

TEACHING SCHEDULE & STUDY SCHEME

M. TECH. PROGRAMME

(Structural Engineering)



PUNJAB TECHNICAL UNIVERSITY, JALANDHAR

August, 2004

**DETAILED SYLLABUS AND OTHER CONDITIONS FOR THE
PROPOSED COURSE
M. TECH. STRUCTURAL ENGINEERING**

<u>Schedule of Teaching</u>			<u>Schedule of Examination</u>				
Lecture	Tutorials (per week)	Total		Time (Hrs.)	Theory Marks	Sessional Viva Marks	Total
4	0	4	All theory subjects	3	100	50	150
			Project			50	100
			Seminar			100	100
			Dissertation				
						Satisfactory/not Satisfactory	

SEMESTER-I

CE-501	Dynamics of Structures
CE-502	Bridge Engineering
CE-503	Theory and Design of Plates and Grids
CE-504	Pre Stressed Concrete Structures
CE-505	Advanced Structural Analysis

SEMESTER-II

CE-506	Plastic Analysis and Design of Steel Structures
CE-507	Computer Aided Design Methods
CE-508	Industrial Structures
CE-	Elective-I
CE-	Elective-II

SEMESTER-III

CE-	Elective-III
CE-	Elective-IV
CE-580	Project
CE-590	Seminar

SEMESTER-IV

CE-500	Dissertation
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LIST OF ELECTIVES**ELECTIVE-I**

CE-509	Expert System in Civil Engineering
CE-510	Advanced Foundation Engineering
CE-511	Probabilistic Methods in Civil Engineering

ELECTIVE-II

CE-512	Instrumentation and Model Simulation
CE-513	Solid Mechanics
CE-514	Advanced Structure Design and Detailing

ELECTIVE-III

CE-515	Theory and Design of Shells
CE-516	Finite Element Methods
CE-517	Composite Materials

ELECTIVE-IV

CE-518	Construction and Maintenance Management
CE-519	High Rise Buildings
CE-520	Disaster Reduction and Management

CE- 501 DYNAMICS OF STRUCTURES

L	T/P
3	1

Introduction, Systems with single degree of freedom (SDOF) Equation of motion – Analysis of free vibration-response to harmonic, impulsive, periodic and general dynamic loadings, forced and free vibration response of MDOF damp and undamped discrete systems-equation of motion- evaluation of natural frequencies and modes – approximate methods, overview of dynamics of continuous elastic systems-flexural beams-shear beams-columns, base excited system-formulation of equations for SDOF & MDOF systems-concepts of spectral quantities and response spectrum-fundamental of earthquake engg., computational and numerical methods-solution of eigen value problems mode superposition method and modal truncation errors-modal acceleration method, direct integration method- explicit and implicit methods.

References:

1. Dynamics of Structures by Clough and Penzien
2. Mechanical Vibrations by G.K. Grover
3. Dynamics of Structures by Walter C. Hurty & Moshe F. Rubinsten

CE-502 BRIDGE ENGINEERING

L	T/P
3	1

Introduction-definition and components of bridges. Layout and planning of bridges-classification, investigations for bridges, preliminary data collection, choice of type of the bridges, hydraulic design of bridges, traffic design of bridges.

Analysis and design of superstructure of straight and curved bridge decks-loadings details, specification-reinforced concrete and steel decks. Decks of various types like slab, hollow and voided slab, beam and slam, box girder etc.

Design of substructure-piers and abutments of different types. Analysis and design of foundations- shallow foundations (open Foundations), deep foundations- well foundations and caisson.

Design and constructional aspects of foundations. Modern methods of construction of concrete and steel bridges- their impact on the analysis and the design. Introduction to analysis and design of long span bridges like suspension and cable stayed bridges.

Special aspects in analysis and design, based on construction methodology. Inspection and maintenance and rehabilitation of bridges.

References:

1. Bridge Deck analysis by Pama & Gusens
2. Bridge deck behavior by Edward V. Hambly
3. Essentials of bridge engineering by D. Johnson Vector

CE-503 THEORY AND DESIGN OF PLATES AND GRIDS

L	T/P
3	1

Plate equation in Cartesian and polar coordinates isotropic plates' analysis of rectangular and circular plates with different boundary conditions and loading-energy methods in analysis of plates-orthotropic plates on elastic foundations.

