COURSE STRUCTURE

AND

DETAILED SYLLABUS

FOR

M.TECH

(STRUCTURAL ENGINEERING)

REGULAR

2015 – Regulations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY

COLLEGE OF ENGINEERING (AUTONOMOUS)

ANANTAPUR – 515 002 (A.P.)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY
COLLEGE OF ENGINEERING :: (AUTONOMOUS)
ANANTAPUR
CIVIL ENGINEERING DEPARTMENT
Curriculum & Course Structure
For M.Tech Course (Structural Engineering)
For the batches admitted from 2015

I SEMESTER:

Code	Subject	L	P	C
15D10101	Advanced Mathematical Methods	4	0	4
15D11101	Matrix Methods of Structural Analysis	4	0	4
15D11102	Theory of Elasticity	4	0	4
15D11103	Theory and Analysis of Plates	4	0	4
	Elective – I	4	0	4
15D11104	Experimental Stress Analysis			
15D11105	Advanced Reinforced Concrete Design			
15D11106	Cost Effective Housing Techniques			
	Elective – II	4	4	2
15D11107	Prestressed concrete			
15D11108	Maintenance and Rehabilitation of Structures			
15D11109	Advanced Foundation Engineering			
15D11110	Advanced Concrete Laboratory	0	4	26

II SEMESTER:

Code	Subject	L	P	C
15D11201	Structural Dynamics	4	0	4
15D11202	Finite Element Analysis of Structures	4	0	4
15D11203	Stability of Structures	4	0	4
15D11204	Analysis of shells and folded plates	4	0	4
	Elective – III	4	0	4
15D11205	1. Design of Bridges			
15D11206	2. Advanced Concrete Technology			
15D11207	3. Earthquake Resistant Structures			
	Elective – IV	4	0	4
15D11208	1. Advanced structural Steel Design			
15D11209	2. Building Construction Management			
15D11210	3. Fracture Mechanics			
15D54201	Research Methodology (Audit Course)	2	0	0
15D11211	CAD Laboratory	0	4	2

III & IV SEMESTERS:

Code	Subject	L	P	C
15D11301	III Semester Seminar – I	0	4	2
15D11401	IV Semester Seminar – II	0	4	2
15D11302	III & IV Semester Project work	--	--	44
		0	8	48

Note :All End Examinations (Theory and Practical)are of three hours duration.

T-Tutorial L-Theory P-Practical/Drawing C-Credits

L	P	C
4	0	4

Subject Code:15D10101

M.Tech
(STRUCTURAL ENGINEERING)
ADVANCED MATHEMATICAL METHODS

First Semester

UNIT-I

Calculus of variation-Concepts of maxima and minima of functions-constraints and Lagrange's multipliers-Extreme value of functional-Euler's equations – solutions of Euler's equation. Hamilton principal- Lagrange equations generalized dynamic excitations – constraints in dynamical systems.

UNIT-II

Numerical solution of ordinary differential equations Taylor series method, Picard's method, Euler's method modified Euler's method & R.K.method. Eigen values and Eigen vectors – general method – Power method, spectral method.

UNIT-III

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 – Parabolic equations bender –Schmidt method-bender - Schmidt recurrence equation, crank-Nicholson difference method.

UNIT-V

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.

TEXT/REFERENCE BOOKS:

1. Numerical methods for Engineers by Steven C.Chapra and Raymond P.Canale – Mc Graw Hill Book Company.
2. Applied numerical analysis by Curtis. F.Gerald- Addeson Wesely Publishing Company.
3. Higher Engineering mathematics by B.S. Grewal Khanna Publishers.
4. C-Language and numerical methods by C-Xavier. New Age International publishers.
5. Computational methods for partial differential equations by M.K.Jain, SKR Lyengar, R.K.Jain.

L	P	C
4	0	4

Subject Code:15D11101

M.Tech
(STRUCTURAL ENGINEERING)
MATRIX METHODS OF STRUCTURAL ANALYSIS

First Semester

1. **INTRODUCTION:-**Indeterminacy-Determination of static and kinematic indeterminacies of two-dimensional and three-dimensional portal frames, pin jointed trusses and hybrid frames-coordinate systems –structural idealization. Introduction To Matrix Methods Of Analysis-Flexibility and stiffness matrices-Force displacement relationships for axial force, couple, torsional moments – stiffness method of analysis and flexibility method of analysis.

2. **ANALYSIS OF CONTINUOUS BEAMS**- stiffness method and flexibility method of analysis –continuous beams of two and three spans with different end conditions-internal hinges.

