REVISED CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SECOND SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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Board of Studies meeting 03.01.2009 Approved in 37th Academic council meeting dt.24-01-2009

Department of Civil Engineering

Graduating Students of BE program of Civil Engineering will be able to

1. Survey, map and plan layouts for buildings, structures and alignments for canals and roads
2. Specify, design, supervise, test and evaluate foundations and superstructures for residences, public buildings, industries, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.
3. Specify, design, supervise and evaluate water conveying systems.
4. Specify, select and formulate environmental engineering systems
5. Specify, design/select and operate hydraulic machines and surge systems
6. Analyze water resources hydrological systems to estimate safe and assured withdrawals.
7. Work in a team using common tools and environments to achieve project objectives

Thiagarajar College of Engineering, Madurai-625015

Department of Civil engineering

Scheduling of Courses

Semester	Theory Courses							Practical / Project	
8th (21)	Elective 6 3:0	Elective 7 3:0	Elective 8 3:0					B88 Project 0:12	
7th (22)	B71 Management Theory and Practice 3:0	B72 Remote Sensing and GIS 3:0	Elective 3 3:0	Elective 4 3:0	Elective 5 3:0		B77 GIS Laboratory 0:1	B78 Project 0:6	
6th (22)	B61 Accounting and Finance 3:0	B62 Transportation Engineering 1 4:0	B63 Geotechnical Engineering 2 4:0	B64 Irrigation and Water Resources Engineering 3:0	Elective 1 3:0	Elective 2 3:0	B67 Highways Lab 0:1	B68 Design and Drawing 0:1	
5th (24)	B51 Engineering Mathematics – 5 4:0	B52 Environmental Engineering 2 3:0	B53 Structural Analysis 2 4:0	B54 Structural Design 2 4:0	B55 Hydrology 3:0	B56 Geotechnical Engineering 1 4:0	B57 Geotechnical Engineering Lab 0:1	B58 Environmental Engineering Lab 0:1	
4th (24)	B41 Engineering Mathematics – 4 4:0	B42 Environmental Engineering 1 3:0	B43 Structural Analysis 1 4:0	B44 Structural Design 1 4:0	B45 Hydraulics and Hydraulic Machinery 3:0	B46 Ecology 2:0	B47 CAD 0:1	B48 Survey Practicals II 0:1	B48 Professional Communication 1:1
3rd (23)	B31 Engineering Mathematics – 3 4:0	B32 Strength of Materials 2 3:0	B33 Surveying 4:0	B34 Fluid Mechanics 3:0	B35 Data Structures 3:0	B36 Concrete Technology 3:0	B37 Survey Practicals I 0:1	B38 Fluid Mechanics Lab 0:1	B39 Concrete Lab
2nd (23)	B21 Engineering Mathematics -2 4:0	B22 Strength of Materials 1 3:0	B23 Engineering Geology 3:0	B24 Computers and Programming 3:0	B25 Materials Science 3:0	B26 Construction Maerials & Technology 4:0	B27 Strength of Materials Lab 0:1	B28 Computer Programming Lab 0:1	B29 Workshop 0:1
1st (25)	H11 Engineering Mathematics – 1 4:0	H12 Physics 3:0	H13 Chemistry 3:0	H14 English 3:0	H15 Basics of ME and CE 4:0	H16 Basics of EEE 4:0	H17 Physics Lab 0:1	H18 Chemistry Lab 0:1	H19 Engineering Graphics 0:2

Board of Studies meeting 03.01.2009   Approved in 37th Academic council meeting dt.24-01-2009

THIAGARAJAR COLLEGE OF ENGINEERING : MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SUBJECTS OF STUDY

(For the candidates admitted from 2008-2009 onwards)

SECOND SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
B 21	Engineering Mathematics II	BS	4	-	-	4
B 22	Strength of Materials 1	DC	3	-	-	3
B 23	Engineering Geology	DC	3	-	-	3
B 24	Computers and Programming	ES	3	-	-	3
B 25	Materials Science	ES	3	-	-	3
B 26	Construction Materials and Technology	DC	4	-	-	4
PRACTICAL						
B 27	Strength of Materials Lab	DC	-	-	2	1
B 28	Computer Programming Lab	ES	-	-	2	1
B 29	Workshop	ES	-	-	2	1
Total			**20**	**-**	**6**	**23**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
DC : Department Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture/Tutorial is equivalent to 1 credit
2/3 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING : MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2008-2009 onwards)

SECOND SEMESTER

S.No.	Sub. code	Name of the subject	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	B21	Engineering Mathematics II	3	50	50	100	25	50
2	B22	Strength of Materials 1	3	50	50	100	25	50
3	B23	Engineering Geology	3	50	50	100	25	50
4	B24	Computers and Programming	3	50	50	100	25	50
5	B25	Materials Science	3	50	50	100	25	50
6	B26	Construction materials and Technology	3	50	50	100	25	50
PRACTICAL								
7	B27	Strength of Materials Lab	3	50	50	100	25	50
8	B28	Computer Programming Lab	3	50	50	100	25	50
9	B29	Workshop	3	50	50	100	25	50

* CA evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

Sub Code	Lectures	Tutorial	Practical	Credit
B 21	4	0	-	4

B21 Engineering Mathematics II

(Common to all branches of Engineering B21, C21, D21, E21, G21, T21)

Program Outcomes addressed

1. An ability to apply knowledge of engineering, information technology, mathematics, and science
2. An ability to identify, formulate and solve engineering problems
3. An ability to engage in life-long learning

Competencies: At the end of the course the students should be able to

1. Formulate and solve problems of engineering dynamics using different differential operators.
2. Formulate the problem of computing areas and volumes through vector integration, and determine them by applying Green, Stokes and Divergence theorems
3. Determine maxima and minima of functions of several variables using analytical and Lagrangian multipliers methods
4. Determine the values of multiple integrals directly or by changing the order of integration or by making transformation with Jacobians.
5. Determine areas and volumes of geometrical figures using multiple integrals, beta and gamma functions.
6. Analyze functions of complex variable in terms of continuity, differentiability and analyticity.
7. Apply Cauchy-Riemann equations and harmonic functions to problems of fluid mechanics, thermodynamics and electro-magnetic fields.
8. Find singularities of complex functions and determine the values of integrals using residues.
9. Geometrically interpret conformal and bilinear transformations

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test3/End-semester examination
1	Remember	10	10	0
2	Understand	30	30	30
3	Apply	60	60	70
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Syllabus

Functions of Several Variables: Partial derivatives and Jacobians, Total differentiation and applications, Lagrangian Multiplier method, Applications to Maxima and Minima **Multiple Integrals:** Double integrals and areas, Triple integrals and volumes, Change of order of integration, Beta and Gamma functions with applications, Change of variables between Cartesian and polar with applications **Vector calculus:** Vector Differentiation with simple applications, Operators Grad, div and curl with properties, Applications to Physics, Vector Integration(three famous theorems), Applications to areas and volumes **Complex Differentiation:** Analytic functions, C-R equations and properties, Harmonic Functions and Milne-Thompson Method, Applications to flow problems, Conformal maps and bilinear transformations, Applications of the bilinear transformations **Complex Integration:** Cauchy's theorem and consequences, Evaluating integrals using Cauchy's integral formula, Taylor and Laurent expansions, Singularities, poles and Cauchy residue theorem, Contour integration using unit circle and semicircular contours

Text Book

B.S. Grewal: Higher Engineering Mathematics, 39th Edn., Khanna Publishers, New Delhi,2006

References

1. Lecture Notes by the faculty of Department of Mathematics, TCE, Madurai
2. Veerarajan T., Engineering Mathematics, 3rd Edn., Tata McGraw Hill, New Delhi, 2004
3. Venkataraman M.K., Multiple Integrals and Gamma, Beta functions, National Publishing Co., 2004
4. Kreyszig E., Advanced Engineering Mathematics, 8th Edn. John Wiley & Sons,2004
5. Thomas Phinny, Calculus,13th Edition Pearson Education, New Delhi,2005
6. Kreyszig E, Advanced Engineering Mathematics, 8th edition,John Wiley&sons.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1.	**Functions of Several Variables**	
1.1	Partial derivatives and Jacobians	2
1.2	Total differentiation and applications	2
1.3	Lagrangian Multiplier method	2
1.4	Applications to Maxima and Minima	2
2.	**Multiple Integrals**	
2.1	Double integrals and areas	1
2.2	Triple integrals and volumes	1
2.3	Change of order of integration	2
2.4	Beta and Gamma functions with applications	2
2.5	Change of variables between Cartesian and polar with applications	2
3	**Vector calculus**	
3.1	Vector Differentiation with simple applications	1
3.2	Operators Grad, div and curl with properties	3
3.3	Applications to Physics	1
3.4	Vector Integration(three famous theorems)	4
3.5	Applications to areas and volumes	3
4	**Complex Differentiation:**	
4.1	Analytic functions, C-R equations and properties	3
4.2	Harmonic Functions and Milne-Thompson Method	2
4.3	Applications to flow problems	1
4.4	Conformal maps and bilinear transformations	2

No.	Topic	No. of Lectures
4.5	Applications of the bilinear transformations	2
5.	**Complex Integration**	
5.1	Cauchy’s theorem and consequences	2
5.2	Evaluating integrals using Cauchy’s integral formula	2
5.3	Taylor and Laurent expansions	2
5.4	Singularities, poles and Cauchy residue theorem	2
5.5	Contour integration using unit circle and semicircular contours	4

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 22	3	0	-	3

B22 Strength of Materials I

Preamble: A structure is made up of constituent elements like beam, column and membrane. The constituent elements should have adequate size to resist applied loads to build a safe structure. Their size is decided by material properties of the elements, particularly their strength. Man seems to have had information regarding the strength of structural material even in ancient times. They had worked out empirical rules which they used to dimension elements of structures like the pyramid, coliseum, harbors, bridges and aqueducts that bring awe to the beholder even today. The Greek had even developed statics, the foundation of mechanics of materials, and people like Archimedes put this into practice by hoisting huge structural elements and putting them in place. But this ancient knowledge was lost during the middle ages and only during the renaissance the science of material strength was recovered. At that time people like Leonardo da Vinci took mechanics of structures to great heights. He investigated the strength of materials experimentally, the bending of beam and its variation with different lengths and loads. He even investigated the strength of columns.