Analysis and design of Grids. Various methods of analyzing grids for roofs and bridges distribution of concentrated loads to various beams of grid floors and bridge decks.

References:

1. Theory of Plates and Shells by Timoshenko, S.
2. Theory and analysis of Plates by Szilard, R.

CE-504 PRESTRESSED CONCRETE STRUCTURES

L	T/P
3	1

Limit state design of statically determinate pre-stressed beams- limit state of collapse by flexure, shear, torsion limit state of serviceability. Anchorage zone stresses for post-tensioned members. Statically indeterminate structures- analysis and design- continuous beams and frames. Choice of profile, linear transformation, concordancy, omically viable profile. Composite beam with precast prestressed beams and cast in situ RC slab- analysis and design. Time dependant effects such as creep, shrinkage etc. on composite construction inclusive of creep relaxation and relaxation creep- partial prestressing principles, analysis and design of simple beams, crack and crack width calculations. Analysis and design of prestressed pipes, tanks and spatial structures- slabs, grids, folded plates and shells.

References

Prestressed concrete structures – Lundy.

Prestressed concrete – T.Y. Lin.

Prestressed concrete – N. Krishna Raju.

CE-505 ADVANCED STRUCTURAL ANALYSIS

L	T/P
3	1

Matrix methods in skeletal structural analysis, force and displacement methods including analysis using substructures. Nonlinear analysis due to plasticity of frames, analysis of plates, folded plates and singly curved shells, conventional and approximate methods.

References:

1. Analysis of framed structures- J.M.Gere and W.Weaver.
2. Computer programming and engg. analysis – I.C.Syal and S.P.Gupta.

CE-506 PLASTIC ANALYSIS OF STRUCTURES

L	T/P
3	1

1. Ductility of metals: Concept of plastic design, over loaded factors, ultimate load as design criteria.
2. Hinge formation in indeterminate structures, Redistribution of moments, Assumption made for structures subjected to bending only.
3. Minimum weight design : concept, assumptions , Design of frame with prismatic measures, Elements of linear programming and its application to minimum weight design problems.
4. Deflections: Assumption, calculation of deflection at ultimate loads, permissible rotations.
5. Secondary design considerations: Influence of direct load, shear, local buckling, lateral buckling, repeated loading and brittle fracture on moment capacity design of eccentrically loaded columns.
6. Problem of incremental: collapse, shake down analysis.
7. Special consideration for design of structures using light gauge metals.

CE-507 COMPUTER AIDED DESIGN METHODS

L	T/P
3	1

Introduction to CAD and its scope simple description of computer hardware.

- Micro, mini etc.
- memory, processor
- Peripheral devices-disks, printer. Video terminals. Graphic floater, graphic screen digitizer.

Computer Graphics: introduction, point plotting techniques, line drawing displays, two-three dimensional transformation, clipping and windowing, segmentation geometric modeling. Three dimensional graphics, curves and surfaces, hidden surface elimination, shading.

Graphic input devices. Graphic input technique, input functions.

Raster graphic fundamentals, interactive raster graphics, raster graphic systems.

Computer aided linkage displays and synthesis, interactive acceleration analysis.

Appreciation of graphic packages.

Matrix methods of structural analysis and associated computer programme assembly of matrices. Solution of equilibrium equations. Flow charts. Typical listing as illustrations.

Introduction to interactive computer programme for the design detailing of simple structural elements: RCC slab, beams, columns, isolated footings etc.

Steel typical members and connections.

Data base management , storing and retrieving of data.

References:

1. Principles of interactive computer graphics by William M. Newman & Robert F.Sproul.
2. Programming in Finite Element by Hunton and owan.
3. Principles of Computer Aided design by Joe Rooney & Philips Steadman.

