Press, 2003
2. Singh, R. B. Natural Hazards and Disaster Management. Rawat Publications, 2006

REFERENCES:

1. Coppola, D. P. (2020). Introduction to International Disaster Management (4th ed.). Elsevier.
2. Shaw, R., & Izumi, T. (2022). Science and Technology in Disaster Risk Reduction in Asia. Springer.
3. Wisner, B., Gaillard, J. C., & Kelman, I. (2021). Handbook of Hazards and Disaster Risk Reduction and Management (2nd ed.). Routledge.
4. Saini, V. K. (2021). Disaster Management in India: Policy, Issues and Perspectives. Sage India.
5. Kelman, I. Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes, Oxford University Press, 2022
6. Sahni, P. & Dhameja, A. Disaster Mitigation: Experiences and Reflections. Prentice Hall of India, 2004.

CORRELATION OF COS WITH THE POS

	PO1	PO2	PO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	2	2	2

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s):Action Verb and BTL(for PO1 to PO3)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	12/60	20	3	Understand	L2	PO1	Thumb Rule	2
2	12/60	20	3	Understand	L2	PO1	Thumb Rule	2
3	12/60	20	3	Understand	L2	PO1	Thumb Rule	2
4	12/60	20	3	Understand	L2	PO1	Thumb Rule	2
5	12/60	20	2	Understand	L2	PO1	Thumb Rule	2

JUSTIFICATION STATEMENTS:

CO1 Understand hazards and disasters, their classifications based on type and nature and their impacts on people
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO2 Understand map disaster-prone areas in India and epidemiological consequences of disasters
CO2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO3 Understand disaster preparedness through monitoring and risk evaluation
CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO4 Understand disaster risk, its reduction, assessment techniques, global cooperation and survival strategies
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO5 Understand disaster mitigation concepts, strategies, trends and related programs in India
CO5 Action Verb is of BTL 2. Using Thumb rule, L3 correlates PO 1 as moderate (2).
CO5 Action Verb is of BTL 2. Using Thumb rule, L3 correlates PO 2 as moderate (2).

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR I SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DMC29902	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2	0	0	0

Course Outcomes: After completion of the course, Student will be able to

COURSE OUTCOMES: At the end of the course, students will be able to	
CO1	Understand the concept of traditional knowledge, its nature, characteristics, and scope
CO2	Understand the need for protecting traditional knowledge and its significance in the global economy
CO3	Analyze the legal framework and policies related to traditional knowledge protection
CO4	Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology
CO5	Analyze the relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	The concept of traditional knowledge, its nature, characteristics, and scope			L2
CO2	Understand	The need for protecting traditional knowledge and its significance		In the global economy	L2
CO3	Analyze	The legal framework and policies	Related to traditional knowledge protection		L4
CO4	Apply	Traditional knowledge in different sectors	Such as engineering, medicine, agriculture, and biotechnology		L3
CO5	Analyze	the relationship between traditional			L4

		knowledge and intellectual property rights, including patents and non-IPR mechanisms			

Unit-I: Introduction to traditional knowledge - Definition, Nature and characteristics, scope and importance - Kinds of traditional knowledge - Physical and social contexts in which traditional knowledge develop - Historical impact of social change on traditional knowledge systems - Indigenous Knowledge (IK) – Characteristics - traditional knowledge vis-à-vis indigenous knowledge -Traditional knowledge Vs western knowledge, traditional knowledge vis-à-vis formal knowledge

Unit-II: Protection of traditional knowledge- Need for protecting traditional knowledge - Significance of TK Protection - Value of TK in global economy - Role of Government to harness TK.

Unit-III: Legal frame work and TK - A)The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 - Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act) – B)The Biological Diversity Act 2002 and Rules 2004 - the protection of traditional knowledge bill, 2016 - Geographical Indicators Act 2003.

Unit-IV: Traditional knowledge and Intellectual property - Systems of traditional knowledge protection - Legal concepts for the protection of traditional knowledge - Certain non-IPR mechanisms of traditional knowledge protection - Patents and traditional knowledge - Strategies to increase protection of traditional knowledge -Global legal FORA for increasing protection of Indian Traditional Knowledge.

Unit-V: Traditional knowledge in different sectors - Traditional knowledge and Engineering - Traditional medicine system - TK and Biotechnology - TK in Agriculture - Traditional societies depend on it for their food and healthcare needs - Importance of conservation and sustainable development of environment - Management of biodiversity, Food security of the country and protection of TK

Prescribed Books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. *Introduction to Indian Knowledge System: Concepts and Applications*, PHI Learning Pvt.Ltd. Delhi, 2022.
2. Basanta Kumar Mohanta and Vipin Kumar Singh,*Traditional Knowledge System and Technology in India,* PratibhaPrakashan 2012.