3. **ANALYSIS OF TWO DIMENSIONAL PORTAL FRAMES & PINJOINTED TRUSSES** – stiffness and flexibility method of analysis of 2D portal frames with different end conditions-plotting of bending moment diagrams. Computation of joint displacement and member forces for pinjointed trusses.

4. **TRANSFORMATION OF CO-ORDINATES** - Local and Global co-ordinate systems-transformation of matrices from local to global coordinates of element stiffness matrix-direct stiffness method of analysis-assembly of global stiffness matrix from element stiffness matrices –static condensation-sub-structuring.

5. **EQUATION SOLVERS-**solution of system of linear algebraic equations-direct inversion method-gauss elimination method-Cholesky method-banded equation solvers-frontal solution technique.

TEXT/REFERENCE BOOKS :

1. Structural Analysis by Pundit & Gupta, Tata MC Graw Hill Book company.
2. Structural Analysis by C.S.Reddy, Tata MC Graw Hill Book company
3. Cotes, R.C., Couties, M.G., and Kong, F.K., Structural Analysis, ELBS.
4. MC.Guire, W.,and Gallagher, R.H., Matrix Structural analysis, John Wiley and sons.
5. John L.Meek., Matrix Strucstural Analysis, MC Graw Hill Book company.
6. Structural Analysis – R.C.Hibbeler, Pearson Education

L	P	C
4	0	4

Subject Code: 15D11102

M.Tech
(STRUCTURAL ENGINEERING)
First Semester

THEORY OF ELASTICITY

1. **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- Compatability equations-stress function-Boundary conditions.

2. **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.

3. **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.

4. **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.

5. **TORSION OF PRISMATICAL BARS:**
   Torsion of prismatic bars- Elliptical cross section-other elementary solutions-membrane anology-Torsion of rectangular bars-solution of torsional problems by energy method-use of soap films in solving torsionol problems-hydra dyanmical analogies-Torsion of shafts, tubes, bars etc.

TEXT/REFERENCE BOOKS :

1. Theory of Elasticity and Plasticity by Timoshenko, S., MC Graw Hill Book company.
2. Advnced Strength of materials by Papoov, MC Graw Hill Book company.
3. Theory of Elasticity and Plasticity by Sadhu Singh. Khanna Publishers.
4. Chen, W.F. and Han, D.J.Plasticity for structural Engineers, Springer – Verlag, New York.
5. Lubliner, J., Plasticity theory, Mac Millan Publishing Co., New York.
6. Foundations of Solid Mechanics by Y.C.Fung, PHI Publications.
7. Advanced Mechanics of Solids by L.S. Srinath, Tata MC Graw Hill Book company.

L	P	C
4	0	4

Subject Code:15D11103

M.Tech (Structural Engineering)

THEORY AND ANALYSIS OF PLATES
First Semester

1. **DERIVATION OF PLATE EQUATIONS FOR RECTANGULAR PLATES –**In plane bending and transverse bending effects.Plates under various loading conditions like concentrated, U.D.L and hydrostatic pressure- Navier and Levy's type of solutions for various boundary conditions.

2. **CIRCULAR PLATES:** Symmetrically loaded, circular plates under various loading conditions, annular plates.

3. **PLATES UNDER SIMULTANEOUS BENDING AND STRECTHING:** Derivation of the governing equation and application to simple cases.

4. **ORTHOTROPIC PLATES:** Derivation of the governing equation, applications to grillage problems as equivalent orthotropic plates.

5. **NUMERICAL AND APPROXIMATE METHODS: E**nergy solutions by variational methods, finite difference and finite element methods of analysis for plate problems.Study of few simple cases for large deflection theory of plates .

REFERENCE BOOKS:

1. Timoshenko, S., and Krieger, S.W., Theory of plates and shells, Mc Graw Hill Book company.
2. Theory of plates by Chandrashekhara, K, Universities Press ltd
3. Szilard, R., Theory and Analysis of Plates, Prentice Hall Inc.
4. N.K.Bairagi, Plate analysis, Khanna Publishers, Delhi, 1986.

L	P	C
4	0	4

Subject Code:15D11104

M.Tech(STRUCTURAL ENGINEERING)
EXPERIMENTAL STRESS ANALYSIS
(Elective-I)
First Semester

1. **PRINCIPLES OF EXPERIMENTAL APPROACH :-**
   Merits of Experimental Analysis Introduction, uses of experimental stress analysis advantages of experimental stress analysis, Different methods –Simplification of problems.
2. **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..
3. **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.
4. **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.
5. **TWO DIMENSIONAL PHOTOELASTICITY :-**
   Introduction – Isochramic 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 photo – Elasticity Properties of Photoelastic Materials.