CE-508 INDUSTRIAL STRUCTURES

L T/P
3 1

1. Planning of industrial structures: Design of single ad multibay industrial structures In steel.
2. Bunkers & Silos In steel
3. Liquid retaining structures in steel
4. Pressure vessels & chimneys in concrete
5. Cooling tower in concrete
6. Structural aspects /design of machine ,foundation in concrete

References:

1. Planning of industrial structures by C.W. Dunham.
2. Structural Engineers Handbook.
3. Design of steel structures-S.K.Duggal

CE-509 EXPERT SYSTEM IN CIVIL ENGINEERING

L T/P
3 1

(Elective Course)

- Chapter –I Introduction
History of expert system research e.g. acquaintance with researchers and their research fields. Current research activities. Conventional programs vs. Expert Systems Advantages and limitations of expert systems
- Chapter –II Architecture of an expert system
Components of expert system
Knowledge base, Inference mechanism
User Interface
- Chapter –III Knowledge base
Knowledge Engineering. Nature of expert knowledge., Knowledge acquisition and knowledge representative e.g. rule based systems, Semature nets, frames, Validity nature base , working memory
- Chapter –IV Inference Engine and user interface, Techniques for inference mechanism, forward chaining and backward chaining , Interface language, terminal interface
- Chapter-V Development of expert systems
Problem formulation, Search spaces, Task for expert system, application to engineering analysis and design, Consideration , Operations Representative application in Civil engg.
There will be project for developing an expert system by small group of students using the profile of a given shell. The project will carry 50 sessional marks.

References:

- A guide to expert system- Waterman D.A.
Introduction to expert systems- Jackson, P.

CE-510 ADVANCED FOUNDATION ENGINEERING

L	T/P
3	1

(Elective Course)

Criteria for foundation choice, bearing capacity, total and differential settlement, tolerance for various types of structures, Interpretation of soil profile for design parameters like modulus of compressibility, modulus of sub grade reaction, Poisson ratio etc., Raft foundations for buildings and tower structures including effects of soil structure interaction and non-linearity, different types of rafts and , methods of analysis , precautions for construction of shallow foundations, Pile foundations, types, method of installation codal practices for permissible loads under vertical and lateral loads, Diaphragm walls, design and construction, foundations for heavy structures, well and caisson foundations, Equipment foundation subjected to dynamic loads. Underground structures, strategies for instrumentation and monitoring of foundation performance.

References

Foundation analysis and design- Bowles, J.E.

Foundation engg- Pech, Hansen and Thornburn.

CE-511 PROBABILITY METHODS IN STRUCTURAL ENGINEERING

L	T/P
3	1

(Elective Course)

Application of basic probability concepts and standard probability distributions of random phenomenon in civil engg. systems- statistic of extremes, statistical estimation of parameters from experimental data point estimators and interval estimators, Hypothesis testing of civil engg. models, elements of quality assurance- acceptance sampling by attributes and by variables- multistage sampling, decision analysis concepts of utility theory posterior analysis –preposterior analysis, elements of reliability theory, applications to design and operations of civil engg. systems.

References:

Linear Programming- G.Hardley.

Linear Programming by L. S. Shrinath.

CE-512 INSTRUMENTATION AND MODEL SIMULATION

L	T/P
3	1

(Elective Course)

Basic concepts of measurement-measurement of displacement, strain, pressure, force, torque etc.-types of strain gauges, (mechanical, electrical resistance, acoustical etc.) electrical resistance strain gauges gauge construction, adhesive and mounting methods-gauge factor-environmental effects. Strain gauge circuits-the potentiometer and the wheatstone bridge-effects of lead wires, switches etc. use of electrical resistance strain gauges in transducer application. Indicating and recording devices-static and dynamic data recording-data (digital and analogue) acquisition and processing systems-elementary systems. Strain analysis methods-Rosette analysis.

Static and dynamic testing techniques equipment for loading, non-destructive testing techniques.

Photo-elasticity – optics of photo elastic- Polaris cope- isoclinic and isochromatics – methods of stress separation – frozen stress method. Introduction to holography and Moiré technique.

References:

1. Experimental stress analysis by Dalley & Riley
2. Experimental stress analysis by Lee
3. Dimensional analysis by Henry Langhar

CE-513 SOLID MECHANICS

L	T/P
3	1

(Elective Course)

Theory of stress, state of stress in a body, Differential equations of equilibrium. Analysis of state of stress at a given point in a body, geometrical theory of strains, displacement components and strain components and relation between them, generalized hooks law, strains expressed in terms of stresses, stresses expressed in terms of strains, torsion of prismatic bars and bending, Saint- Venant method, three dimensional stress systems , tensors, unsymmetrical bending.

