SCHEME AND SYLLABI FOR

SIXTH SEMESTER

OF

BACHELOR OF

TECHNOLOGY IN

CIVIL ENGINEERING

FROM 2009 ADMISSION ONWARDS

CALICUT UNIVERSITY (P.O), THENHIPALAM

6th Semester

Sl. No	Code	Subject	Hours / week			Marks		Sem-end Duration Hours	Credits
			L	T	P/D	Inte-rnal	Sem-end		
1	CE09 601	Hydrology & Irrigation Engineering	4	1	-	30	70	3	5
2	CE09 602	Structural Design II	3	1	-	30	70	3	4
3	CE09 603	Structural Analysis III	3	1	-	30	70	3	4
4	CE09 604	Geotechnical Engineering II	3	1	-	30	70	3	4
5	CE09 605	Transportation Engineering II	2	1	-	30	70	3	3
6	CE09 Lxx	Elective I	3	1	-	30	70	3	4
7	*CE09607(P)*	Geotechnical Engineering Lab	-	-	3	50	50	3	2
8	*CE09608(P)*	Materials Testing Lab II	-	-	3	50	50	3	2
		Total	**18**	**6**	**6**				**28**

Elective I

CE09 L01 Advanced Mechanics of Materials
CE09 L02 Traffic Engineering
CE09 L03 Maintenance and Repair of Buildings
CE09 L04 Computer Applications and Operations Research
CE09 L05 Functional Design of Buildings

CE09: 601 HYDROLOGY AND IRRIGATION ENGINEERING

Teaching scheme **Credits:** 5
4 hours lecture and 1 hour tutorial per week

Objective:
Students are expected to realize the importance of water resources and its application in irrigation engineering

Module I (18 hours)
Introduction: hydrologic cycle - application of hydrology in engineering - water balance equation - water resources of India.
Precipitation: Types, forms and measurement of precipitation –network design- presentation of data - average precipitation over an area - mass curve and hyetograph – double mass curve - depth-area-duration and intensity - duration-frequency analysis - probable maximum precipitation.
Runoff - Characteristics of runoff - factors affecting runoff - yield from a catchment.
Hydrograph analysis - components of hydrograph - base flow separation - rainfall- run off relations - unit hydrograph theory - derivation of unit hydrograph - applications and limitations of unit hydrograph - S hydrograph.

Module II (19 hours)
Irrigation - necessity - advantages - disadvantages – types- flow and lift irrigation - perennial and inundation irrigation –methods of irrigation-flooding, furrow, sprinkler and drip-important crops and crop seasons - duty and delta - water requirement - irrigation efficiency - direct and storage irrigation - multipurpose projects
Reservoir-types -investigation and planning - selection of site - fixation of storage capacity - flow duration curves - flow mass curve - reservoir sedimentation
Head works:- storage and diversion works-selection of site – Component and layout of Diversion head works – Head regulator and cross regulator (no design) - silt excluder and silt extractor - weirs - types of weirs- seepage theories – Biligh's and Khosla's theory –method of independent variables.

Module III (19 hours)
Distribution works: classification of canals - alignment of canals - considerations for fixing longitudinal slopes of canals - cross section of canals - burrow pits - spoil banks - service roads - back berm - counter berm – off take alignment - maintenance of irrigation canals - design of canals - erodible canals - canals in alluvial soils - regime theory - Kennedy's theory and Lacey's theory - silting in canal and prevention - scour - protection against scour - losses in irrigation canals - water logging - causes of water logging - measures for prevention of water logging - drainage - benefits of drainage - types of drains - design and maintenance of open drains - tile drains - layout of tile drain system -lining of irrigation canals - necessity and advantages of lining - disadvantage of lining - types of lining.
canal structures – Canal falls, canal outlets, canal escapes, cross drainage works.

Module IV (16 hours)
Floods - estimation of peak discharge - rational method - unit hydrograph method – frequency analysis.
River training and flood control works- river behaviour - control and training of rivers- objectives of river training- types of training works – guide banks – groynes - levees - flood banks - Flood control by regulating reservoirs - flood storage basin - flood warning –flood plain zoning.