But the first attempt to find safe dimension for a structural element, analytically, was attempted only in the 17th century. It started with Galileo's famous book on strength and mechanics of materials, called, 'Two New Sciences.' That was the start of Strength of Materials. There was rapid development in the field of mechanics of materials at the end of the 19th century. Testing of materials attracted attention and soon the National Bureau of Standards was born in USA. Research took on a new turn facilitating closer contact between engineers and physicists. Meanwhile in the field of Strength of Materials, refinements in stress analysis, both analytical and experimental took place. Fields like fracture mechanics, stress concentration, ductility, strength theories, fatigue, experimental stress analysis are few among a vast horde of new fields of study that have emerged from a renewed interest in Strength of Materials in twentieth century.

Program Outcomes addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

d. An ability to identify, formulate and solve engineering problems

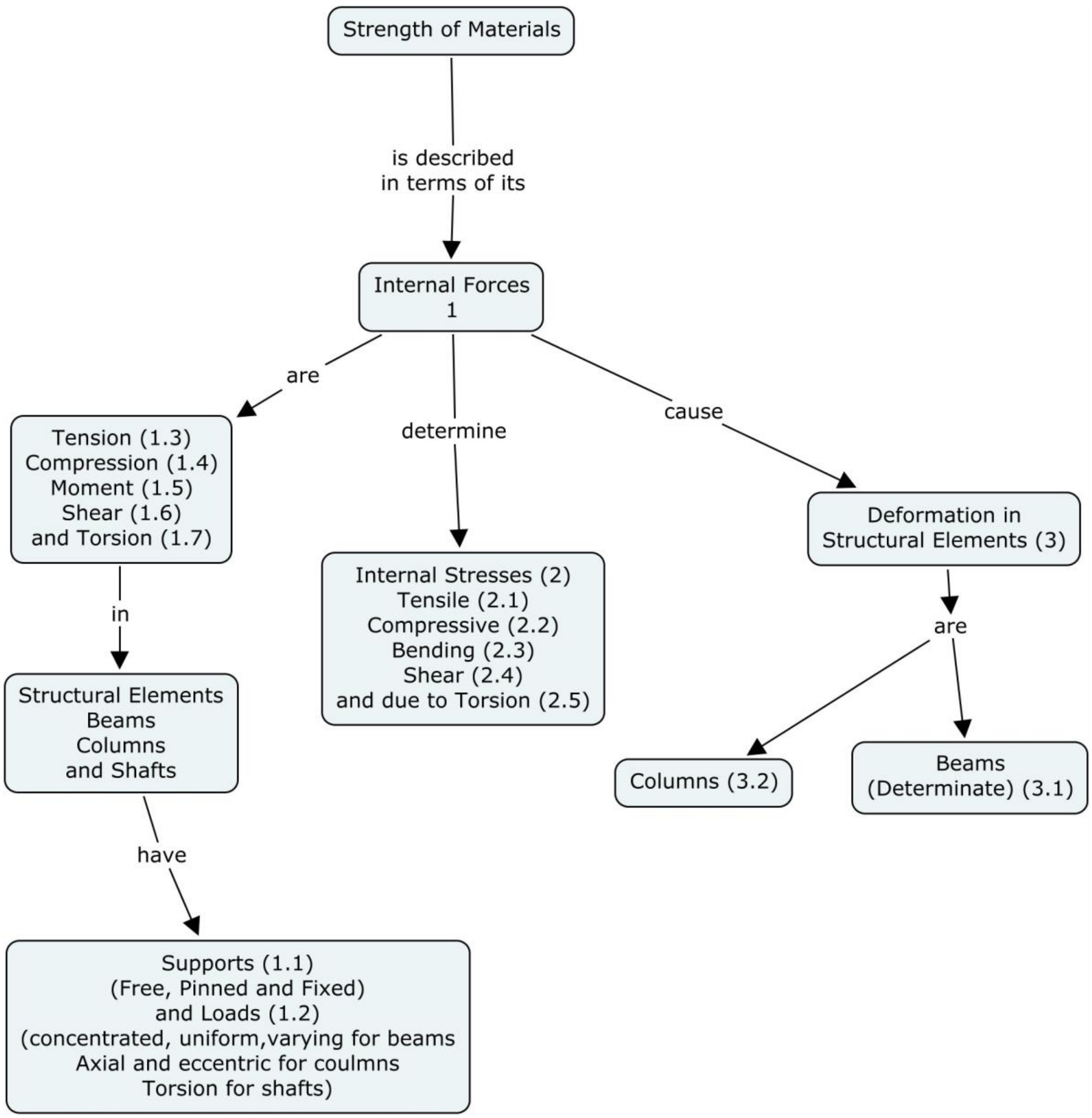
Competencies: At the end of the course the student should be able to

1. Determine elastic constants of materials (wood, steel and aluminum).
2. Represent three-dimensional structural elements (beams, columns and slabs) as two-dimensional rigid bodies with end conditions and loads.
3. Determine the internal stresses (compression, tension, shear and shear stress, bending moment and stress, slope and deflection, torsion and torsion stress) in two-dimensional determinate structural elements for different end conditions and loads.
4. Determine the load carrying capacity and failure pattern of short and long columns

Assessment Pattern

	Bloom's Category	Test 1	Test 2	End-semester examination
1.	Remember	30	20	10
2.	Understand	30	20	10
3.	Apply	20	30	40
4.	Analyze	10	20	20
5.	Evaluate	10	10	20
6.	Create	0	0	0

Concept Map:



Syllabus:

Supports: Free, Pinned, Fixed**; Loads:** Concentrated, uniform, varying for beams; Axial and eccentric for columns; Torsion for shafts**; Internal Forces:** Tension, Compression, Moment, Shear, Torsion **Internal Stresses:** Tensile Stresses, Compressive Stresses, Bending Stresses, Shear Stresses, Stress due to impact, Stresses due to Torsion, springs-open and close coiled**;**

Structural Elements: Beams – Slope and deflection: Double Integration Method, Moment Area Method and Macaulay's Method and Columns – Core and stresses, Long Columns – Euler's critical load, empirical formula, secant formula,

References

1. Ferdinand P. Beer and E. Russell Johnston Jr: Mechanics of Materials**,** 1992, McGraw Hill Book Company, Singapore
2. James M. Gere and Stephen P. Timoshenko: Mechanics of Materials (3^{rd} edition), 2002, McGraw Hill Book Company, Singapore.
3. Timoshenko, S.P. and D.H. Young. *Elements of Strength of Materials*, 5th edition. (SI Units) Affiliated East-West Prent. Ltd. New Delhi

Course Contents and Lecture Schedule

Sl. No.	Topic	Hrs
1.	**Internal Forces**	
1.1	Supports (Free, Pinned and Fixed)	1
1.2	Loads (Concentrated, uniform, varying for beams; Axial and eccentric for columns; Torsion for shafts)	1
1.3	Tension	2
1.4	Compression	1
1.5	Moment - BMD	4
1.6	Shear - SFD	4
1.7	Torsion	1
2.	**Internal Stresses**	
2.1	Tensile Stresses	1
2.2	Compressive Stresses	1
2.3	Bending Stresses	3
2.4	Shear Stresses	2
2.5	Stress due to impact	1
2.6	Stresses due to Torsion, springs – open and close coiled	5
3.	**Structural Elements**	
3.1	Beams – Slope and deflection	
3.1.1	Double Integration Method	3

3.1.2	Moment Area Method	2
3.1.3	Macaulay's Method	2
3.2	Columns	
3.2.1	Short Columns – Core and stresses	3
3.2.2	Long Columns –End conditions and effective length - Euler's critical load, empirical formula, secant formula	3

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 23	3	0	-	3

B23 Engineering Geology

Preamble: Geology is the science and study of the solid and liquid matter that constitute the Earth. The field of geology encompasses the study of the composition, structure, physical properties, dynamics, and history of Earth materials, and the processes by which they are formed, moved, and changed. 'Engineering Geology' is the application of the geologic sciences to engineering practice for the purpose of assuring that the geologic factors affecting the location, design, construction, operation and maintenance of engineering works are recognized and adequately provided for. Engineering geologists investigate and provide geologic and geotechnical recommendations, analysis, and design. Engineering geologic studies may be performed during the planning, environmental impact analysis, civil engineering design, value engineering and construction phases of public and private works projects, and during post-construction and forensic phases of projects. Works completed by engineering geologists include; geologic hazards, geotechnical, material properties, landslide and slope stability, erosion, flooding, dewatering seismic investigations, etc.

The field work of an engineering geologist is typically culminated in analysis of the data and the preparation of an engineering geologic report, geotechnical report, fault hazard or seismic hazard report, geophysical report, ground water resource report or hydrogeologic report. An engineering geologic report describes the objectives, methodology, references cited, tests performed, findings and recommendations for development. A civil engineer should be able understand an engineering geologic report, and incorporate adequate measures into the design of engineering works he is concerned with.