References

1. Theory of elasticity- S.Timoshenko
2. Theory of elasticity-M.Filonenko
3. Solid mechanics-S.H. Crandall

CE-514 ADVANCED STRUCTURAL DESIGN AND DETAILING

L	T/P
3	1

(Elective Course)

1. Introduction Introduction to limit state method of design, provisions in the Indian standard codes for loading wind loads and seismic loads, design and detailing of concrete structures.
2. BIS Handbook for design, Examples of design using handbook.
3. Design of Structures as per I.S. 1893 for Earthquake Resistant Design Construction.
4. Design and Detailing Requirements as per 4326-1993.
5. Design and Detailing of Earthen Buildings as per 13827-1993.
6. Design and Detailing of Masonry Structures as per I.S. 13828-1993
7. Design and Ductile Detailing of R.C.C. Structures as per I.S. 13920-1993
8. Repair and Seismic Strengthening of Buildings as per I.S. 13935-1993.

References:

1. Dayaratnam, P. Reinforced Concrete Structure
2. Jain, A.K. Reinforced Concrete, Limit State Method of Design.
3. Punmia, B.C. Reinforced Concrete Structures, Vol II
4. Jain and jaikrishna Plain and Reinforced Concrete Vol II.
5. Design of Steel Structures by P.Dayaratnam
6. Design of Steel Structures by S.K. Duggal
7. B.I.S. Codes 1893, 4326, 13827, 13828, 13920, 13935

CE-515 THEORY AND DESIGN OF SHELLS

L	T/P
3	1

(Elective Course)

Classification of Shells-membrane and bending theory for singly curved and doubly curved shells. Various approximations- design of cylinder shells. HP shells, conoids- analysis of folded plates-design of diaphragms – detailing of reinforcements for shells – formwork for shells and folded plates.

References:

1. Theory of Plates and Shells by Timoshenko, S.
2. Concrete Shell Roofs by Ramaswamy.

CE-516 FINITE ELEMENT ANALYSIS

L	T/P
3	1

(Elective Course)

Basic equations of solid mechanics-review of equilibrium conditions, strain – displacement relations, stress – strain relations, principles of virtual work and stationary potential energy and various formulations.

Approximate methods Rayleigh, Ritz weighted residual (Galerkin) and finite difference methods.

Finite element method: displacement model-shape functions Lagrange and Serendipity elements. Element properties-isoperimetric elements-numerical integration technique assemblage of elements and solution technique for static analysis.

Analysis of framed structures-2D & 3D truss and beam element and applications.

Analysis of plan stress/strain and ax symmetric solids-triangular, quadrilateral and isoperimetric elements, incompatible modes. Three dimensional stress analysis-isoperimetric 8 and 20 noded elements. Analysis of plate bending-basic equations of thin plate theory Reissner-Mindlin theory- plate elements and applications. Analysis of shells-degenerated shell elements. Finite element programming and FEA software.

References:

1. Finite Element Analysis – Theory and Programming by Krishanmurthy, C.S.
2. Numerical Method in Finite Element Analysis by Bathe, K.J. & Wilson, E.L.

CE-517-COMPOSITE MATERIALS

L	T/P
3	1

(Elective Course)

1. FIBRE REINFORCED CONCRETE: Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures, Properties of Freshly mixed FRC, Mechanics and properties of Fibre reinforced concrete, Composite Material approach, Application of fibre reinforced concrete.
2. FLY ASH CONCRETE: Classification of Indian Flyashes, Properties of Flyash, Reaction Mechanism, Proportioning of Flyash concretes, Properties of Flyash concrete in fresh and hardened state, Durability of flyash concrete.
3. POLYMER CONCRETE: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete.
4. FERRO CEMENT: Constituent materials and their properties, Mechanical properties of ferro cement, Construction techniques and application of ferro cement.
5. HIGH PERFORMANCE CONCRETE: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.
6. SULPHUR CONCRETE AND SULPHUR INFILTRATED CONCRETE: Process technology, Mechanical properties, Durability and applications of sulphur concrete, Sulphur infiltrated concrete, Infiltration techniques, Mechanical properties, Durability and applications of sulphur infiltrated concrete.
7. LIGHT WEIGHT CONCRETE: Properties of light weight concretes, Pumice concrete, Aerated cement mortars, No fines concrete, Design and applications of light weight concrete.