Text books

1. Subramanya K., Engineering Hydrology, Tata McGraw Hill
2. Punmia B.C. & Lal P.B., Irrigation and Water Power, Lexmi Publications
3. Dr. Modi P.N., Irrigation Water Resources & Water Power, Standard publishers
4. Asawa, Irrigation Engineering, Wiley Eastern

Reference books

1. Regunath H.M., Hydrology, Prentice Hall
2. Chow V.T et. al., Applied Hydrology, McGraw Hill
3. Priyani V.B., The Fundamentals Principles of Irrigation Engineering, Charotar
4. Sahasrabudhe S.R., Irrigation Engineering & Hydraulic Structures
5. Varshney R.S., Theory & Design of Irrigation structures Vol. I & II, Nem Chand
6. Michael A.M., Irrigation - Theory & Practice, Vikas Publishing House
7. S.K Garg, Irrigation Engineering and Hydraulic structures, Khanna publishers
8. IS: 5968 (1987) – Guide for the planning and layout of canal system for irrigation

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Maximum Total marks:

CE09 602: STRUCTURAL DESIGN II

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives

- To familiarize the fundamental aspects of structural behaviour and design of steel structures satisfying the requirements such as safety, feasibility and economy of steel structures
- To introduce concepts on design of timber structures

Module I (12 hours)
Review of concepts of plastic analysis of beams and frames. Introduction to structural steel sections, material property, stresses, loads, types of design-rigid, semi rigid – Analysis and design of riveted, bolted and welded connections to resist direct force and moment-design of single and double angle ties-design of struts.

Module II (20 hours)
Solid and built-up columns for axial loads - design of battens and lacings. Design of eccentrically loaded solid & built-up columns
Analysis and Design of laterally restrained & unrestrained simple & compound beams-Design for flexure, shear, deflection, and bearing.

Module III (12 hours)
Column bases, column –beam connections-moment resistant connections (in plane, out of plane)
Design of roof trusses: types of roof trusses-selection-design loads and load combinations-assessment of forces due to wind-design principles-design of purlins, design of joints-design of members.

Module IV (10 hours)
Design of timber structures: types of timber - classification - allowable stresses-design of beams-flexure, shear, bearing and deflection considerations-Design of columns. Design of composite beam sections with timber and steel.

Note:
All designs shall be done as per current I.S. specifications
Special importance shall be given to detailing in designs
S.I. units shall be followed
IS 800, IS 883, IS 875 and SP 6 shall be permitted in the examination hall.

Text Book:
1. Subramanian N, Design of steel Structures, Oxford University Press
2. IS 800 – 2007, Code of practice for Structural steel design, BIS
3. Punmia B. C., Jain A. K. and Jain A. K., Design of Steel Structures, Laxmi Publications (P) Ltd.

Reference Books:
1. Ram Chandra., Design of steel Structures. Vol I & II Standard Book House
2. Arya and Ajmani., Design of Steel Structures., Nemchand
3. S.K.Duggal., Design of steel Structures, Tata McGraw-Hill
4. P.Dayaratnam., Design of Steel Structures ,Wheeler Publishing

5. Lin & Bresler, Design in Structural Steel, John Wiley
6. M.A. Kazimi and R.S. Jindal, Design of Steel Structures, Prentice-Hall of India
7. Krishnaraju N., Structural Design and Drawing-Reinforced Concrete and Steel, University Press
8. Raghupathi, Steel Structures, Tata McGraw Hill

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
IS: 800, IS: 883, IS: 875 and SP 6 are allowed in the exam hall

Maximum Total marks: 70

CE09 603: STRUCTURAL ANALYSIS III

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- To enable the students to have a comprehensive idea of matrix structural analysis with emphasis on the relative advantages of the flexibility method and the stiffness method
- To enable the students to visualize structural dynamics problems with a proper blend of structural analysis and vibration theory

Module I (17 hours)

Matrix analysis of structures: static and kinematic indeterminacy-force and displacement method of analysis-definition of flexibility and stiffness influence coefficients-development of flexibility matrices by physical approach

Flexibility method: flexibility matrices for truss and frame elements-load transformation matrix-development of total flexibility matrix of the structure-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects

Module II (11 hours)

Stiffness method: Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements-displacement transformation matrix-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects

Module III (11 hours)

Introduction to direct stiffness method-Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates- assembly of load vector and stiffness matrix, solution of two span continuous beam-single bay single storey portal frame.