Reference Books :-

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.Experimental Stress analysis by U.C.Jindal, Pearson Pubilications.
4. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers.

L	P	C
4	0	4

Subject Code:15D11105

M.Tech (STRUCTURAL ENGINEERING)
(ELECTIVE – I)
ADVANCED REINFORCED CONCRETE DESIGN

1. **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 continues beams by IS 456 - Deflection of Cantilevers - Deflection of Slabs.**Estimation of Crackwidth in Reinforced Concrete Members:**Introduction - Factors affecting Crackwidth in beams - Mechanism of Flexural cracking Calculation of crack widths - Simple Empirical method - Estimation of Crackwidth in -beams by IS 456 of BS 8110 - Shrinkage and Thermal Cracking
2. **Design of Reinforced Concrete 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
3. **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.
4. **Design of plain concrete walls & 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 wallsIntroduction - 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
5. **Design of Reinforced Concrete Members for Fire Resistance:**
   Introduction - ISO 834 standard heating conditions- Grading or classifications - 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 - Analystical determination of the ultimate bending moment capacity of reinforced concrete beams under fire - Other considerations

TEXT/REFERENCE BOOKS :

1. P.Purushothaman, Reinforced concrete Structural Elements: Behaviour, analysis and Design, TATA MC Graw Hill.
2. C.E. Reynolds and J.C. Steedman, Reinforced Concrete Desigers Hand bood, A view point publication.

3. Limit State Design of Reinforced Concrete Structures by P.Dayaratnam, Oxford & IBH Publishers, 2004 edition.
4. Advanced RCC by N.Krishna Raju, CBS Publishers & Distributors.
5. Reinforced cement concrete Structures – Devadas Menon, TATA MC Graw Hill.
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L	P	C
4	0	4

Subject Code:15D11106

M.Tech(STRUCTURAL ENGINEERING)

ELECTIVE –1

COST EFFECTIVE HOUSING TECHNIQUES

1. a) **Housing Scenario**

Introducing - Status of urban housing - Status of Rural Housing

b) Housing Finance:

Introducing - Existing finance system in India - Government role as facilitator - Status at Rural Housing Finance - Impedimently in housing finance and related issues

a**) Land use and physical planning for housing**

introduction - Planning of urban land - Urban land ceiling and regulation act - Efficiency of building bye lass - Residential Densities

b) Housing the urban poor

Introduction - Living conditions in slums - Approaches and strategies for housing urban poor

2. Development and adoption of low cost housing technology

Introduction - Adoption of innovative cost effective construction techniques - Adoption of precast elements in partial prefatroices - Adopting of total prefactcation of mass housing in India- General remarks on pre cast rooting/flooring systems - Economical wall system - Single Brick thick loading bearing wall - 19cm thick load bearing masonery walls - Half brick thick load bearing wall - Flyash grypsym thick for masonry - Stone Block masonery - Adoption of precast R.C. plank and join system for roof/floor in the building

3. Alternative building materials for low cost housing

Introduction - Substitute for scarce materials – Ferrocement - Gypsum boards - Timber substitutions - Industrial wastes - Agricultural wastes - Fitire starateru; for ,p,topm of alternative building maintenance

Low cost Infrastructure services:

Introduce - Present status - Technological options - Low cost sanitation - Domestic wall - Water supply, energy

4. Rural Housing:

Introduction traditional practice of rural housing continuous - Mud Housing technology- Mud roofs - Characteristics of mud - Fire treatment for thatch roof - Soil stabilization - Rural Housing programs

5. Housing in Disaster prone areas:

Introduction – Earthquake - Damages to houses - Traditional prone areas - Type of Damages and Railways of non-engineered buildings - Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions. Requirement’s of structural safety of thin precost roofing units against

Earthquake forcesStatus of R& D in earthquake strengthening measures - Floods, cyclone, future safety

TEXT BOOKS

1. Building materials for low –income houses – International council for building research studies and documentation.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Properties of concrete – Neville A.m. Pitman Publishing Limited, London.
4. Light weight concrete, Academic Kiado, Rudhai.G – Publishing home of Hungarian Academy of Sciences 1963.
5. Low cost Housing – G.C. Mathur.
6. Modern trends in housing in developing countries – A.G. Madhava Rao, D.S. Ramachandra Murthy & G.Annamalai.

L	P	C
4	0	4

Subject Code:15D11107

M.Tech(STRUCTURAL ENGINEERING)

PRESTRESSED CONCRETE
(ELECTIVE – II)
First Semester

1. **INTRODUCTION:**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.

2. **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.

3. **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. Introduction-Factors influencing deflections-short term and long term deflections of uncracked and cracked members.