Program outcomes addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

d. An ability to identify, formulate and solve engineering problems

Competencies:

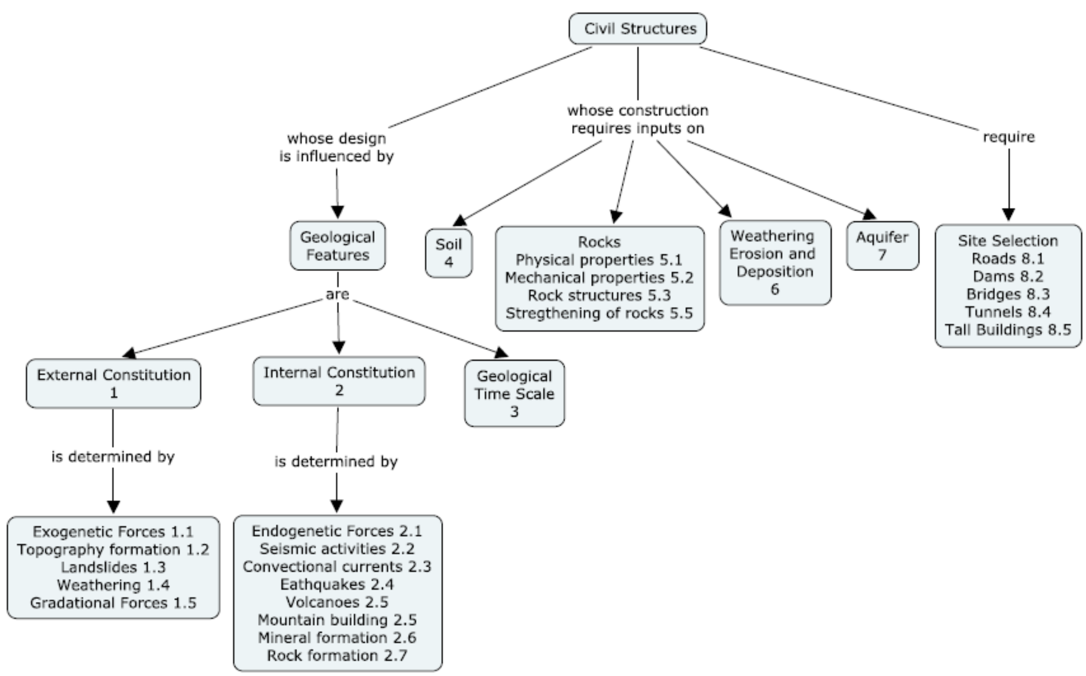
1. Explain geological activities (endogenetic and exogenetic) that result in earthquakes, volcanic eruption, formation of mountains and landslides.
2. Explain the impact of gradational forces on civil engineering activities and works.

3. Identify and describe given mineral and rock samples.
4. Assess the engineering properties of rocks and suggest means of strengthening it for civil engineering requirements.
5. Determine the geological aspects relevant to the design of civil structures like bridges, tunnels, dams, tall buildings and roads

Assessment Pattern

	Cognitive Level	Test 1	Test 2	Test3/End semester examination
1	Remember	20	20	10
2	Understand	40	40	20
3	Apply	20	20	30
4	Analyze	20	20	20
5	Create	0	0	20
6	Evaluate	0	0	0

Concept Map



Syllabus

Geological Features - External Constitution: Exogenetic Forces, Topography Formation: Continents and Oceans, Weathering, Landslides, Gradational Forces;

Geological Features - Internal Constitution: Endogenetic Forces, Seismic Activities, Convectional Currents, Earthquakes, Volcanoes, Mountain Building, Mineral and Rock Formation; **Geological Time Scale; Soil Characterization; Rocks:** Physical Properties, Mechanical Properties, Rock Structures, Strengthening of Rocks **Weathering Erosion and Deposition; Aquifer; Site Selection:** Roads, Dams, Bridges, Tunnels, Tall Structures

Textbook

Parbin Singh: Engineering and General Geology, Sixth Edition, S.K.Kattaria & Sons, 2001.

Reference Book

1.Tony Waltham: Foundations of Engineering Geology, Taylor & Francis, 2009.

2.Marcus Mathews, Bruce Mencies and Noel Simons: A Short course in Geology for Civil Engineers, Thomas Telford Services Limited, 2008.

3.Roy E.Hunt: Geologic Hazards: A field guide for geotechnical engineers, CRCP|LIc,2007.

4.F.G.Bell: Engineering Geology, Butterworth-Heimann,2007.

5.Roy E.Hunt: Characteristics of geologic materials and formations, CRCP|LIc,2006.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1.	**Geological Features: External Constitution**	
1.1	Topography and Exogenous Forces	2
1.2	Topography Formation: Continents and Oceans	1
1.3	Weathering	1
1.4	Landslides	2
1.5	Gradational Forces	2
2.	**Geological Features: Internal Constitution**	
2.1	Endogenous Forces	2
2.2	Seismic Activities	2
2.3	Convectional Currents	2
2.4	Earthquakes	2

No.	Topic	No. of Lectures
2.5	Volcanoes	1
2.6	Mountain Building	1
2.7	Mineral Formation	3
2.8	Rock Formation	3
3.	**Geological Time Scale**	1
4.	**Soil Characterization**	1
5.	**Rocks**	
5.1	Physical Properties	1
5.2	Mechanical Properties	1
5.3	Rock Structures	3
5.4	Strengthening of Rocks	2
6.	**Weathering Erosion and Deposition**	1
7.	**Aquifer**	1
8.	**Site Selection**	
8.1	Roads	1
8.2	Dams	1
8.3	Bridges	1
8.4	Tunnels	1
8.5	Tall Structures	1

Course Designer:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 24	3	0	-	3

B24 Computers and Programming

(Common to all branches of Engineering B24, C24, D24, E24, G24, T24)

Program Outcomes addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

c. An ability to design a system or component, or process to meet stated specifications

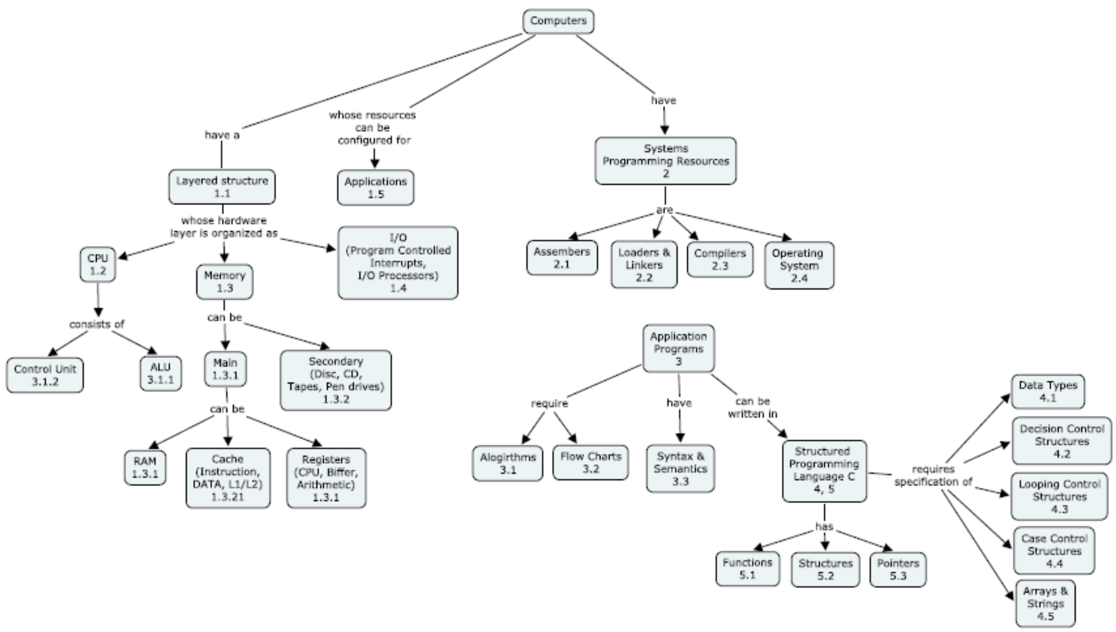
Competencies

1. Select computers for different applications.
2. Comprehend the nature of problems that a computer can solve extremely well - be able to list 5 non-trivial, interesting problems (unique in their own way) which are difficult to solve for a human being but can be solved easily by a computer.
3. Comprehend the following terms in the context of problem solving by a computer: Problem specification, input-output analysis, algorithm, flowchart, pseudo-program, programming language, assembly language, machine language, compiler, assembler, program correctness
4. Explain the difference between arrays and linked lists, and create two examples where arrays are better than linked lists and two examples where linked lists are better than arrays.
5. Explain the difference between iteration and recursion, and create two examples where iteration is better than recursion and two examples where recursion is better than iteration.
6. Design the flowchart and write efficient code for problems like
   - Recursive and iterative programs for binary search
   - Recursive and iterative programs for Fibonacci numbers
   - Recursive and iterative programs for finding the GCD of two numbers
   - Reverse a linked list while traversing it only once
7. Explain the role of pointers in implementing singly linked lists, doubly linked lists, binary trees, and general trees.
8. Explain the reason why different constructs are available for iteration, such as "for" loops, "do...while" loops.