Module IV (15 hours)

Structural dynamics-introduction-degrees of freedom-single degree of freedom-linear systems-equation of motion, D'Alembert's principle-damping-free response of damped and undamped systems-logarithmic decrement-transient response – Vibration isolation – Introduction to two degree of freedom systems

Text books:

1. Gere, J.M. and William Weaver, Matrix Analysis of framed structures, CBS Publishers
2. Clough R.W. and Penzein, J., Dynamics of structures, Tata McGraw Hill
3. Anil. K. Chopra, Dynamics of structures, Pearson Education/ Prentice Hall India
4. Beaufait. F.W., Basic concepts of structural analysis,
5. Denhartog, Mechanical Vibration
6. Rajasekharan.S. and Sankarasubramanian G., Computational structural Mechanics, PHI
7. Reddy C.S., Basic structural analysis, Tata McGraw Hill

Reference books:

1. Wang C.K., Matrix method of structural analysis, International Text book company
2. Przemeineicki J.S., Theory of Matrix structural analysis, Tata McGraw Hill
3. Meivovitch L., Elements of vibration analysis
4. Thimoshenko.,Vibration problems in Engineering
5. Biggs, Structural Dynamics
6. Coates.R.C, and Coutie M.G., Structural Analysis

7. Madhujith Mukhopadhyay and Abdul Hamid Sheikh, Matrix and Finite Element Analysis of Structures, Ane Books India

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions* *.4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Maximum Total marks: 70

CE09 604: GEOTECHNICAL ENGINEERING II

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective

- To impart knowledge in behaviour and design aspects of various types of foundations

Module I (13 hours)

1. Stresses due to applied loads: Introduction- Boussinesque's equations for vertical pressure due to point loads, uniformly distributed loads and strip load - assumptions and limitations - pressure bulb – Newmark's charts and their use – Westergaard's formula for point loads- Approximate methods for vertical stress-distribution of contact pressure beneath footings.

2. Site investigation and soil exploration: objectives - planning - reconnaissance - depth and lateral extent of explorations -methods of subsurface exploration - test pits - Auger borings - rotary drilling –Types of soil samples-split spoon samplers- Standard penetration test- hand cut samples- boring log - soil profile- geophysical methods (in brief).

Module II (13 hours)

3. Foundation - general consideration: functions of foundations - definition of shallow and deep foundation - different types of shallow and deep foundations- selection of type of foundation - advantages and limitations of various types of foundations.

4. Bearing capacity of shallow foundations: Ultimate and allowable bearing capacity- net bearing pressure- Allowable soil pressure –Types of shear failure. Terzaghi's equation for bearing capacity for continuous, circular, rectangular and square footings -- bearing capacity factors and charts - - effect of water table on bearing capacity- Skemption's formulae, Meyerhof's formulae and IS code formula –bearing capacity based on SPT.

Module III (15 hours)

5. Settlement analysis: Introduction- causes of settlement – immediate, consolidation and total settlement – loads for settlement analysis-estimation of immediate and consolidation settlement - Allowable settlement-Maximum and differential settlements as per Indian standard- net safe settlement pressure based on SPT- cracks due to settlements- plate load test.

6. Footings: types of footings - depth of footing- foundation loading- principles of design of footings – strip/continuous, individual and combined (Rectangular, trapezoidal and strap only) footings - footings subjected to eccentric loading - conventional procedure for proportioning footings for equal settlements.

7. Open excavation: Open foundation excavations with unsupported slopes-supports for shallow and deep excavations-stress distribution in sheeting and bracing of shallow excavations.