4. **Shear, bond, Bearing and Anchorage:** shear in PSC beams –Principal stresses –Conventional elastic design for shear-transfer of prestress in pretensioned members-transmission length –Bond stresses-bearing at anchorage –Anchorage zone stresses in post-tensioned members-Analysis and design of end blocks by Guyon, Magnel and approximate methods –Anchorage zone reinforcements.

5. **Statistically indeterminate structures**: Introduction –advantages and disadvantages of continuity –Layouts for continuous beams-primary and secondary moments –Elastic analysis of continuous beams-Linear transformation-Concordant cable profile-Design of continuous beams.**Circular prestressing**: Introduction –Circumferential prestressing Design of Prestressed concrete tanks –vertical prestressing in tanks-Dome prestressing.

REFERENCE BOOKS:

1. Prestressed Concrete by S. Krishna raju, TMH Pubilishers.
2. Prestressed Concrete by S. Ramamrutham, Dhanpati Rai Pubilicartions.
3. Prestressed concrete design by Praveen Nagarajan, Pearson Pubilications.
4. T.Y.Lin, Design of Prestressed Concrete Structures, Asian Publishing house, Bombay, 1953.
5. Y.Guyon, Prestressed Concrete, Vol.I&II, Wiley and Sons, 1960.
6. F.Leohhardt, Prestressed concrete Design and construction, Wilhelm Ernst and shon, Berlin, 1964.
7. C.E.Reynolds and J.C. Steedman, Reinforced concrete designers hand bood, A view point publication, 1989.
8. Edward P.Nawy, Prentice Hall – Prestressed Concrete.
9. Prestressed Concrete – by Raj Gopal, Narsoa Pubilications.

L	P	C
4	0	4

Subject Code:15D11108

M.Tech (Structural Engineering)

MAINTENANCE AND REHABILITATION OF STRUCTURES

ELECTIVE – II
First Semester

1. **Influence on serviceability and Durability**:- General : Quality assurance for concrete construction, As built concrete properties, strength, permeability, volume changes, thermal properties, cracking. Effects due to climate, temperature, chemicals, wear and erosion, design and construction errors, corrosion mechanism, Effects of cover thickness and cracking methods of corrosion protection, inhibitors, resistant steels, coatings cathodic protection.

2. **Maintenance and Repair Strategies** :- Inspection, Structural Appraisal, Economic appraisal, components of equality assurance, conceptual bases for quality assurance schemes.

3. **Materials for Repair :-** Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

4. **Techniques for Repair :-** Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

5. **Case Studies :-** Repairs to overcome low member strength, Deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.

TEXT/REFERENCE BOOKS:

1. Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical, U.K. 1991.
2. RT.Allen and S.C. Edwards, Repair of concrete Structures, Blakie and sons, UK, 1987.
3. MS. Shetty, Concrete Technology – Theory and practice, S.Chand and company, New Delhi, 1992.
4. Santhakumar, A.R.Training Course notes on damage assessment and Repair in low cost housing RHDC-NBO Anna University, Madras, July, 1992.
5. Raikar, R.N.learning from failures – deficiencies in Design, construction and service – R&D centre (SDCPL), Raikar Bhavan, Bombay, 1987.
6. N.Palaniappan, Estate Management, Anna Institute of Management, Madras Sep. 1992.
7. F.K.Garas, J.L.Clarke, GST Armer, Structural Assessment, Butterworths, UK Aporil 1987.
8. A.R. Santhakumar, Concrete chemicals – Theory and applications, Indian society for construction Engineering and Technology, Madras. 1993 (In press)

L	P	C
4	0	4

Subject Code:15D11109

M.Tech (Structural Engineering)

ADVANCED FOUNDATION ENGINEERING
ELECTIVE – II
First Semester

1. **SHALLOW FOUNDATIONS-I:** General requirements of foundations. types of shallow foundations and the factors governing the selection of type of shallow foundation. Bearing capacity of shallow foundations by Terzaghi's theory and Meyerhof's theory (derivation of expressions and solution to problems based on these theories). Local shear and general shear failure and their identification

2. **SHALLOW FOUNDATIONS-II:** Bearing capacity of isolated footing subjected to eccentric and inclined loads. bearing capacity of isolated footing resting on stratified soils- Button's theory and Siva reddy analysis. Analysis and structural design of R.C.C isolated, combined and strap footings.

3. **DEEP FOUNDATIONS-I:** Pile foundations-types of pile foundations. estimation of bearing capacity of pile foundation by dynamic and static formulae. Bearing capacity and settlement analysis of pile groups. Negative skin Friction, Pile load tests.Sheet Pile Walls.Cantilever sheet piles and anchored bulkheads, Earth Pressure diagram,Determination of depth of embedment in sands and clays-Timbering of trenches-Earth Pressure diagrams-forces in struts.