Assessment Pattern

	Bloom's Category	Test 1	Test 2	End-semester examination
1	Remember	20	10	0
2	Understand	20	20	10
3	Apply	50	40	50
4	Analyze	10	20	20
5	Evaluate	0	10	20
6	Create	0	0	0

Concept Map:



Syllabus

Introduction to computers: Layered Structure of a computer, CPU, Memory, Input/Output, Configuring resources of computers for applications **Systems Programming Computers:** Assemblers, Loaders and Linkers, Compilers, Operating Systems **Application Programming:** Algorithms, Flowcharts, Syntax, semantics and execution, **Structured Programming Language:** Symbols and data types, Looping control structures, Decision control structures, Case control structures, Arrays and Strings, **Functions and Pointers:** Functions, Structures, and Pointers

References

1. Leland L. Beck: System Software, Pearson Education, 3rd Edition, 2004
2. John. J Donovan: System Programming, Tata McGraw Hill Edition, 2000
3. Yashavant Kanetkar: Programming in ANSI C, 2nd Edition-BPB Publications
4. Yashavant Kanetkar: Let us C, BPB Publications 8th Edition 2007
5. Yeshavant Kanetkar: Understanding Pointers in C, 2nd Edition BPB Publications

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Introduction to computers**	
1.1	Layered Structure of a computer	1
1.2	CPU, Memory	1
1.3	Input/Output	2
1.4	Configuring resources of computers for applications	1
2	**Applications Programming**	
2.1	Algorithms	1
2.2	Flowcharts	1
2.3	Syntax, semantics and execution	1
3.	**Structured Programming Language**	
3.1	Symbols and data types	1
3.2	Looping control structures	3
3.3	Decision control structures	3
3.4	Case control structures	2
3.5	Arrays and Strings	3
4.	**Functions and Pointers**	
4.1	Functions	3
4.2	Structures	3

No.	Topic	No. of Lectures
4.3	Pointers	4
5	**Systems Programming**	
5.1	Assemblers	2
5.2	Loaders and Linkers	4
5.3	Compilers	2
5.4	Operating Systems	2

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 25	3	0	-	3

B25 Materials Science

Program Outcomes Addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

Competencies:

1. Explain the physics of thermal expansion, electrical conductivity, ferromagnetic behavior, mechanical hardness, fatigue, creep, and wear at bulk and nano particle level.
2. Explain the chemistry of corrosion and its impact on materials.
3. Recommend appropriate wood, steel, composite materials and plastics for different building elements
4. Identify the requirements of weather proofing for buildings, building elements and structures, recommend required paints and varnishes, and estimate their cost-performance
5. Identify the acoustic requirements for buildings, and recommend required materials and estimate their cost-performance

Assessment Pattern

	Bloom's Category	Test 1	Test 2	End-semester examination
1	Remember	20	20	20
2	Understand	30	30	30
3	Apply	30	30	30
4	Analyze	0	0	0
5	Evaluate	20	20	20
6	Create	0	0	0

Syllabus

Engineering Properties of Materials: Thermal Properties: Expansion, Heat Capacity and Conductivity, Electrical Properties: Conductivity, Dielectric Constant, Dielectric Losses, Dielectric Breakdown, and Insulation, Magnetic Properties: Permittivity, Permeability, Hysteresis, Susceptibility, Magnetic Intensity, Magnetic Saturation and Anisotropy; Mechanical Properties of Bulk Materials: Hardness, Tensile Strength, Fatigue, Creep, Wear; Mechanical Properties of Nano-particles; Corrosion **Construction Materials:** Wood, Steel, FRP, Plastics **Weather Proofing**

Materials: Paints, Water and heat proofing chemical formulations **Acoustic Absorbers and Reflectors**: Plaster-of-Paris, Foam plastics, Rubber, Glass

References

1. Van Vlack L.H.: Elements of Materials Science and Engineering, 6th Edition, Addison-Wesley, 1989
2. Callister W. D.: Materials Science and Engineering, John Wiley &Sons, 2007

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Engineering Properties of Materials**	
1.1	Thermal Properties: Expansion, Heat Capacity and Conductivity	3
1.2	Electrical Properties: Conductivity, Dielectric Constant, Dielectric Losses, Dielectric Breakdown, and Insulation	3
1.3	Magnetic Properties: Permittivity, Permeability, Hysteresis, Susceptibility, Magnetic Intensity, Magnetic Saturation and Anisotropy	3
1.4	Mechanical Properties of Bulk Materials: Hardness, Tensile Strength, Fatigue, Creep, Wear	3
1.5	Mechanical Properties of Nano-particles	3
1.6	Corrosion	3
2	**Construction Materials**	
2.1	Wood	3
2.2	Steel	4
2.3	FRP	3
2.4	Plastics	2
3	**Weather Proofing Materials**	
3.1	Paints	3
3.2	Water and heat proofing chemical formulations	2
4	**Acoustic Absorbers and Reflectors**	

4.1	Plaster-of-Paris	2
4.2	Foam plastics	2
4.3	Rubber	2

Course Designers:

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3. **V. Veeraganesh vvphy@tce.edu**

Sub Code	Lectures	Tutorial	Practical	Credit
B 26	4	0	-	4

B26 Construction Materials and Technology

Program Outcomes Addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

b. An ability to identify, formulate and solve engineering problems

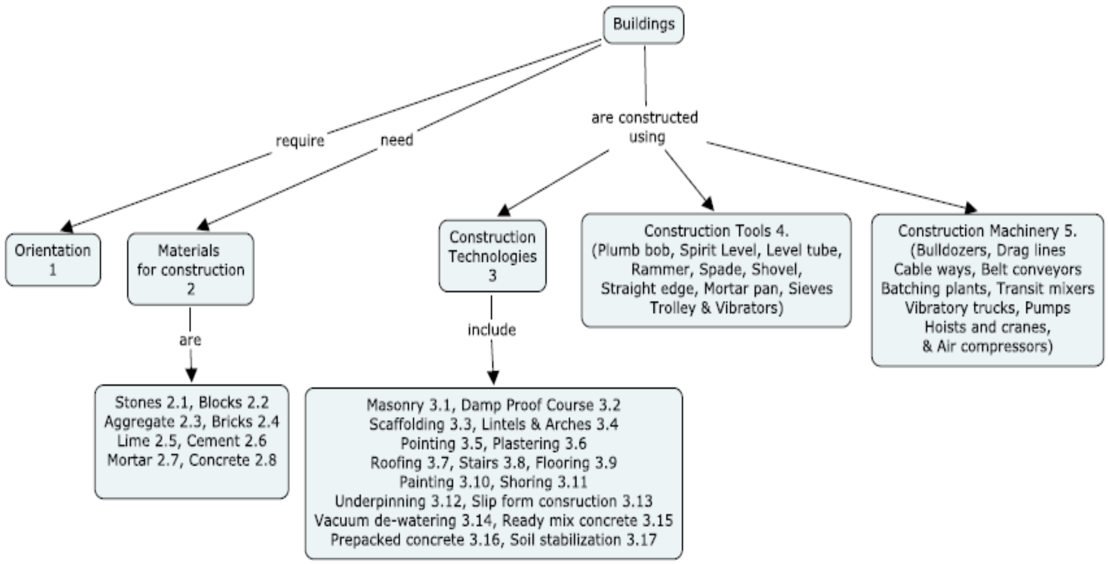
Competencies:

1. Select the site for a building based on soil characteristics, topography, climate, access to water, available communication and transport facilities, and access to power.
2. Position different components of a residential building based on natural factors including direction of sun light, direction and intensity of wind, and rain fall
3. Select materials for construction of a given building based on specifications for use in construction and cost.
4. Select the technology (brick, stone, and concrete) for construction of different components of the super-structure (walls, columns, beams, lintels, arches, stairs, roof and floors) of residential buildings, and specify the method (bonds of brick masonry, bonds of stone masonry, types of concrete construction, pointing, and scaffolding) of construction.
5. Explain the technology of production/preparation of construction materials (timber, asphalt, bitumen, cement, lime, aggregates, mortar, bricks, stone blocks and concrete)
6. State test procedures for different materials used in construction
7. Design a stair case
8. Select appropriate equipment/machinery for various uses in construction
9. Recommend appropriate construction techniques for different structures

Assessment Pattern

	Bloom's Category	Test 1	Test 2	End-semester examination
1	Remember	20	20	20
2	Understand	40	40	40
3	Apply	20	20	20
4	Analyze	10	10	10
5	Evaluation	10	10	10
6	Create	0	0	0

Concept Map:



Syllabus

Orientation of Buildings: Site selection and its influencing factors, National Building Codal provisions for components of residential buildings: Open spaces, Living room, Bed room, Kitchen, Bathroom and Water closet, National Building Codal provisions for lighting and ventilation aspects in buildings **Materials for Construction:** Stones, Blocks, Aggregate, Bricks, Lime, Cement, Mortar, Concrete. **Technologies of Construction:** Masonry, Damp Proof Course, Scaffolding, Lintels and Arches, Pointing, Plastering, Roofing, Stairs, Flooring, Painting. **Construction Tools and Machinery:** Tools: plumb bob, spirit level, level tube, rammer, spade, shovels, straight edge, mortar pans, sieves, trolley, vibrators, bulldozers, draglines, cableways, belt conveyors Machinery: batching plants, transit mixers and vibratory trucks for ready mixed concrete, pumps, air compressors, hoists and cranes, Choice of construction equipments for different types of works **Special Construction Techniques:** Shoring, Underpinning, Slip form Construction, Vacuum de-watering, Ready Mix Concrete, Pre-packed Concrete, Soil Stabilization

References:

1. Punmia B.C, “Building Construction”, Laxmi Publications Pvt. Ltd., 2005
2. Surendra Singh, “Building Materials”, Vikas Publishing Company, New Delhi, 1996
3. Rangwala. S. C., “Engineering Materials”, Charotar Publishing House, Anand, India, 1997
4. Deodhar S.V., “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi, 2007

5. Bindra and Arora, " Building Materials and Construction", Dhanpat Rai & Sons, New Delhi, 1994
6. National Building Code of India, 2005
7. Peurifoy.R.L., "Construction Planning, Equipments and Methods", McGraw Hill Co., New York, 2005

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1.	**Orientation Buildings**	
1.1	Site selection and its influencing factors	2
1.2	National Building Codal provisions for components of residential buildings: Open spaces, Living room, Bed room, Kitchen, Bathroom and Water closet	5
1.3	National Building Codal provisions for lighting and ventilation aspects in buildings	2
2.	**Materials for Construction**	
2.1	Stones	2
2.2	Blocks	1
2.3	Aggregate	1
2.4	Bricks	3
2.5	Lime	2
2.6	Cement	2
2.7	Mortar	1
2.8	Concrete	2
3.	**Technologies of Construction**	
3.1	Masonry	3
3.2	Damp Proof Course	2
3.3	Scaffolding	1
3.4	Lintels and Arches	2

No.	Topic	No. of Lectures
3.5	Pointing	1
3.6	Plastering	1
3.7	Roofing	2
3.8	Stairs	3
3.9	Flooring	2
3.10	Painting	1
4.	**Construction Tools and Machinery**	4
5.	**Special Construction Techniques**	5

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 27	-	-	2	1

B27 Strength of Materials Lab

Objective: The students of civil engineering would get exposure to material properties and get trained to determine these properties of the materials.