Module IV (13 hours)

8. Raft foundations: Types –Principles of design of raft foundation- bearing capacity equations- for raft on sand based on SPT results (Teng's equation, Bowle's equation and IS 6403 formula) – raft on clay (Skempton's formula) - design methods - floating foundations - conventional design procedure for rigid mat.

9. Pile foundations: uses of piles - classification of piles - determination of type and length of piles - determination of bearing capacity of axially loaded single vertical pile – static (Meyerhof's formula) and dynamic (Engineering News Record formula and Hiley's formula) - pile load tests (IS methods) - negative skin friction – pile group - group action, pile spacing and efficiency of pile groups.

Note: Structural designs of foundations are not contemplated in this course.

Text Books

1. Arora K.R., *Soil Mechanics & Foundation Engineering.* Standard Publications
2. Joseph E. and Bowles, *Foundation Analysis & Design*, McGraw Hill
3. Punmia B. C., *Soil Mechanics & Foundations*, Laxmi Publications

Reference books

1. Gopal Ranjan and Rao A.S.R., *Basic and applied soil mechanics*, New Age International Publishers
2. Venkatramiah, *Geotechnical Engineering*, New Age International Publishers
3. Shashi K. Gulhati and Manoj Dutta, Geotechnical Engineering, Tata McGraw-Hill Publishing Compay Limited, New Delhi.
4. Leonards G.A., *Foundation Engineering*, McGraw Hill
5. Teng W.C., *Foundation Design*, PHI
6. Tomlinson M.J., *Foundation Design & Construction*, Pitman
7. Murthy V.N.S., *Soil Mechanics & Foundations*
8. Coduto, *Geotechnical Engineering Principles and Practices*, Pearson Education

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Note: No charts, tables, codes are permitted in the Examination hall .If necessary relevant data shall be given along with the question by the question paper setter.
Maximum Total marks: 70

CE 09 605: TRANSPORTATION ENGINEERING II

Teaching scheme **Credits:** 3
2 hours lecture and 1 hour tutorial per week

Objective*:*

- To build a strong, stable and deep concept in different means of transportation, to have a clear picture in the details of design, construction and maintenance of structures coming under this field.

Module I (14 hours)
Permanent way: functions and requirements of permanent way - components - typical cross sections - gauges - functions and requirements of components of permanent way - sleeper density - coning of wheels creep and wear in rails - rail fasteners - defects, failures and joints in rails - material assessment for unit length of track – Geometric design of railway track - horizontal curves - super elevation - cant deficiency - negative super elevation - safe speed on curves - gradients and grade compensation - worked out problems

Module II (7 hours)
Signalling and interlocking - signal control systems - points and crossings - track junctions - track
circuiting - track alignment - construction of railway track - railway stations and yards.
Railway construction and maintenance
Construction of railway track- earth work plate laying and packing-maintenance of track - alignment - gauge-renewal of component parts-drainage - modern methods of track maintenance.

Module III (9 hours)
Elements of harbour - ports - various design considerations of a harbour - classifications - site selection factors - wet and dry docks - lock and lock gates - site selection, configuration and types of breakwaters - details of quays, piers, fenders, dolphins, slipways - transit shed and warehouse - navigational aids

Module IV (6 hours)
Tunneling: - Location survey and factors to be considered - different sections - shafts - transferring of centre line - methods of tunneling in hard rocks and soft soils - different methods for lining, ventilation, lighting and drainage

Text books:
1. Antia K.F., Railway Track, New Book Company Pvt. Ltd.
2. Subhash C Saxena and Satyapal Arora, A Text Book of Railway Engineering, Dhanapat Rai and Sons, NewDelhi
3 Quinn A.D., Design and Construction of Ports and Marine Structures, McGraw Hill.