4. **DEEP FOUNDATIONS-II:** Well foundations-Elements of well foundation. forces acting on a well foundation. Depth and bearing capacity of well foundation. Design of individual components of well foundation (only forces acting and principles of design). Problems associated with well sinking.

5. **FOUNDATIONS IN PROBLEMATIC SOILS:** Foundations in black cotton soils-basic foundation problems associated with black cotton soils. Lime column techniques-principles and execution. Under reamed piles-principle of functioning of under reamed pile-Analysis and structural design of under reamed pile. Use of Cohesive Non Swelling (CNS) layer below shallow foundations.

TEXT BOOKS:
- Analysis and Design of Foundations and Retaining Structures-Shamsher Prakash,Gopal Ranjan and Swami Saran.

Reference Books:
- **Analysis and Design of Foundations-J.E.Bowles**
- **Foundation Design and Construction-Tomlinson**
- **Foundation Design-Teng.**
- **Geotechnical Engg – C.Venkatramaiah**

L	P	C
0	4	2

Subject Code:15D11110

M.Tech(Structural Engineering)

ADVANCED CONCRETE LABORATORY
First Semester

List of Experiments:

1. Mix Design of Concrete and Casting of Specimen.
2. Young's Modulus of Concrete
3. Accelerated curing test on Concrete cubes.
4. Non destructive tests on concrete.
5. Mix design of high strength concrete including casting and testing of specimens.
6. Mix design of fly ash concrete including casting and testing of specimens.
7. Bending test on a RCC beam under.

a) single point load
b) Three point load

L	P	C
4	0	4

Subject Code:15D11201

M.Tech (STRUCTURAL ENGINEERING)

STRUCTURAL DYNAMICS
Second Semester

1. **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.

2. **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

3. **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

4. **Practical vibration analysis:** Stodola method- Fundamental mode analysis –analysis of second and higher modes –Holzer's method –basic procedure –transfer matrix procedure

5. **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 case-Equation of motion –Analysis of undamped free shapes of simple beams with different end conditions-principles of application to continuous beams.

REFERENCE BOOKS:

- A.K.Chopra, "Structural Dynamics for Earthquake Engineering",Pearson Pubilications
- Dynamics of structures by Clough & Penziem
- Structural dynamics by Mario Paz
- I.S:1893(latest)" code of practice for earthquakes resistant design of stuctures"
- Anderson R.A fundamentals of vibration, Amerind Pulblishing Co.,1972.

L	P	C
4	0	4

Subject Code:15D11202

M.Tech(STRUCTURAL ENGINEERING) II- SEMESTER

FINITE ELEMENT ANALYSIS OF STRUCTURES

1. **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 form-plane stress, plane strain and Axi-symmetric bodies of revolution with axi symmetric loading

2. **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.

3. **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.

4. **Isoparametric formulation**-Concept, Different isoparametric elements for 2d analysis-Formulation of 4-noded and 8-noded isoparametric quadrilateral elements – Lagrangian elements-serendipity elements. **Axi symmetric analysis** –bodies of revolution-axi symmetric modelling –strain displacement relationship-formulation of axi symmetric elements.

5. **Three Dimensional FEM-**Different 3-D elements, 3D strain –displacement relationship- formulation of hexahedral and isoparametric solid element.

REFERENCE BOOKS:

1. Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla and Ashok D. Belegundu – Pearson Education Publications.
2. Finite Element analysis – Theory & Programming by C.S.Krishna Murthy- Tata Mc.Graw Hill Publishers Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla, Universities Press India Ltd. Hyderabad.
3. Finite element method and its application by Desai ,2012, Pearson Pubilications.
4. Finite element methods by Darrel W.Pepper, Vikas Pubilishers
5. Finite element analysis and procedures in engineering by H.V.Lakshminaryana, 3rd edition, universities press, Hyderabad.
6. Finite element analysis in Engineering Design by S.Rajasekharan, S.Chand Publications, New Delhi.
7. Finite element analysis by S.S. Bhavakatti-New age international publishers

L	P	C
4	0	4

Subject Code:15D11203

M.Tech(STRUCTURAL ENGINEERING)II-SEMESTER

STABILITY OF STRUCTURES

1. **Formulations related to beam columns :** 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 – application of Trignometric series –Determination of allowable stresses.