List of Experiments

1. Determination of Young's Modulus by conducting Tension Test (Mild Steel)
2. Determination of Young's Modulus by conducting Deflection Test on rectangular wooden member
3. Determination of Young's Modulus by conducting Deflection Test on steel
4. Determination of Young's Modulus by conducting Deflection Test on Aluminium box section
5. Determination of Young's Modulus by conducting Torsion Test on Cast Iron
6. Determination of Young's Modulus by conducting Bending Test I (Verification of Maxwell's Reciprocal Theorem)
7. Determination of Young's Modulus by conducting Bending Test II (Huggenberger Tensometer)
8. Determination of Young's Modulus by conducting Spring Test (Tension spring)
9. Determination of Young's Modulus by conducting Spring Test (Compression spring)
10. Determination of Shear strength and Hardness Number (Mild Steel, Aluminium and Copper)
11. Determination of Modulus of Elasticity by conducting Compression Test on concrete cylinder
12. Determination of Energy Absorption by conducting Impact Test

Sub Code	Lectures	Tutorial	Practical	Credit
B 28	-	-	2	1

B28 Computer Programming Lab

(Common to all branches of Engineering B28, C28, D28, E28, G28, T28)

Any twelve experiments to be performed

List of Experiments

1. Simple Programs
    a. Fibonacci Series
    b. Sum of set of numbers
    c. Generation of prime numbers
2. Matrix Addition, Subtraction and Multiplication
3. Sorting of Names & Numbers
4. String Manipulation
5. Bitwise Operation
6. Macro Expansion with Conditional Compilation
7. Array of Structures
8. Pointers to functions
9. Pointers to Pointers
10. File Manipulations
    a. Read the file and display the contents of the file
    b. Read the lines from the keyboard and write it into a specified file
12. Store and retrieve the structure elements in a specific file
13. Program to illustrate int 86() function
14. Program for creating files with read and write permissions

Sub Code	Lectures	Tutorial	Practical	Credit
B 29	-	-	2	1

B29 Work Shop

(Common to all branches of Engineering B29, C29, D29, E29, G29, T29)

Objective: The students of all branches of engineering would get exposure to basic practices in a mechanical workshop. The students get trained to acquire skills at basic level in fitting, carpentry, joining, metal forming and plumbing.

List of Exercises

I Fitting (Any four exercises)

1. Fitting tools and practice
2. Joining of two different metals with adhesives
3. Preparation of single step joint
4. Preparation of 'V' joint
5. Preparation of Gauge joint
6. Preparation of Taper sep joint

II Carpentry (Any four exercises)

1. Carpentry tools and practice
2. Joining different types of wood with adhesives
3. Preparation of Half joint
4. Preparation of Dovetail joint
5. Preparation of T-brittle joint
6. Turning on wood lathe

III Demonstration on Tools and Practice (Any four exercises)

1. Welding
2. Soldering
3. Brazing
4. Foundry and Moulding practice
5. Smithy forging
6. Plumbing
7. House wiring
8. Press work

Terminal Examination: Students are tested in fitting and carpentry trades

BOARD OF STUDIES MEETING

B.E Degree (Civil Engineering) Program

Third Semester

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
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Web: www.tce.edu

CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

THIRD SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
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Department of Civil Engineering

Graduating Students of BE program of Civil Engineering will be able to

1. Survey, map and plan layouts for buildings, structures and alignments for canals and roads
2. Specify, design, supervise, test and evaluate foundations and superstructures for residences, public buildings, industries, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.
3. Specify, design, supervise and evaluate water conveying systems.
4. Specify, select and formulate environmental engineering systems
5. Specify, design/select and operate hydraulic machines and surge systems
6. Analyze water resources hydrological systems to estimate safe and assured withdrawals.
7. Work in a team using common tools and environments to achieve project objectives

Thiagarajar College of Engineering, Madurai-625015

Department of Civil engineering

Scheduling of Courses

Semester	Theory Courses							Practical / Project	
8th (21)	Elective 6 3:0	Elective 7 3:0	Elective 8 3:0					B88 Project 0:12	
7th (22)	B71 Management Theory and Practice 3:0	B72 Remote Sensing and GIS 3:0	Elective 3 3:0	Elective 4 3:0	Elective 5 3:0		B77 GIS Laboratory 0:1	B78 Project 0:6	
6th (22)	B61 Accounting and Finance 3:0	B62 Transportation Engineering 1 4:0	B63 Geotechnical Engineering 2 4:0	B64 Irrigation and Water Resources Engineering 3:0	Elective 1 3:0	Elective 2 3:0	B67 Highways Lab 0:1	B68 Design and Drawing 0:1	
5th (25)	B51 Engineering Mathematics – 5 4:0	B52 Environmental Engineering 2 3:0	B53 Structural Analysis 2 4:0	B54 Structural Design 2 4:0	B55 Hydrology 3:0	B56 Geotechnical Engineering 1 4:0	B57 Geotechnical Engineering Lab 0:1	B58 Environmental Engineering Lab 0:1	B59 CAD 0:1
4th (24)	B41 Engineering Mathematics – 4 4:0	B42 Environmental Engineering 1 3:0	B43 Structural Analysis 1 4:0	B44 Structural Design 1 4:0	B45 Hydraulics and Hydraulic Machinery 3:0	B46 Ecology 2:0	B47 Survey Lab II 0:1	B48 Fluid Mechanics Lab 0:1	B48 Professional Communication 1:1
3rd (22)	B31 Engineering Mathematics – 3 4:0	B32 Strength of Materials 2 3:0	B33 Surveying 4:0	B34 Fluid Mechanics 3:0	B35 Data Structures 3:0	B36 Concrete Technology 3:0	B37 Survey LabI 0:1	B38 Concrete Lab 0:1	
2nd (23)	B21 Engineering Mathematics -2 4:0	B22 Strength of Materials 1 3:0	B23 Engineering Geology 3:0	B24 Computers and Programming 3:0	B25 Materials Science 3:0	B26 Construction Maerials & Technology 4:0	B27 Strength of Materials Lab 0:1	B28 Computer Programming Lab 0:1	B29 Workshop 0:1
1st (25)	H11 Engineering Mathematics – 1 4:0	H12 Physics 3:0	H13 Chemistry 3:0	H14 English 3:0	H15 Basics of ME and CE 4:0	H16 Basics of EEE 4:0	H17 Physics Lab 0:1	H18 Chemistry Lab 0:1	H19 Engineering Graphics 0:2

THIAGARAJAR COLLEGE OF ENGINEERING : MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SUBJECTS OF STUDY
(For the candidates admitted from 2008-2009 onwards)

THIRD SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
B 31	Engineering Mathematics III	BS	4	-	-	4
B 32	Strength of Materials II	DC	3	-	-	3
B 33	Surveying	DC	4	-	-	4
B 34	Fluid Mechanics	DC	3	-	-	3
B 35	Data Structures	ES	3	-	-	3
B 36	Concrete Technology	DC	3	-	-	3
PRACTICAL						
B 37	Survey Lab-I	DC	-	-	3	1
B 38	Concrete Lab	DC	-	-	3	1
Total			**20**	**-**	**6**	**22**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
DC : Department Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture/Tutorial is equivalent to 1 credit
2/3 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING : MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2008-2009 onwards)

THIRD SEMESTER

S.No.	Sub. code	Name of the subject	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	B31	Engineering Mathematics III	3	50	50	100	25	50
2	B32	Strength of Materials II	3	50	50	100	25	50
3	B33	Surveying	3	50	50	100	25	50
4	B34	Fluid Mechanics	3	50	50	100	25	50
5	B35	Data structures	3	50	50	100	25	50
6	B36	Concrete Technology	3	50	50	100	25	50
PRACTICAL								
7	B37	Survey Lab-I	3	50	50	100	25	50
8	B38	Concrete Lab	3	50	50	100	25	50

* CA evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks

Sub Code	Lectures	Tutorial	Practical	Credit
B 31	4	0	-	4

B31 Engineering Mathematics III 4:0

(Common to all branches of Engineering, B31,C31,D31,E31,G31,T31)

Preamble:

An engineering student needs to have some basic mathematical tools and techniques. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraises him the complete procedure for solving different kinds of problems that occur in engineering. Based on this the course aims at giving the adequate exposure in the theory and applications of Fourier series, Fourier Transforms, PDE's and BVP

Program Outcomes addressed

a. Graduates will demonstrate knowledge of mathematics, science and engineering.

b. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

j. Graduate will develop confidence for self education and ability for life-long learning.

Competencies

At the end of the course the student should be able to

1. Express the periodic functions arising in the study of engineering problems as Fourier series of Sines and Cosines.
2. Find the Fourier series for the typical waveforms.
3. Find the Fourier series for discrete data using Harmonic Analysis.
4. To study some of the well-known integral transforms (like Fourier, Fourier Sine and Cosine) and properties.
5. Formulate simple Engineering problems as Partial Differential Equations and state the boundary conditions.
6. Solve Partial Differential Equations, linear, nonlinear, homogeneous and non-homogeneous, by various methods.
7. Solve the standard Partial Differential Equations arising in engineering problems like Wave equation, Heat flow equation (one dimensional and two dimensional, Cartesian and polar coordinates) by Fourier series.