Reference Books

1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
2. Kak, S.C. "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), 1987

3. Subbarayappa, B.V. and Sarma, K.V. *Indian Astronomy: A Source Book*, Nehru Centre, Mumbai, 1985.
4. Bag, A.K. *History of Technology in India*, Vol. I, Indian National Science Academy, New Delhi, 1997.
5. Acarya, P.K. *Indian Architecture*, Munshiram Manoharlal Publishers, New Delhi, 1996.
6. Banerjea, P. *Public Administration in Ancient India,* Macmillan, London, 1961.
7. Kapoor Kapil, Singh Avadhesh,*Indian Knowledge Systems Vol – I & II,* Indian Institute of Advanced Study ,Shimla ,H.P., 2022

E-Resources:
1.https://www.youtube.com/watch?v=LZP1StpYEPM 2.http://nptel.ac.in/courses/121106003/

CORRELATION OF COS WITH THE POS

	PO1	**PO2**	**PO3**
CO1	1		
CO2	1		
CO3	2	3	
CO4	2		
CO5	3		

JUSTIFICATION STATEMENTS:

CO1 Understand the concept of traditional knowledge, its nature, characteristics, and scope

CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as low (1).

CO2 Understand the need for protecting traditional knowledge and its significance in the global economy

CO2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as low (1)

CO3 Analyze the legal framework and policies related to traditional knowledge protection

CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO3 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 2 as high (3).

CO4 Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology

CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO 1 as moderate (2).

CO5 Analyze the relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

CO5 Action Verb is of BTL 3. Using Thumb rule, L3 correlates PO 3 as high (3).

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II-SEMESTER

S.No.	Course codes	Course Name	Category	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P				
1.	25DPC2005	Structural Dynamics	PC	3	0	0	3	40	60	100
2.	25DPC2006	Stability of Structures	PC	3	0	0	3	40	60	100
3.	**Program Elective – III**		PE	3	0	0	3	40	60	100
	25DPE2007	Finite Element Methods for Structural Engineering								
	25DPE2008	Advanced Steel Structures Design								
	25DPE2009	Theory of Plates and Shells								
4.	**Program Elective – IV**		PE	3	0	0	3	40	60	100
	25DPE2010	Design of Prestressed Concrete								
	25DPE2011	Design of Bridges								
	25DPE2012	Structural Health Monitoring								
5.	25DPC2007	Advanced Structural Engineering Laboratory	PC	0	0	4	2	40	60	100
6.	25DPC2008	Advanced Structural Analysis and Design Laboratory	PC	0	0	4	2	40	60	100
7.	25DMC5801	Quantum Technologies And Applications	MC	2	0	0	2	30		30
8.	25DPC2009	Comprehensive Viva Voce	PC	0	0	0	2	100		100
9.	25DMC2004 25DMC2005 25DMC2006 25DMC2007	Audit Course – II Constitution of India Pedagogy Studies Stress Management by Yoga Personality Development through Life Enlightenment Skills.	AC	2	0	0	0	30		30
Total							20	400	360	760

****Students must undergo an Industry Internship after I Year II Semester for a duration of 6 to 8 weeks that will be evaluated in III semester.**

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2005	STRUCTURAL DYNAMICS	3	0	0	3

UNIT-I

Theory Of Vibrations: Introduction –Elements Of A Vibratory System – Degrees Of Freedom-Continuous Systems –Lumped Mass Idealization –Oscillatory Motion –Simple Harmonic Motion –Pictorial Representation Of S.H.M - Free Vibrations Of Single Degree Of Freedom (SDOF) Systems –Undamped And Damped –Critical Damping –Logarithmic Decrement –Forced Vibrations Of SDOF Systems-Harmonic Excitation –Dynamic Magnification Factor- Bandwidth. Fundamental Objective Of Dynamic Analysis-Types Of Prescribed Loading- Methods Of Discretization- Formulation Of The Equations Of Motion.