2. **Elastic Buckling of Bars:** Elastic buckling of straight columns –Effect of shear stress on buckling-Eccentrically and laterally loaded columns –energy methods – Buckling of a bar on elastic foundation, Buckling of a bar with intermediate compressive forces and distributed axial loads –Buckling of bars with change in cross section –Effect of shear force on critical load –Built up columns

3. **Inelastic Buckling and Torsional Buckling :** Buckling of straight bars-Double modulus theory –Tangent modulus theory. Pure torsion of thin walled bar of open cross section-Non –Uniform torsion of thin walled bars of open cross section-Torsional buckling –Buckling under Torsion and Flexure.

4. **Mathematical Treatment of Stability Problems:** Buckling problem orthogonality realation –Ritz method-Timoshenko method, Galerkin method

5. **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.

REFERNCE BOOKS:

1. Stability of metalic structure by Bleich –Mc Graw hill
2. Theory of Beam columns Vol I by chen & Atsuta Mc.Graw Hill
3. Smitses,Elastic stability of structures, Prentice Hall,1973.
4. Timoshenko, S., and Gere., theory of Elastic stability, Mc Graw Hill Book company, 1973.
5. Brush and Almorth., Buckling of bars plates and shells, Mc Graw Hill book company ,1975.
6. Chajes, A., Principles of Structural Stability Theory, Prentice Hall,1974
7. Ashwini Kumar, stability theory of structures, TATA Mc Graw Hill publishing company Ltd, New Delhi,1985.

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Subject Code:15D11204

M.Tech (STRUCTURAL ENGINEERING)
II- SEMESTER

ANALYSIS OF SHELLS AND FOLDED PLATES

1. **Equations of equilibrium :** Introduction, classification, derivation of stress Resultants, Principles of membrane theory and bending theory.

2. **Cylindrical shells:** Derivation of governing DKJ equation for bending theory, details of Schorer's theory, Applications to the analysis and design of short shells and long shells. Introduction of ASCE manual co-efficients for design.

3. **Introduction to shells of double curvature**: (other than shells of revolution:) Geometry and analysis of elliptic paraboloid, rotational paraboloid and hyperbolic paraboloid shapes by membrane theory.

4. **Folded Plates:** Folded plate theory, plate and slab action, Whitney's theory, Simpson's theory for the analysis of different types of folded plates (Design is not included)

5. **Shells of double Curvature**-Surfaces of revolution .Derivation of equilibrium equations by membrane theory, Applications to spherical shell and rotational Hyperboloid

TEXT / REFERENCE BOOKS:

1. Design and construction of concrete shell roofs by G.S. Rama Swamy – CBS Publishers & Distributors, 485, Jain Bhawan Bhola Nath Nagar, shahotra, Delhi.
2. Fundamentals of the analysis and design of shell structures by Vasant S.kelkar Robert T.Swell – Prentice hall, Inc., Englewood cliffs, new Jersy -02632.
3. N.k.Bairagi, Shell analysis, Khanna Publishers, Delhi, 1990.
4. Billington, Ithin shell concrete structures, Mc Graw Hill Book company, New york, St. Louis, Sand Francisco, Toronto, London.
5. ASCE Manual of Engineering practice No.31, design of cylindrical concrete shell roofs ASC, Newyork.

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Subject Code:15D11205

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER

DESIGN OF BRIDGES
ELECTIVE-III

1. 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.

2. 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.

3. 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.

4. Prestressed Concrete Bridges – General features – Advantages of Prestressed concrete bridges – pretensioned 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 elastometric pot bearings.

5. Piers and abutments – General features – Bed block – Materials for piers and abutments – typies 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.Bridge foundations – General Aspects – Types of foundations – Pile foundations – well foundations – caisson foundations.

TEXT/REFERENCES :

1. Essentials of bridges engineering – D.Hohnson Victor oxford & IBH publishers co-Private Ltd.
2. Design of concrete bridges MC aswanin VN Vazrani, MM Ratwani, Khanna publishers.
3. Bridge Engineering – S.Ponnuswamy.
4. BRowe, R.E., Concrete Bridge Design, C.R.Books Ltd., London, 1962.
5. Taylor F.W., Thomson, S.E., and Smulski E., Reinforced concrete Bridges, John wiley and sons, New york, 1955.
6. Derrick Beckett, an Introduction to Structural Design of concrete bridges, surrey University; press, Henlely – thomes, oxford shire, 1973
7. Bakht.B.and Jaegar, L.G. bridge Analysis simplified, Mc Graw Hill, 1985.
8. Design of Bridges – N.Krishna Raju – Oxford & IBH
9. Design of Bridge structures – FR Jagadeesh, M.A. jaya Ram – Eastern Economy edition.