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3/End-semester examination
1	Remember	10	10	0
2	Understand	30	30	30
3	Apply	60	60	70
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Syllabus

Fourier Series: Dirichlet's conditions, General Fourier Series, Half range Sine and Cosine series, Parseval's Identity, Harmonic Analysis, Complex form of Fourier Series. **Fourier Transformation:** Fourier Integral Theorem, Fourier Transform, Fourier Sine and Cosine Transforms, Convolution Theorem, properties, Parseval's Identity, Discrete Fourier Transform, Discrete Time Fourier Transform, Demonstration of Fourier transforms and its properties using MATLAB (Tutorial).**Partial Differential Equations**: Formation, Solution of standard types of first order equations, Lagrange's linear equation, Linear partial differential equations of second and higher order with constant coefficient. **Boundary Value Problem**: Classification of Second Order linear partial differential equations, One-dimensional Wave equation, One dimensional heat equation, Solution by Fourier Series, Steady State Solution of two dimensional heat equation in Cartesian Co-ordinates, Laplace equation in Polar Co-ordinates, Solution by Fourier Series method.

Text Book

B.S. Grewal: Higher Engineering Mathematics, 39th Edn. , Khanna Publishers, New Delhi, 2007.

References

1. Lecture Notes by the faculty of Department of Mathematics, TCE ,Madurai.
2. Veerarajan .T: Engineering Mathematics, 3rd Edition. , Tata McGraw Hill, NewDelhi, 2004
3. Kreyszig,E., "Advanced Engineering Mathematics", John wiley and sons,(Asia)Pte Ltd., Singapore.2006.

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 32	3	0	-	3

B32-Strength of Materials - II **3:0**

Preamble: This course is a follow up of the course B22: Strength of Materials-I offered in the second semester. This course aims at determining the behavior of members of a structure subjected to flexure, shear and axial force

Programme outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
- Graduates will be able to communicate effectively in both verbal and written form.
- Graduates will develop confidence for self education and ability for life-long learning.
- Graduates can participate and succeed in competitive examinations

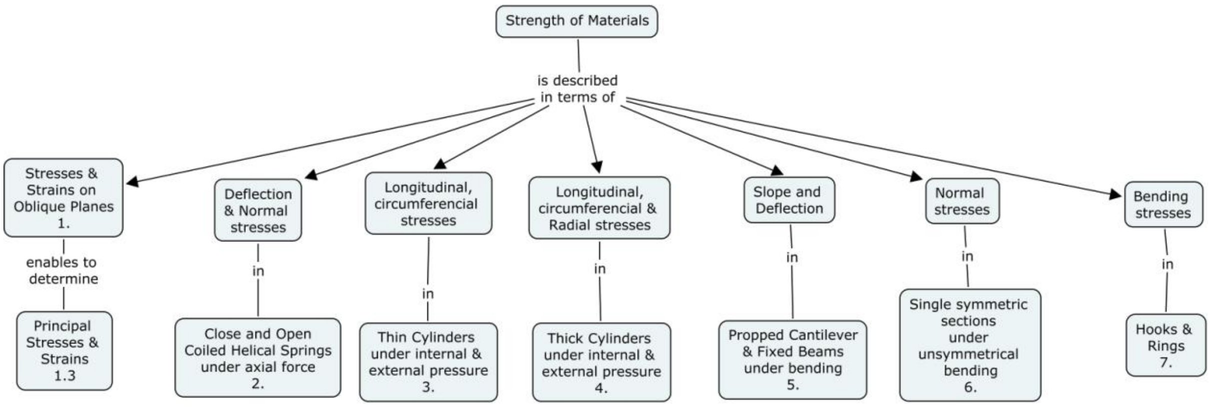
Competencies: At the end of the course the students will be able to

1. Represent, in both graphical and mathematical forms, principal stresses and strains in 2-D systems
2. Explain the behavior of open and closed coiled helical springs
3. Calculate the bending stresses of rectangular and angular sections under unsymmetrical bending.
4. Locate the shear centre for single symmetry sections
5. Calculate the stresses in hooks and rings
6. Determine the stresses in thin and thick cylinders
7. Determine slope and deflection for indeterminate beam members

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3 / End-semester examination
1	Remember	20	20	10
2	Understand	20	20	10
3	Apply	40	40	60
4	Analyze	20	20	20
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Syllabus

Stress and strain on oblique plane - State of stress in 2D stress or strain system, stresses and strains on an oblique plane subjected to 2-D stress or strain system, principal stress and its plane, principal strain and its plane, Mohr's circle construction for principal stress / principal strain. **Springs** - Types of springs, terminology, concept of closed coiled helical springs, closed coiled helical spring subjected to axial load, axial twist, concept of open coiled helical spring, Open coiled helical spring subjected to axial load, axial twist, springs in series and springs in parallel **Thin cylinder** – Introduction, behavior of thin cylinder under internal pressure, Stress in thin cylinder and design of thin cylinder **Thick cylinder** – Lame's theory and its applications, stress in thick cylinder **Deformation of propped and fixed beam** - Subjected to concentrated load and UDL, double integration method, Macaulay's method, Moment Area method **Unsymmetrical bending of sections like Rectangular, I section, channel section & T Section)** - Product of inertia, evaluation of bending stress, deflection due to unsymmetrical bending, shear centre **Bending of curved bars** - Bars with small initial curvature, bars with large initial curvature, derivation of Winkler Bach equation, Determination of constant 'm' for rectangular, trapezoidal and triangular sections, stresses in hooks and rings subjected to forces acting in axis of symmetry

Text books

1. Rajput: Strength of Materials, S.Chand publishers, 4th Edition, New Delhi, 2007
2. Bansal R.K.: A Textbook of strength of materials, Laxmi publications, New Delhi, 4th Edition, 2007.

References

1. Miller F.E.: Mechanics of Materials, International Text Book Company, 1995.
2. Popov P.: Engineering Mechanics, Prentice Hall India Ltd., 2005
3. Beer: Mechanics of Materials, Tata Mc GrawHill, s 4th Edition 2006
4. Punmia B.C, et. al.: Mechanics of Materials, Laxmi Publications, New Delhi, 2007.
5. Punmia B.C, et. al. : Theory of Structures [SMTS-2], Laxmi Publications, New Delhi, 2007

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 33	4	0	-	4

B33 Surveying **4:0**

Preamble:

Surveying is the art of taking measurements which will determine the relative positions of various points on the surface of the earth. It may be represented on a plan to a convenient and suitable scale. The various natural and artificial features may be shown in their correct horizontal and vertical positions.

Program Outcomes addressed:

- Graduates will demonstrate knowledge of Mathematics, Science and Engineering.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems.

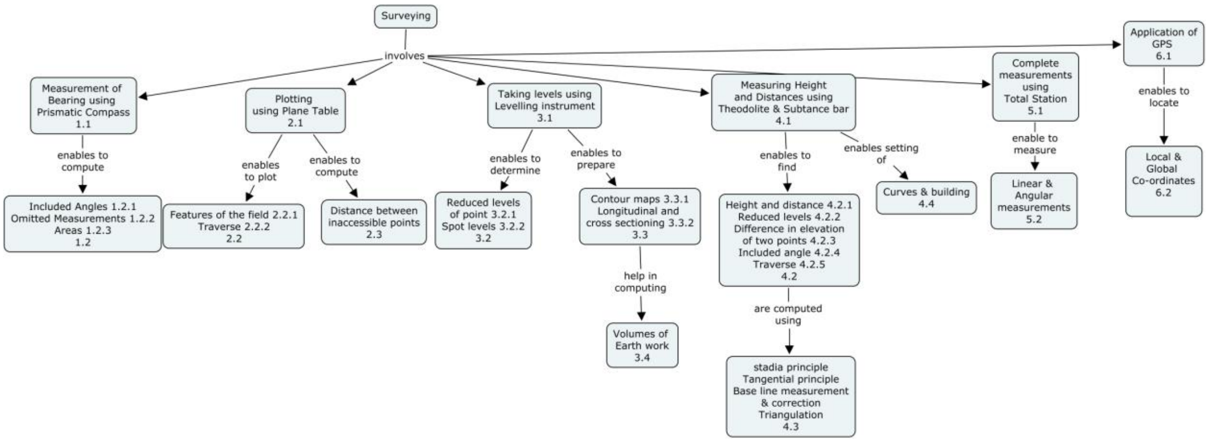
Competencies:

1. Determine included angles, sides and areas of a polygons using compass traverse.
2. Determine the inaccessible distance by using intersection method of plane table.
3. Plot the actual feature (plan of any object) using plane table traversing.
4. Determine the reduced levels of various points using leveling instrument.
5. Compute the volume of cutting and filling using contours, longitudinal and cross sectioning.
6. Set simple circular, compound and transition curves in the field.
7. Measure the heights of towers and hills and determine the distances between them using theodolite.

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3/End-semester examination
1	Remember	30	20	10
2	Understand	30	30	30
3	Apply	40	50	60
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Syllabus:

Linearmeasurements, Ranging and chaining, obstacles in chaining. Measurement of Bearings using Prismatic Compass: Prismatic compass; Derived measurements from bearings: included angles, omitted measurements and areas, local attraction, magnetic declination. Plotting using Plane Tables: Plane table; Plane table plots: features of the field and traverse; Computing distance between inaccessible points using plane table plots. Levels using Leveling Instrument: Dumpy level and auto level; Derived levels: Reduced levels of points and spot levels; Derived maps and sections from level measurement: Contour maps, longitudinal and cross sectioning; Volume of earth work. Measurements with Theodolite and Subtence bar: Theodolite and Subtence bar; Measurements using theodolite: Stadia, tangential and triangulation principles, reduced levels, difference between elevations of two points, included angles and traverse; Setting of buildings and curves. Total station and its applications,EDM, GPS and its applications.