References:
1. Agarwal. M.M., Railway Engineering, Prabha & Co. New Delhi, 1998
2. J.F Mundrey Railway track Engg. Tata Mc Graw Hill, New Delhi
3. P. Sreenivasan, Dock and Harbour Engineering,

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Maximum Total marks: 70

CE09 L x ELECTIVE I

CE09 607(P): GEOTECHNICAL ENGINEERING LAB

Teaching scheme **Credits:** 2

3 hours practical per week

List of Experiments

1. Specific gravity of coarse and fine grained soils
2. Grain size analysis (a) Sieve analysis
3. Atterberg limits and indices
4. Determination of field density (a) sand replacement method (b) core cutter method
5. Determination of coefficient of permeability by
   (a) Constant head method (b) variable head method
6. Consolidation test
7. Compaction test (a) IS light compaction test (b) IS heavy compaction test
8. California bearing ratio test
9. Direct shear test
10. Unconfined compressive strength test
11. Triaxial shear test
12. Tests on aggregates: Los Angeles abrasion test, Shape test, Aggregate Impact value.
13. Tests on bitumen: Penetration test, Softening test, Ductility test & Specific Gravity.

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

End Semester Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

CE09 608(P): MATERIAL TESTING LAB -II

Teaching scheme **Credits:** 2
3 hours practical per week

Objective:
To study strength aspects of concrete & Metals

List of Experiments

1. Tension test on mild steel specimens using Universal Testing Machine (UTM) and suitable extensometer
2. Shear test on mild steel rod
3. Torsion test on metal rods
4. Torsion test on metal wires – torsion pendulum
5. Spring test
   a) Open coiled spring
   b) Close coiled springs
6. Impact test
   a) Izod test
   b) Charpy test
7. Hardness test
   a) Brinell Hardness test
   b) Rockwell Hardness test
   c) Vickers Hardness test
8. Casting of concrete cubes & cylinders with specified proportions/mix
9. Split tensile strength of concrete cylinders
10. Compression test on concrete cubes & cylinders – Determination of Modulii of elasticity
11. Flexural test on concrete beams
12. Study/demonstration on Electrical resistance strain gauges, load cell

Internal Continuous Assessment *(Maximum Marks-50)*

60%-Laboratory practical and record
30%- Test/s
10%- Regularity in the class

End Semester Examination *(Maximum Marks-50)*

70% - Procedure, conducting experiment, results, tabulation, and inference
20% - Viva voce
10% - Fair record

CE09 L01: ADVANCED MECHANICS OF MATERIALS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objective:

- To review and make more useful the methods and results presented in the first course on Mechanics of Materials.
- To show the limitations of the ordinary formulas of Strength of Materials, to consider the conditions under which these limitations are significant and to extend the subject to include a variety of important topics more complex than those usually involved in a first course.

Module 1 (16 hrs)

Stress, Principal stresses, Strain energy:

Stress at a point – stress on an arbitrarily oriented plane-stress transformations- strain theory-principal stresses & strains (2d & 3d)- Generalized Hooke's law-Equations of thermo-elasticity for isotropic materials-strain energy density- stress concentration.

Failure & Failure criteria:

Modes of failure –yield failure criteria-introduction to fracture mechanics-cracks & brittle fracture-fatigue-elastic and inelastic buckling.

Module II (14 hrs)

Beams on elastic foundation:

Basic equations-Winkler foundations- semi-infinite beams with concentrated loads-infinite beams with concentrated loads-uniformly distributed load-beams of finite length.

Curved Beams:

Circumferential stresses-radial stress and shear stress in curved beams-sections having thin flanges-closed sections with thin walls-deflections of sharply curved beams.

Module III (12 hrs)

Elements of theory of elasticity

Displacements-strains and compatibility-equilibrium equations and boundary conditions-stress field solutions for plane stress problems-polynomial solutions in Cartesian coordinates-displacements calculated from stresses-plane stress problems in polar coordinates.

Module IV (12 hrs)

Torsion

Torsion of a cylindrical bar of circular cross section- St. Venant's semi inverse method-stress function approach-elliptical, equilateral triangle & narrow rectangular cross sections-Prandtl's membrane analogy-Hollow thin wall torsion members-multiply connected cross sections- thin wall torsion members with restrained ends.