UNIT-II

Single Degree Of Freedom System: Formulation And Solutions Of The Equation Of Motion - Free Vibration Response –Response To Harmonic, Periodic, Impulsive And General Dynamic Loading –Duhamel Integral

UNIT-III

Multi Degree Of Freedom System: Selection Of The Degree Of Freedom –Evaluation Of Structural Property Matrices-Formulation Of The MDOF Equations Of Motion –Undamped Free Vibrations-Solution Of Eigen Value Problem For Natural Frequencies And Mode Shapes-Analysis Of Dynamic Response –Normal Coordinates –Uncoupled Equations Of Motion –Orthogonal Properties Of Normal Modes-Mode Superposition Procedure

UNIT-IV

Practical Vibration Analysis: Stodola Method- Fundamental Mode Analysis –Analysis of Second and Higher Modes –Holzer's Method –Basic Procedure –Transfer Matrix Procedure

UNIT-V

Introduction To Earthquake Analysis: Introduction –Excitation By Rigid Base Translation –Lumped Mass Approach -SDOF And MDOF System- I.S Code Methods Of Analysis. Continuous System: Introduction –Flexural Vibrations Of Beams- Elementary CaseEquation Of Motion –Analysis Of Undamped Free Shapes Of Simple Beams With Different End Conditions-Principles Of Application To Continuous Beams.

REFERENCES:

1. Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.

3. Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
4. Dynamics of Structures, Humar J. L., Prentice Hall. 5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2006	STABILITY OF STRUCTURES	3	0	0	3

UNIT – I:

Beam Columns: Stability, Strength, and Stiffness, Concept of Stability, Differential Equation for Beam Columns –Beam Column with Concentrated Loads Continuous Lateral Load –Couples -Beam Column with Built in Ends – Continuous Beams with Axial Load.

UNIT – II:

Elastic Buckling of bars: Elastic Buckling of Straight Columns –Effect of Shear Stress on Buckling-Eccentrically and Laterally Loaded Columns, Buckling of A Bar with Intermediate Compressive Forces, Effect of Shear Force on Critical Load –Built Up Columns.

UNIT – III:

Energy Methods: Buckling of a Bar on Elastic Foundation, Distributed Axial Loads Buckling of Bars with varying Cross Section.

UNIT – IV:

Mathematical Treatment of Stability Problems: Buckling Problem Orthogonality Relation –Ritz Method-Timoshenko Method, Galerkin Method

UNIT -V:

Lateral Buckling of Simply Supported Beams and Rectangular Plates: Beams of Rectangular Cross Section Subjected for Pure Bending. Derivation Of Equation of Rectangular Plate Subjected to Constant Compression in Two Directions and One Direction.

REFERENCES:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Theory of Beam Columns Vol I by Chen & Atsuta Mc.Graw Hill.
4. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York.
5. Stability of Metalic Structure by Bleich, Mc Graw Hill

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2007	FINITE ELEMENT METHODS FOR STRUCTURAL ENGINEERING	3	0	0	3

UNIT – I

Introduction-Concepts Of FEM –Steps Involved –Merits &Demerits –Energy Principles Discretization –Rayleigh –Ritz Method Of Functional Approximation. Elastic Formulations: Stress Equations-Strain Displacement Relationships in Matrix FormPlane Stress, Plane Strain AndAxi-Symmetric Bodies Of Revolution With Axi Symmetric Loading

UNIT – II

One Dimensional FEM-Stiffness Matrix For Beam And Bar Elements Shape Functions For ID Elements –Static Condensation Of Global Stiffness Matrix- Solution –Initial Strain And Temperature Effects- Numerical Integration Techniques.

UNIT – III

Two Dimensional FEM - Different Types of Elements For Plane Stress And Plane Strain Analysis – Displacement Models –Generalized Coordinates-Shape Functions-Convergent And Compatibility Requirements –Geometric Invariance – Natural Coordinate System-Area And Volume Coordinates-Generation Of Element Stiffness And Nodal Load Matrices –Static Condensation.

UNIT – IV

Isoparametric Formulation - Concept, Different Isoparametric Elements For 2D AnalysisFormulation Of 4-Noded And 8-Noded Isoparametric Quadrilateral Elements –Lagrangian Elements-Serendipity Elements. Axi Symmetric Modelling –Strain Displacement Relationship-Formulation OfAxi Symmetric Elements.

UNIT -V

Three Dimensional FEM: Different 3-D Elements, 3D Strain –Displacement Relationship-Formulation of Hexahedral And Isoparametric Solid Element.

REFERENCES:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005. 1. A First course in Finite element method by Daryl Logan, Third edition, Thomson Asia publishers, 2002.
2. Finite element analysis by S.S.Bhavikatti, Third edition, New Age International Publishers, 2015.
3. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
4. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
5. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2008	**ADVANCED STEEL STRUCTURES DESIGN**	**3**	**0**	**0**	**3**

UNIT – I

Design of Steel Structures: Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift

UNIT – II

Stability of Beams: Local Buckling of Compression Flange &Web, Lateral Torsional Buckling.