Text Books

1 T.P. Kanetkar," Surveying and leveling vol. I & II ", United Book Corporation, Pune,23rd Edition,1997.

2 B C. Punmia and A.K Jain," Surveying and Vol. I, II & III laxmi Publication,2005.

3. N.N.Basak,"Surveying and leveling", Tata McGraw Hill Publishing Company Ltd, New Delhi,2004.

Reference Books:

1. D. Clark, "Plane & Geodetic Surveying Vol. I & II,CBS Publishers and Distributors, Delhi,2004.

2. K.R. Arora," Surveying Vol. I, II & III ", Standard Book House Publishers & Distributors, New Delhi,2008

Course Designers

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2. T. Baskaran tbciv@tce.edu

Sub Code	Lectures	Tutorial	Practical	Credit
B 34	3	0	-	3

B34 Fluid Mechanics 3:0

Preamble: Fluid Mechanics is a subject of physics dealing with the action of fluids at rest or in motion, and with applications and devices in engineering using fluids. It can be subdivided into two major areas, fluid statics, which deals with fluids at rest, and fluid dynamics, concerned with fluids in motion. Applications of fluid mechanics involve all kinds of flow machinery, including jet propulsion, turbines, and pumps. Hydraulics is mainly concerned with machines and structures such as hydraulic turbines, dams, and hydraulic pressures, using water or other liquids. Fluid mechanics is basic to such diverse fields as aeronautics, chemical, civil, and mechanical engineering.

Program outcomes addressed:

- Graduates will demonstrate knowledge of Mathematics, Science and Engineering
- Graduates will demonstrate an ability to identify, formulate and solve Engineering problems.
- Graduates will demonstrate skills to use modern Engineering tools, softwares and equipments to analyze problems.

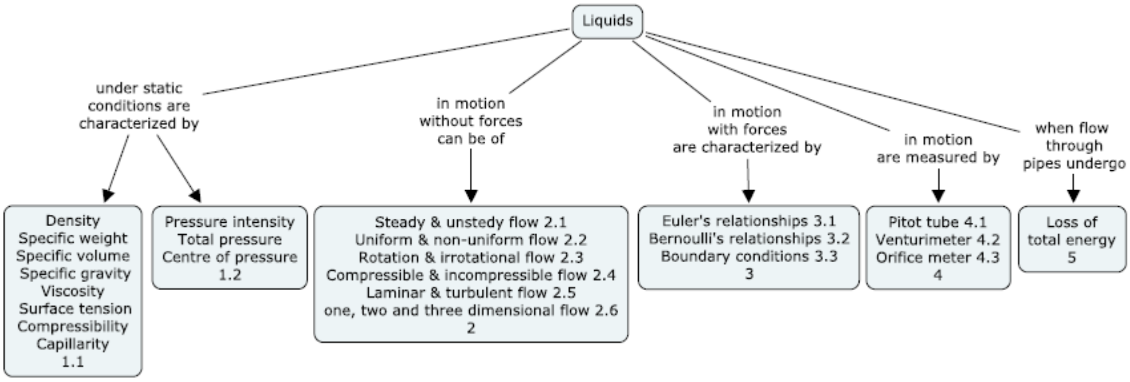
Competencies: At the end of the course the student should be able to

1. Explain the basic properties of fluids.
2. Determine the variation of pressure in fluid at rest, and calculate the forces exerted by a fluid at rest on plane or curved submerged surfaces.
3. Distinguish between various types of fluid flows.
4. Understand the use and limitations of the Bernoulli's equation, and apply it to solve a variety of fluid flow problems.
5. Calculate major and minor losses associated with pipe flow.
6. Determine the nature of flow in pipes based on Reynold's number.
7. Determine the boundary layer thickness and other boundary layer properties.

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3/End-semester examination
1	Remember	30	20	20
2	Understand	40	40	20
3	Apply	30	40	60
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Syllabus:

Fluid Statics: Fluid Properties like Density, Specific weight, Specific volume, Specific gravity, Viscosity, Surface tension, Compressibility, Capillarity. Types of fluids. **Pressure measurements:** Pascal's law, Hydrostatic law, Manometers, Pressure gauges, Total pressure and centre of pressure on submerged surfaces. **Fluid Kinematics:** Steady and unsteady flow, Uniform and non-uniform flow, Rotational and irrotational flow, Compressible and incompressible flow, Laminar and turbulent flow, One, two and three dimensional flow. Continuity equation, potential and stream function. **Fluid Dynamics:** Euler's equation, Bernoulli's equation, Boundary layer flow. **Flow Measurement:** Discharge measurement in pipes using Pitot-tube, Venturimeter and Orificemeter. **Flow through Pipes:** Reynolds Experiment, Laminar and turbulent flow through pipes, major and minor losses in pipe flow, Pipes in parallel and in series.

Text Book:

1. Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics" Standard Book House, New Delhi, 2005

References:

1. Bansal R.K, "Fluid Mechanics and Hydraulic Machines" Laxmi Publications, New Delhi, 2005

2. Kumar.K.L, "Engineering Fluid Mechanics" Eurasia Publishing House (P) Ltd, New Delhi, 2003

3. Yunus A. Cengel and John M. Cimbala, "Fluid Mechanics" Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, 2006

4. Subramanya K, "1000 Solved problems in Fluid Mechanics" Tata Mcgraw-Hill Publishing Company Ltd, New Delhi, 2006

5. John A.Robertson, Clayton T. Crowe, Donald F. Elger, "Engineering Fluid Mechanics" 7th Edition, John Wiley & Sons, 2001.

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 35	3	0	-	3

B35 Data Structures 3:0

(Common to all branches of Engineering B35/C25/D35/E35/G35/T25)

Program Outcomes addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science

c. An ability to design a system or component, or process to meet stated specifications

d. An ability to identify, formulate and solve engineering problems

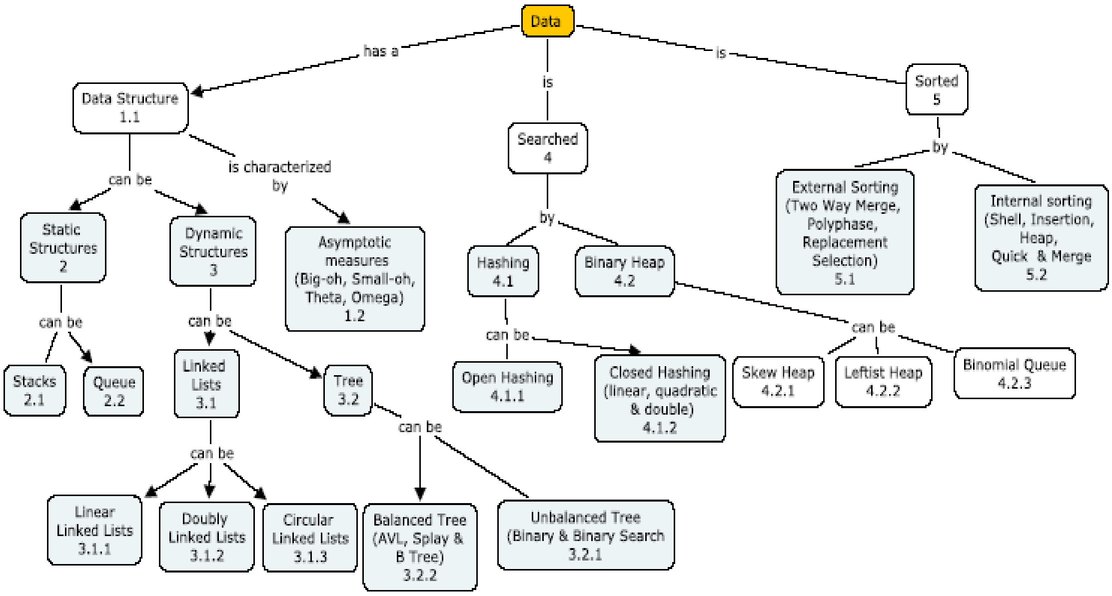
Competencies

1. Ability to identify and implement appropriate data structure for a given application
2. Comprehend the terms "data abstraction", "abstract data type", and "data structures", and how data structures and algorithms have to be blended carefully to obtain efficient implementations.
3. Explain the notion of time complexity and the asymptotic notions of "Big Oh" with non-trivial examples.
4. Explain the difference between worst case complexity and best case complexity. Justify with an example algorithm for each of the complexities: O(n), O(n*2), O(n*3), O(2**n), O(n log n), O(n*2 log n),O(log n), O(log log n), O(sqrt(n)).
5. Identify all the trade-offs involved in choosing static versus dynamic data structures
6. In the context of searching, identify the trade-offs involved in selecting the most efficient data structure.
7. In the context of sorting, identify the trade-offs involved in selecting: (a) bubble-sort (b) insertion sort (c) selection sort (d) quick sort (e) merge sort (f) heap sort.

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3 / End-semester examination
1	Remember	30	20	10
2	Understand	30	20	10
3	Apply	20	30	20
4	Analyze	10	20	30
5	Evaluate	10	10	30
6	Create	0	0	0

Concept Map



Syllabus

Data: Data Structure, Asymptotic Measures **Static Data Structures:** Stacks, Queues **Dynamic Data Structures:** Linked Lists: Linear Linked Lists, Doubly Linked Lists and Circular Linked Lists, Trees: Unbalanced and Balanced Trees, **Data Search:** Hashing: Open Hashing and Closed Hashing; Heap: Skew Heap, Leftist Heap, Binomial Queue **Data Sorting:** Internal Sorting: Insertion sorting, Shell sorting, Quick sorting, Merge sorting and Heap sorting; External Sorting

Textbook

1. Richard F. Gilberg , Behrouz A. Forouzan: Data Structures: A Pseudocode Approach With C, 2nd Edition, Thomson Learning, 2003

Reference

1. Mark Allen Weiss: Data Structures and Algorithms in C, Addison-Wesley, 1997

Course Designers:

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2. **S. Sudha ssj@tce.edu**
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Sub Code	Lectures	Tutorial	Practical	Credit
B 36	3	0	-	3

B36-Concrete Technology 3:0

Preamble:

Knowledge on the topics namely cement, aggregates, mortar, concrete- properties, tests and manufacturing procedure, ready- mix concrete, pre-packed concrete and vacuum concrete is being taught at elementary level in the previous semester subject; B26-Construction Materials & Technology along with other construction materials. However, a thorough knowledge on the topics related to concrete is essential. Moreover, this subject would help students to understand the behavior of concrete, forming the basis for advanced subjects such as Structural Engineering Design.