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Subject Code:15D11206

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER

ADVANCED CONCRETE TECHNOLOGY
ELECTIVE-III

1. **Cements and Admixtures**: Portland cement – Chemical composition - Hydration, setting and finenesses 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.

2. **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 – practical grading – Road note No.4 grading of fine and coarse aggregates gap graded aggregate – maximum aggregate size.

3. **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.

4. **Elasticity, Shrinkage and Creep**: Modulus of elasticity – dynamic modulus of elasticity – poisson's ratio – Early volume changes – swelling – Draying 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.

5. **Mix Design**: Proportioning of concrete mixes by various methods – fineness modulus, trial and error, mix density, Road Note. No. 4, ACI and ISI code methods – factors in the choice of mix proportions – Durability of concrete – quality control of concrete – Statistical methods – High strength concrete mix design. **Special concrete's**: Light weight concretes –light weight aggregate concrete- Mix design – Cellular concrete - No fines concrete – High density concrete – Fiber reinforced concrete – Different types of fibers - factories affecting properties of FRC – Applications polymer concrete – types of polymer concrete properties of polymer concrete applications

TEXT/ REFERENCE BOOKS:

1. Properties of Concrete by A.M.Neville – Pearson publication – 4th edition
2. Concrete Technology by M.S.Shetty. – S.Chand & Co. ; 2004
3. Design of Concrete Mix by Krishna Raju, CBS pubilishers.
4. Concrete: Micro structure, Properties and Materials – P.K.Mehta and J.M.Monteiro, Mc-Graw Hill Publishers
5. Concrete Technology by A.R. Santha Kumar, Oxford university Press, New Delhi
6. Concrete Technology by A.M.Neville – Pearson publication
7. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi
8. Non-Destructive Test and Evaluation of materials by J.Prasad & C.G.K. Nair , Tata Mcgraw hill Publishers, New Delhi

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Subject Code:15D11207

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER
EARTHQUAKE RESISTANT STRUCTURES
ELECTIVE – III

1. **Engineering seismology :**
   Earthquake – causes of earthquake – earthquakes and seismic waves – scale and intensity of earthquakes – seismic activity – Measurements of earth quakes – seismometer- strong motion accelerograph / field observation of ground motion – analysis of earthquakes waves – earth quake motion – amplification of characteristics of surface layers – earthquake motion on the ground surface;
2. **Vibration of structures under ground motion:**
   Elastic vibration of simple structures – modelling of structures and equations of motion – freevibrations of simple structures – steady state forced vibrations – Non steady state forced vibrations – response spectrum representations; Relation between the nature of the ground motion and structural damage.
3. **Design approaches:** Methods of analysis – selection of analysis – equivalent lateral force procedure seismic base shear – seismic design co-efficient - vertical distribution of seismic forces and horizontal shear – twisting moment - Over turning moment – vertical seismic load and orthogonal effects lateral deflection – P- Δ characteristics effect – soil structure Interaction. Seismic – Graphs study, earthquake records for design – factors affecting Accelerogram characteristics - artificial Accelerogram – zoning map.Dynamic – analysis procedure: Model analysis – Inelastic – time history analysis Evaluation of the results.
4.. **Earthquake – Resistant design of structural Components and systems:**
   Introduction – monolithic reinforced – concrete structures – precast concrete structures – Prestressed concrete structures – steel structures – composite – structures, masonry structures – Timber structures.
5. Fundamentals of seismic planning: Selection of materials and types of construction form of superstructure – framing systems and seismic units – devices for reducing. Earthquake loads,

TEXT / REFERENCE BOOKS:

1. Design of earthquake resistant structures by Minoru Wakabayashi.
2. A.K.Chopra, Strucutural Dynamics for Earthquake Engineering", Pearson Pubilications.
3. R.W.Clough and 'Dynamics of structures'. Mc Graw – Hill, 2nd edition, 1992.
4. N.M Newmark and E.Rosenblueth, Fundamentals of Earthquake Engineering' prentice hall,1971.
5. David Key, Earthquake design practice for buildings." Thomas telford,London,1988
6. R.L. Wegel, Earthquake Engg; Prentice Hall 12nd edition 1989.
7. J.A. Blume, N.M. Newmark, L.H. Corning., Design of Multi –storied Buildings for Earthquake ground motions', Portland Cement Association, Chicago,1961
8. I.S.Codes No. 1893,4326,13920.
9. Earthquake Resistant Design by Pankaj Agarwal.