Text books:

1. R.D.Cook and W.C.Young, Advanced Mechanics of Materials, 2nd edition, Prentice Hall Intl,Inc.1999.
2. A.P.Boresi and O.M.Sidebottom, Advanced Mechanics of Materials, 4th edition, John Wiley & Sons,Inc.1985

References:

1. Timoshenko S.P and Goodier J.N, Theory of elasticity, McGraw Hill.
2. Srinath L.S, Advanced Mechanics of Solids, Tata McGraw Hill.
3. S P Timoschenko, Strength of Materials Vol II ,CBS Publishers
4. Shames, E.H., Mechanics of Deformable solids.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Maximum Total marks: 70

CE09 L02: TRAFFIC ENGINEERING

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Module I (12 hours)
Scope of traffic engineering & study of its elements - introduction - objectives and scope of traffic engineering - components of road traffic - vehicle, driver and road – road user and vehicle characteristics and their effect on road traffic - traffic maneuvers – traffic stream characteristics - relationship between speed, flow and density - sampling in traffic studies - adequacy of sample size

Module II (14 hours)
Traffic engineering studies and analysis - objectives - methods of study - equipment -data collection - analysis and interpretation (including case studies) of speed, speed and delay, volume, origin and destination, parking, accident & other studies .

Module III (14 hours)
Design, regulation and management of traffic engineering facilities - control of traffic movements through time sharing and space sharing concepts - design of canalizing islands, T, Y, skewed, staggered, round about, Mini-round about and other forms of at grade intersection - crossings including provision for safe crossing of pedestrians and cyclists - grade separated intersections - their warrants and design features - bus stop location and bus bay design - road lighting - regulations on vehicles, drivers and traffic - planning and design of one-way-streets - reversible lanes and roadways - turn regulation - transit and carpool lanes - pedestrian facilities.

Module IV (14 hours)
Traffic control devices and environmental control - traffic signs - markings and signals - different methods of signal design - redesign of existing signals including case studies - signal system and co-ordination - air and noise pollution of different transport modes - visual impacts - impacts on land development - technological approaches to improving environment.

Text Books
1. Pignatyaro L., Traffic Engineering – Theory & Practice , John Wiley
2. Kadiyali L.R., Traffic and Transport planning, Khanna Publishers

Reference Books
1. The Institute of Transportation Engineers, Transportation and Traffic Engineering Hand Book, Prentice Hall, Chapters 8, 17, 23, and 24
2. O' Flaherty C.A., Highways – Traffic planning & Engineering, Edward Arnold
3. MC Shane W.R.and Roess R.P., Traffic Engineering, Prentice Hall
4. IRC – SP41, Guide lines for the Design of At-Grade Intersections in Rural & Urban Areas
5. Salter R.J., Highway Traffic Analysis and Design, ELBS
6. Matson, Smith and Hurd, Traffic Engineering, McGraw Hill Book Co.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Problem solving questions.* *4×10 marks= 40 Marks*

Two questions from each module with choice to answer one question.

Maximum Total marks: 70

CE09 L03: MAINTENANCE AND REPAIR OF BUILDINGS

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objective:

To study the durability aspects of buildings, causes and process of failure and repair and rehabilitation methods.

Module I (13 Hours)

Durability of buildings: Life expectancy of different types of buildings –effect of environmental elements such as heat, dampness, frost and precipitation on buildings-effect of chemical agents on building materials-effect of pollution on buildings-effect of fire on building-damage by biological agents like plants, trees, algae, fungus, moss, insects, etc.

Module II (15 hours)

Failure and repair of buildings: Definition of building failure-types of failures-methodology for investigation of failures-diagnostic testing methods and equipments-repair of cracks in concrete and masonry-methods of repair-repair and strengthening of concrete buildings-foundation repair and strengthening-underpinning-leakage of roofs and repair methods

Module III (13 hours)

Maintenance of buildings: Reliability principles and its applications in selection of systems for building- routine maintenance of building-maintenance cost-specifications for maintenance works-dampness-damp proof courses-construction details for prevention of dampness-termite proofing-fire protection-corrosion protection.