UNIT – III

Stability of Columns: Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.

UNIT – IV

Method of Designs: Allowable Stress Design, Plastic Design, Load and Resistance Factor Design.

UNIT -V

Strength Criteria: Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor,Effective Length,PM Interaction, Biaxial Bending, Joint Panel Zones. Connections:Welded, Bolted, Location Beam Column, Column Foundation, Splices

REFERENCES:

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
3. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., HeymanJ., ELBS.
4. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
5. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
6. SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2009	THEORY OF PLATES AND SHELLS	3	0	0	3

UNIT – I

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT – II

Static Analysis of Plates: Governing Equation for a Rectangular Plate, Navier Solution for Simply-Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT – III

Circular Plates: Analysis under Axis- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT – IV

Static Analysis of Shells: Membrane Theory of Shells - Cylindrical, Thermal Stresses in Plate/ Shell

UNIT -V

Shells of Revolution with Bending Resistance: Cylindrical Shells, Application to Pipes and Pressure Vessels.

REFERENCES:

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.
3. Thin Elastic Shells, KrausH., John Wiley and Sons.
4. Theory of Plates, Chandra shekhara K., Universities Press.
5. Design and Construction of Concrete Shells, Rama swamy G.S.

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2010	DESIGN OF PRESTRESSED CONCRETE	3	0	0	3

UNIT – I

Introduction to prestressed concrete: Development of Prestressed Concrete –Advantages and Disadvantages of PSC over RCC –General Principles of Pre-Stressing-Pre Tensioning and Post Tensioning –Materials Used In PSC-High Strength Concrete –High Tension Steel Different Types /Methods/Systems of Prestressing.

UNIT – II

Losses Of Prestress: Estimation of the Loss of Prestress due to various causes like Elastic Shortening of Concrete, Creep of Concrete, Shrinkage of concrete, Relaxation of Steel, Slip in Anchorage, Friction Etc.

UNIT – III

Flexure & Deflections: Analysis of Sections for Flexure in Accordance with Elastic Theory-Allowable Stresses-Design Criteria as Per I.S Code of Practice –Elastic Design of Beams (Rectangular, I And T Sections) For Flexure –Introduction to Partial Prestressing.

UNIT – IV

Shear, Bond, Bearing and Anchorage: Shear in PSC Beams –Principal Stresses Conventional Elastic Design for Shear-Transfer of Prestress in Pre-tensioned Members Transmission Length –Bond Stresses-Bearing at Anchorage – Anchorage Zone Stresses in Post-Tensioned Members.

UNIT-V

DESIGN OF TENSION AND COMPRESSION MEMBERS Design of tension members-application in the design of prestressed pipes and prestressed concrete cylindrical water tanks.

REFERENCES:

1. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981
2. Prestressed Concrete By S. Ramamrutham, Dhanpati Rai Pubilicartions.
3. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2011	DESIGN OF BRIDGES	3	0	0	3

UNIT – I

Introduction – Classification, Investigations And Planning, Choice Of Type – Economic Span Length – IRC Specifications For Road Bridges, Standard Live Loads, Other Forces Acting On Bridges, General Design Considerations.

UNIT – II

Design of Box Culverts – General Aspects – Design Loads – Design Moments, Shears And Thrusts – Design Of Critical Section. Design of Slab Bridges – Effective Width of Analysis – Workings Stress Design And Detailing of Slab Bridges For IRC Loading.

UNIT – III

T-Beam Bridges – Introduction – Wheel Load Analysis – B.M. In Slab – Pigaud's Theory – Analysis of Longitudinal Girders by Courbon's Theory Working Stress Design And Detailing of Reinforced Concrete T-Beam Bridges For IRC Loading.

UNIT – IV

Prestressed Concrete Bridges – General Features – Advantages Of Prestressed Concrete Bridges – Pre-tensioned Prestressed Concrete Bridges – Post Tensioned Prestressed Concrete Bridge Decks. Design of Post Tensioned Prestressed Concrete Slab Bridge Deck. Bridge Bearings – General Features – Types Of Bearings – Forces On Bearings Basis For Selection Of Bearings – Design Principles Of Steel Rocker And Roller Bearings And Its Design – Design Of Elastometric Pad Bearing Detailing Of Elastomeric Pot Bearings.

UNIT-V

Piers and Abutments – General Features – Bed Block – Materials For Piers And Abutments – Types Of Piers – Forces Acting On Piers – Design Of Pier – Stability Analysis Of Piers – General Features Of Abutments – Forces Acting On Abutments – Stability Analysis Of Abutments.