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Subject Code:15D11208

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER

ELECTIVE-IV
ADVANCED STRUCTURAL STEEL DESIGN

1. Design of self supporting stacks/chimneys – Considerations for preliminary design (industrial requirements – thermal requirement – mechanical force requirement – wind load and dead load estimation) – Detailed estimation of wind; dead-and other accidental – loads; Analysis; Detailed design including provision of stakes /spoilers – Design of super structure only.
2. Analysis of multi-storey frames using approximate methods and substitute frame method:
   a) Cantilever method &
   b) Portal method

3. Design of Gantry Girder – Introduction – Loads acting on the ganny girder – permissible stresses - types of gantry girders and crane sails – crane data – maximum moments and shears – design procedure (restricted to electrically operated cranes)
4. Theorems of plastic analysis, applications to the cases of rectangular portal frames. Principles of optimization in structural design – Application to simple – rectangular portal frame – minimum weight design.

5. General methods of plastic design: combining mechanics methods, plastic moment redistribution method; Application to few cases of simple two storied rectangular portal frames including estimation of deflection.

Books for reference:

1. Plastic analysis of structures by B.G.Neal
2. Steel Skeleton V.I and II by Baker
3. Design of steel structures by Vazarani and Ratwani
4. Strength of materials (Vol-II)) by Timoshenko.
5. Analysis of Steel Structure by Manohar.
6. Analysis of Steel Structure by Pinfold
7. Analysis of Steel Structure by Arya & Azmani
8. Analysis of Steel Structure by Relevant IS codes.
9. Analysis of Steel Structure by Punmia, B.C.

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Subject Code:15D11209

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER
BUILDING CONSTRUCTION MANAGEMENT
ELECTIVE-IV

1. Introduction – Types constructions public and private contract management – scrutinizing tenders and acceptance of tenders, contracted, changes and terminating of contract – subcontracts construction organizations – organizational chart- Decentralization payrolls and records – organization chart of a construction company.

2. Construction practices – Times Management – bar chart, CPM, PERT – Progress report

3. Resources management and inventor- Basic concepts equipment management, material management inventory control.

4. Accounts management – Basic concepts, Accounting system and book keeping, depreciation, Balance sheet, profit and loss account, internal auditing. Quality control by statistical methods, sampling plan and control charts, safety requirements.

5. Cost and Financial Management – Cost volume relationship, cost control system, budget concept of valuation, cost of equity capital management cash. Labor and industrial; laws – payment of wages act. Contract labor, workmen's compensation, insurance, industrial disputes act.

REFERENCE:

1. Construction project management by Jha ,Pearson pubilications,New Delhi.
2. Construction Technology by Subir K.Sarkar and Subhajit Saraswati – Oxford Higher Education- Univ.Press, Delhi.
3. Project Planning and Control with PERT and CPM by Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi.
4. Optimal design of water distribution networks P.R.Bhave, Narosa Publishing house 2003.
5. Total Project management, the Indian context- by : P.K.JOY- Mac Millan Publishers India Limited.

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Subject Code:15D11210

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER
ELECTIVE-IV
Fracture Mechanics

1. **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

2. **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

3. **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

4. **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 behaviour:
Introduction - An engineering concept of plane stress - The R curve concept

5. **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)

REFERENCES;

1. Elementary engineering fracture mechanics - David Broek, Battelle, columbus laboratories, columbus, Ohieo, USA
2. Fracture and Fatigue Control in Structures - john M.Barsom, Senior consultant United states Steel corporation & Stanley T.Rolfe, Ross H.Forney Professor of Engineering University of Kansas. &Stanley T.Rolfe, Ross H.forney Professor of Engineering, University of Kansas

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Subject Code:15D54201

M.Tech (STRUCTURAL ENGINEERING) II- SEMESTER

RESEARCH METHODOLOGY

(Audit Course)

(Audit Course For M.Tech. –II Semester Program from 2015 admitted batches onwards)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text books:

1. **Research Methodology:Methods and Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.**
2. **Research Methodology: A Step by Step Guide for Beginners- Ranjit Kumar, Sage Publications (Available as pdf on internet)**
3. **Research Methodology and Statistical Tools – P.Narayana Reddy and G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.**

REFERENCES:

1. Scientists must Write - Robert Barrass (Available as pdf on internet)

2. Crafting Your Research Future –Charles X. Ling and Quiang Yang (Available as pdf on internet)

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Subject Code:15D11211

M.Tech
(STRUCTURAL ENGINEERING)
II- SEMESTER

CAD LABORATORY

1. Analysis of cantilever, simply supported beam, fixed beams, continuous beams for different loading conditions.
2. Design of R.C.C. beams, slabs, foundations.
3. Design of steel tension Members
4. Reinforcement detailing in beam using graphics.
5. Reinforcement detailing in slabs using graphics.
6. Reinforcement detailing in foundation using graphics.