Module IV (13 hours)

Conservation and recycling: Performance of construction materials and components in service-rehabilitation of constructed facilities-conservation movement-materials and methods for conservation work-recycling of old buildings and its advantages- examples

Text Books:

1. Smith P & Julian W, Building services, Applied science publications
2. S Champion-Failure and repair of concrete structurers

References:

1. Peter H. Emmons, Concrete Repair and Maintenance, Galgotia Publishers
2. Jacob Feld –construction failure
3. Mckaig T.M, Building failures, Applied science publications
4. SP:25 BIS, Causes and Prevention of Cracks in buildings
5. Shetty M. S., Concrete Technology, S Chand and company
6. SP:62 (S&T)-1997, BIS, Hand Book on Building Construction Practice, pp. 457-765
7. Philip.H.Perkins , Concrete Structures – Repair water proofing & Protection
8. Raikar, Durable Structures – Through Planning for Preventive Maintenance, R & D Centre, Structural Designers and Consultants Pvt. Ltd., Vashi, New Bombay
9. Raikar, Diagnosis and Treatment of Structures in Distress, R & D Centre, Structural Designers and Consultants Pvt. Ltd., Vashi, New Bombay
10. Repair and Strengthening of Reinforced Concrete, Stone and Brick Masonry Buildings, United Nations Industrial Development Organisation, Vienna.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*

All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*

Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.

PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*

Two questions from each module with choice to answer one question.

Maximum Total marks: 70

CE09 L04: COMPUTER APPLICATIONS AND OPERATIONS RESEARCH

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives:

- To enable the students to familiarize with mathematical models and numerical tools for solving and optimizing engineering problems.

A. Numerical methods in civil engineering

Module I (16 hours)

Introduction to numerical methods in civil engineering: importance of numerical methods in civil engineering - sources of errors in numerical methods - number representations - fixed and floating point numbers - significant digits - round off errors - development of computer algorithms - pseudo code

Solution of algebraic and transcendental equations in one variable: bisection method - method of false position - Newton-Raphson method - successive approximation method - development of computer algorithms for each of the above methods

System of linear algebraic equations: solution of linear algebraic equations using Gauss elimination method and LU decomposition method - solution by iterative method - conditions of convergence-III conditioned system of equations - applications in civil engineering problems – matrix structural analysis

Module II (13 hours)

Eigen value problems: examples of formulation of structural stability and structural dynamics problems as Eigen value problems in civil engineering - principal stresses and strains - free vibration of multi degree of freedom systems - determination of Eigen values and Eigen vectors by power method and Jacobi's method

Interpolation: Newton's formulae - Gauss' formulae - lagrangian interpolation - cubic spline interpolation

Module III (12 hours)

Numerical differentiation and integration: numerical differentiation using Newton's and Gauss' formulae - maximum and minimum values of tabulated functions - Newton Cote's integration formulae - numerical integration using trapezoidal formula - Simpson's formulae and Gauss quadrature - development of computer algorithms for numerical integration

Numerical solution of ordinary differential equations: Taylor's series method - Euler's method - Runge-Kutta method - finite difference method for the solution of boundary value problems

B. Optimisation methods in civil engineering

Module IV (13 hours)

Linear programming problems: statement of an optimisation problem - linear and nonlinear programming problems - standard form of linear programming problems - simplex algorithm - degeneracy, duality, transportation problem, assignment problem- applications of linear programming problems in civil engineering - limit design of steel portal frames

Introduction to Genetic Algorithms- basic concept - problem formulation - operations- convergence criteria.

Text Books

1. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India
2. Scarborough J.B., Numerical Mathematical Analysis, Oxford and IBH
3. Rao S.S., Engineering Optimization-Theory and Applications, New Age International Publishers

Reference books:

1. Krishnamoorthy E.V. and Sen S.K., *Numerical Algorithms*, Affiliated East West Press
2. Kirsch U., *Optimum Structural Design*, McGraw Hill
3. Fox R.L., *Optimization Methods for Engineering Design*, Addison Wesley
4. Singiresu S. Rao, Engineering Optimization (Theory and Practice) 3rd Edition, New Age International (P) Ltd.
5. Press W.H., et al. Numerical Recipes in C – The art of Computation, Cambridge Press
6. Goldberg D.E., Genetic Algorithms in Search, Optimisation and Machine Learning, Addison Wesley Publishing Company.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
10% - Regularity in the class