References:

1. Concrete Technology-A.M. Neville
2. Concrete Technology-M.L. Gambhir.

CE-518 CONSTRUCTION AND MAINTENANCE MANAGEMENT

L	T/P
3	1

(Elective Course)

1. Services in Residential, Commercial and Medical buildings
 - (A) Sanitation, water supply, electric wiring, rain water disposal, lighting & illumination, calculation methods for these services
 - (B) Air Conditioning & Ventilation: Natural ventilation, control cooling systems, modern systems of air conditioning, ducting systems, different mechanical means of air conditioning.
 - (C) CCD-CS: General principles of transmission and passage of sound reverberation, absorption, reflection, acoustic materials and their co-efficiency, principles of good acoustic design.
 - (D) Thermal Insulation: Behavior of various building materials & thermal conductivity. Thermal insulation for air conditioned interior spaces, working out air conditioning loads for different spaces.
 - (E) Fire Safety Dye.
2. Architectural controls and building byelaws : Role of building byelaws in a city, local byelaws and architectural controls, façade control and zoning plans.
3. Regional planning: Understanding of physical, social and economical parameters for regional planning.
4. Landscaping: Forces of man and nature, their relationship and effect on shaping landscape, site analysis, site and.

CE-519 HIGH RISE BUILDINGS

L	T/P
3	1

(Elective Course)

Tall Building systems and Concepts: environmental systems. Service systems, construction system, foundation design, architectural- structural interaction.

Tall building criteria and loading gravity load. Earthquake loadings, wind loading and effects, fire and blast, quality control crib Structural safety.

Structural design of tall steel buildings: commentary on structural standards, elastic analysis and design. Plastic analysis and design, stability. Design methods based on stiffness, fatigue and fracture, load factor(Limit State) design.

Structural design of tall concrete and masonry buildings: commentary structural standards, plastic analysis-strength of members and correction, non-linear analysis and limit design, stability, stiffness and crack control creep shrinkage and temperature effects. Limit state design , masonry structures.

Frame-shear wall systems: Twist of frame. Analysis of shear wall, frame wall interaction, analysis of coupled shear wall, computation of earthquake load dynamic analysis of tall building.

References:

1. Structural Analysis and design of Tall Buildings by Tara Nath Bungale
2. Advances in tall buildings by Beedle L.S.
3. Analysis of Shear walled buildings
4. Design of multistory reinforced concrete buildings for earthquake motion by J.A. Blume, N.M. Newmark.

CE-520 DISASTER REDUCTION AND MANAGEMENT

L	T/P
3	1

(Elective Course)

1. Disaster Reduction

Earthquake resistant design of structures, Response spectra and design earthquake parameters, Principles and philosophies, Codal provisions, Factors affecting damage to structures, Enforcement of codal provisions, Strong motion instrumentation and data processing, Effective rescue operation, General planning and design aspects, Conventional earthquake resistant design, Seismic base isolation method, retrofitting, Training and lecturing at various levels, Preparedness to meet earthquake disaster, Programmes for public awareness, demonstrations and exhibitions, Information management (Safety, emergencies, management and planning, design, response, user experience problems and case studies), Proper land use practices, long term disaster preparedness measures.

Precautions after a major earthquake, Preparedness for medical supply Emergency care (First aid, Home remedies), Disposal of dead bodies (Human and Cattle) , Care for old and orphans.

2. Indirect Damages

Damage due to ground failures, Landslides, rockslides, liquefaction, fire, floods, tsunamis, release of hazardous material like poisonous gas, nuclear radiation.

3. Disaster Management

Management cell, Central crisis management core group, damage reconnaissance, Management of relief and rehabilitation (Infrasture rehabilitation, Housing rehabilitation, Social rehabilitation), Role of volunteers, Emergency operation centres, Information system, Danger zone restrictions, Cooperation with local authority, Coordination for international relief, Role of government, NGO's, Bussiness and donors, Role of remote sensing in relief operations, Information management and related technologies in engineering and disaster management.

The design and management of Disaster Information Resource Network, Asian Disaster Preparedness Centre, Regional data base, Contacts and Sources, CD - ROM Library for Natural Disaster Management, Regional Disaster Documentation Centre, Non Governmental Organisations.