REFERENCES:

1. Essentials Of Bridges Engineering – D.Hohnson Victor Oxford & IBH Publishers CoPrivate Ltd.
2. Design Of Concrete Bridges MC Aswanin VN Vazrani, MM Ratwani, Khanna Publishers.
3. Bridge Engineering – S.Ponnuswamy.

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPE2012	STRUCTURAL HEALTH MONITORING	3	0	0	3

UNIT I

Introduction - Definition of SHM – Classification, Types and Components of SHM – Advantagesand Benefits of SHM.

UNIT II

Sensing Technologies: Strain Measurement – LVDT – Temperature Sensors – Fiber Optic Sensing Technology - DIC. Methodology : Sensors – Selection of Sensors – Installation and placement – Data acquisition

UNIT III

Communication – Processing and Analysis – Staorage – Dianostics and Prognostics – Retrievalof data.

UNIT IV

Testing: Static Field Testing – Dynamic field testing - Stress history data - Dynamic load allowance tests - Ambient vibration tests - Forced Vibration Method - Dynamic response methods Data Acquisition: Static data acquisition systems - Dynamic data acquisition systems - Components of Data acquisition system - Hardware for Remote data acquisition systems.

UNIT V

Remote Structural health monitoring: Remote Structural Health Monitoring - Importance and Advantages – Methodology – IoT applications in SHM – Application Machine leaning Techniques in SHM.

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I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2007	**ADVANCED STRUCTURAL ENGINEERING LABORATORY**	**0**	**0**	**4**	**3**

LIST OF EXPERIMENTS/ASSIGNMENTS:

DESIGN OF STRUCTURES USING SOFTWARE

1. Analysis of Cantilever, Simply Supported Beam, Fixed Beams, Continuous Beams for Different Loading Conditions.
2. Analysis and design of plane and space frame
3. Analysis and Design of plane and space truss
4. Analysis, design and detailing of a multistoried building and Preparation of detailed drawings of different structural elements
5. Wind analysis on tall structure
6. Analysis and Design of steel transmission line tower

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DPC2008	**ADVANCED STRUCTURAL ANALYSIS AND DESIGN LABORATORY**	**0**	**0**	**4**	**3**

LIST OF EXPERIMENTS:

1. Dynamic analysis of tall buildings
2. Analysis and design of bridge girder
3. Analysis of Cylindrical shell
4. Analysis and Design of Water Tanks.
5. Design of Raft, Combined, Isolated foundations.
6. Analysis and Design of prestressed concrete continuous slab
7. Analysis and Design of prestressed concrete continuous beam

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M. Tech - Structural Engineering **AK25 REGULATIONS**

I YEAR II SEMESTER

Subject Code	Subject Name	L	T	P	CREDITS
25DMC5801	**QUANTUM TECHNOLOGIES AND APPLICATIONS**	**2**	**0**	**0**	**2**

UNIT 1: INTRODUCTION TO QUANTUM THEORY AND TECHNOLOGIES

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison, Quantum states and measurement: nature of observation, Overview of quantum systems: electrons, photons, atoms, The concept of quantization: discrete energy levels, Why quantum? Strategic, scientific, and technological significance, A snapshot of quantum technologies: Computing, Communication, and Sensing, National and global quantum missions: India's Quantum Mission, EU, USA, China

UNIT 2: THEORETICAL STRUCTURE OF QUANTUM INFORMATION SYSTEMS

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract, The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences, Philosophical implications: randomness, determinism, and observer role

UNIT 3: BUILDING A QUANTUM COMPUTER – THEORETICAL CHALLENGES AND REQUIREMENTS

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:
Why maintaining entanglement is difficult, Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison), Superconducting circuits, Trapped ions, Photonics, Visions reality: what's working and what remains elusive, The role of quantum software in managing theoretical complexities

UNIT 4: QUANTUM COMMUNICATION AND COMPUTING – THEORETICAL PERSPECTIVE

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD), Role of Entanglement in Communication, The Idea of the Quantum Internet – Secure Global Networking, Introduction to Quantum Computing, Quantum Parallelism (Many States at Once), Classical vs Quantum Gates, Challenges: Decoherence and Error Correction, Real-World Importance and Future Potential

UNIT 5: APPLICATIONS, USE CASES, AND THE QUANTUM FUTURE

Real-world application domains: Healthcare (drug discovery), Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum, Ethical, societal, and policy considerations, Challenges to adoption: cost,

skills, standardization, Emerging careers in quantum: roles, skillsets, and preparation pathways, Educational and research landscape – India's opportunity in the global quantum race

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
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