University Examination pattern

PART A: *Short answer questions* *5×2 marks=10 Marks*
All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.
PART B: *Analytical / Problem solving questions* *4×5 marks=20 Marks*
Candidates have to answer four questions out of six. There should be at least one question from each module and not more than two questions from any module.
PART C: *Analytical / Problem solving questions.* *4×10 marks= 40 Marks*
Two questions from each module with choice to answer one question.
Maximum Total marks: 70

CE09 L05: FUNCTIONAL DESIGN OF BUILDINGS

Teaching scheme **Credits:** 4
3 hours lecture and 1 hour tutorial per week

Objectives:

- To study the design concepts for acoustical and lighting services
- To study principles of climatic design of buildings for tropical climates.

Module I (13 Hours)
Introduction to functional design – principles.
Acoustics : Physics of sound – frequency, intensity, variation with time, dB scale – measurement – airborne and structure borne propagation – effect of noise on man – behavior of sound in free field and enclosures – Sabine's formula – design criteria for spaces – acoustical defects – sound reduction, sound insulation and reverberation control – typical situation like offices, flats, auditorium and factories – acoustic materials – properties – types and fixtures.

Module II (13 Hours)
Lighting and Illumination Engineering: Types of visual tasks – principles of day lighting – day light factor – sky component – internal reflected component – external reflected component – design of windows for lighting – effect of orientation – evaluation of lighting by windows, skylights – artificial lighting – illumination requirements for various buildings – measurement – lux meter – lamps and luminaries – polar distribution curves – design of artificial lighting – lumen method – point by point method – coefficient of utilisation – room index – maintenance factor – room reflectance – glare – flood lighting of building exteriors – street lighting of building neighbourhood.

Module III (16 Hours)
Climatic elements: Climate on a global scale – solar radiation – radiation at earth's surface – measurement of solar radiation - earth's thermal balance – winds – trade winds – Westerlies – polar winds – wind data measurement at site – air pressure – atmospheric humidity – measurement – psychometric chart – condensation and precipitation – climatic graph – temperature inversion – influence of topography – urban climates – comparison and classification of climates.
Thermal comfort: Human body's heat production – body's heat loss – thermal balance of a body – heat loss in various environments – effect of prolonged thermal exposure –subjective variables – thermal comfort indices – effective temperature – psychometric chart – ET and its use – effect of radiation – mean radiant temperature – ET nomograms – finding CET – comfort zone
Thermo physical properties of building materials: Thermal quantities – heat flow – thermal conductivity – resistance and transmittance and surface coefficient – cavities – Solar radiation – absorbed, reflected and transmitted sol- air temperature concept- solar gain factor.
Heat flow through buildings – thermal transmittance of structural elements – thermal gradients – heat gain calculation - periodic heat flow – time lag and decrement factor.
Sun's movement and building – apparent movement of sun – solar charts and its use.

Module IV (12 Hours)
Design criteria for control of climate – passive and active building design – passive approach by orientation, glazing, shading, choice of building materials etc. Thermal insulation – insulating materials – properties – insulation of roofs, walls and openings.
Shading devices – shadow angles – internal blinds and curtains – heat absorbing glasses – effect of orientation on incident solar radiation and internal temperature – active systems – low energy cooling. Introduction to Intelligent buildings.

Text Book:

1. Koenigseberger, Manual of tropical Housing and Building Part I – Climatic design, Orient Longman

Reference Books:

1. Ajitha Simha, D. Building Environment, Tata McGraw Hill Publishing Co., New Delhi
2. Givoni B. Man, Climate and Architecture, Applied Science Publication.
3. Knudsen V.O. and Harris C.M., Acoustical Design in Architecture, John Wiley
4. Bureau of Indian Standards, National Building Code of India 1983
5. Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T) – 1987
6. Narasimham V., An Introduction to Building Physics
7. Krishnan, Climate responsive architecture, Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-30)*

60% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.
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