Program Outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering
- Graduates will demonstrate an ability to design a system, component or process as per needs and specifications
- Graduates will understand the impact of engineering solutions on the society and also will be aware of contemporary issues
- Graduates will develop confidence for self education and ability for life- long learning
- Graduates can participate and succeed in competitive examinations

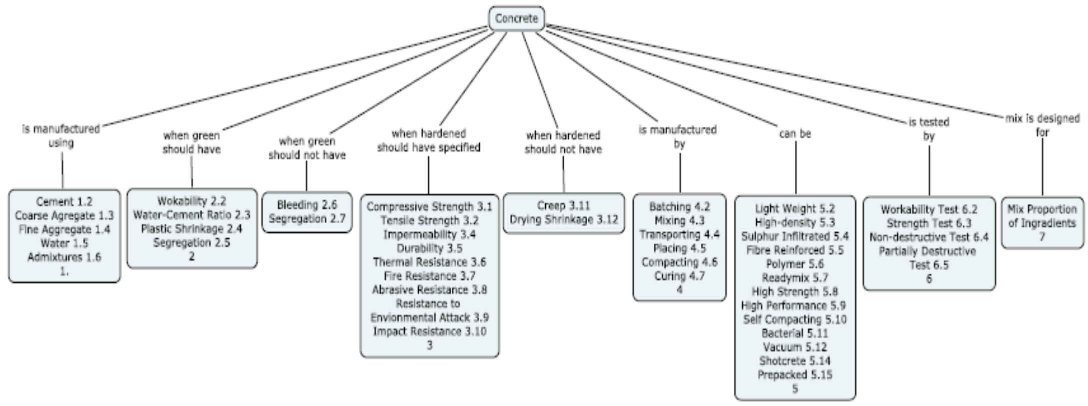
Competencies:

1. State the manufacturing of cement and its properties
2. State test procedure for the constituents of concrete (cement, fine and coarse aggregate)
3. State the properties and uses of different types of cement
4. Discuss the properties and test procedure for fresh and hardened concrete
5. Discuss the essential requirements of aggregates (coarse and fine) for making concrete
6. Explain the factors influencing durability of concrete
7. Explain the properties, manufacturing procedure and applications of different types of concrete
8. Explain the importance of quality control in different stages of making concrete
9. Explain the role of additives in different types of concrete
10. List the various equipments and machineries along with their purposes in making concrete
11. Design a concrete mix as per stated specifications

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test 3 / End-semester examination
1	Remember	30	20	20
2	Understand	50	50	50
3	Apply	20	30	30
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Syllabus

Concrete Making Materials: Concrete : Introduction, Cement: Raw materials, manufacture, composition, hydration, types of cement, tests and specifications- consistency, setting time, compressive strength, tensile strength, soundness test, fineness test, chemical analysis Coarse Aggregate: Source- natural and artificial, size, shape, gradation of aggregates, fineness modulus, alkali-aggregate reaction, test on aggregates- impact, crushing, abrasion, attrition, water absorption, presence of deleterious content. Fine Aggregate: Source- natural and artificial, gradation of aggregates, fineness modulus, tests- sieve analysis, bulking of sand, presence of deleterious content. Water: Test for quality- Chloride, Sulphate, Hardness, pH, presence of total solids. Admixtures: Accelerators, retarders, waterproofing compounds, air entraining agents, workability agents, bonding admixtures, pozzolanic admixtures, silica fumes, fly ash, blast furnace slag, super-plasticizers **Fresh Concrete:** Workability: Factors influencing- mix proportion, size and shape of aggregate, surface texture, grading of aggregates, plastic shrinkage, Water-Cement ratio - influence on workability, Segregation, Bleeding. **Hardened Concrete:** Hardened concrete, Compressive strength, Tensile strength, Impermeability, Durability, Thermal resistance, Fire resistance, Abrasive resistance, Resistance to environmental attack, Impact resistance , Creep, Drying shrinkage. **Manufacturing of Concrete:** Manufacturing process, Batching-Types of batching, Mixing, Transporting, Placing, Compacting, Curing. **Types of Concrete:** Concrete for different purposes, Light weight concrete- light weight aggregate, no fines concrete, air-entraining concrete, High Density Concrete, Sulphur Infiltrated Concrete, Fibre Reinforced Concrete, Polymer Concrete: Polymer impregnated concrete, Polymer cement concrete, partially impregnated polymer concrete, polymer concrete , Ready mix Concrete, High Strength Concrete, High Performance Concrete, Self compacting Concrete, Pumped Concrete, Bacterial Concrete/Self healing concrete, Shotcrete, Gunite, Vacuum Concrete, Prepacked Concrete.

Testing of Concrete: Concrete testing: Tests on fresh concrete and hardened concrete, Workability test: Slump test, Compaction factor test, flow table test, Vee-Bee consistometer test. Strength Test (Compressive, Split tensile and Flexure), Non-destructive test, Partially destructive test. **Design of Concrete Mix:** Mix Design: ACI method (Concept only), Road Note method (Concept only), IS method – problems

Text Books:

1. Kumar P. Mehta, "Concrete- Microstructure, Properties and Materials", 3rd edition, ICI publications, Chennai, 2005.
2. Santhakumar A.R., "Concrete Technology", Oxford University Press, New Delhi, 2006
3. Shetty M.S., "Concrete Technology", S.Chand & Co. Ltd., New Delhi, 2008

References:

1. Neville. A.M. & Brooks.J.J, "Concrete Technology", Dorling Kindersley (India) Pvt. Ltd., 2006.
2. Gambhir M., "Concrete Technology", Tata McGraw Hill Publishing Co., New Delhi, 2004.
3. Rafat Siddique, "Special Structural Concrete", Galgotiya Publishing Pvt. Ltd., New Delhi, 2000

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 37	0	0	1	1

B37 SURVEY LAB-I **0:1**

Objectives

This subject is designed to teach the students about linear measurements, different kinds of surveying techniques and contouring.

List of Experiments

1. Chain survey- Ranging and Chaining- Booking
2. Setting out rectangle by using chain and cross staff.
3. Prismatic compass-Open traverse-Booking.
4. Prismatic compass-Closed traverse-Plotting.
5. Radiation method.
6. Intersection method.
7. Three point problem –Trial and error method & Tracing paper method.
8. Three point problem-Bessel's method & Right angle triangle method.
9. Two point problem
10. Plane table traverse
11. Study of Levels and booking of readings
12. Fly Levelling- Height of collimation method.
13. Fly Levelling- Rise and fall method.
14. Spot levels and contouring.
15. Study of minor instruments.
16. Plotting of LS and CS.

Course Designers

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2. T. Baskaran tbciv@tce.edu

Sub Code	Lectures	Tutorial	Practical	Credit
B 38	0	0	1	1

B38 Concrete Lab **0:1**

Objectives

To impart knowledge on testing of materials used in concrete and introduce the methodology of mix design.

List of Experiments

1. Determination of consistency and initial setting time of cement
2. Determination of soundness of cement
3. Determination of bulk density, specific gravity and void ratio for coarse and fine aggregate
4. Determination of Fineness Modulus and grading zone of fine aggregate
5. Determination of Fineness Modulus of coarse aggregate
6. Determination of maximum bulk of fine aggregate
7. Determination of crushing strength and impact value of coarse aggregate
8. Determination of workability of concrete by slump test and casting of specimens
9. Determination of workability of concrete by compaction factor test and casting of specimens
10. Determination of workability and consistency of concrete by Vee Bee consistometer test
11. Determination of consistency of concrete by Flow table test
12. Design of concrete mix by IS method and casting of specimens
13. Test on hardened concrete (Cube compressive strength, Split cylinder test, Flexure test and Rebound Hammer test)
14. Determination of Elastic Modulus of concrete

Demonstration

1. Determination of fineness of cement

Course Designers

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BOARD OF STUDIES MEETING

B.E Degree (Civil Engineering) Program

Fourth Semester

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

FOURTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41
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Web: www.tce.edu

Department of Civil Engineering

Graduating Students of BE program of Civil Engineering will be able to

1. Survey, map and plan layouts for buildings, structures and alignments for canals and roads
2. Specify, design, supervise, test and evaluate foundations and superstructures for residences, public buildings, industries, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.
3. Specify, design, supervise and evaluate water conveying systems.
4. Specify, select and formulate environmental engineering systems
5. Specify, design/select and operate hydraulic machines and surge systems
6. Analyze water resources hydrological systems to estimate safe and assured withdrawals.
7. Work in a team using common tools and environments to achieve project

   Objectives

Thiagarajar College of Engineering, Madurai-625015

Department of Civil engineering

Scheduling of Courses

Semester	**Theory Courses**							**Practical / Project**	
8th (21)	Elective 6 3:0	Elective 7 3:0	Elective 8 3:0					B88 Project 0:12	
7th (22)	B71 Management Theory and Practice 3:0	B72 Remote Sensing and GIS 3:0	Elective 3 3:0	Elective 4 3:0	Elective 5 3:0		B77 GIS Laboratory 0:1	B78 Project 0:6	
6th (22)	B61 Accounting and Finance 3:0	B62 Transportation Engineering 1 4:0	B63 Geotechnical Engineering 2 4:0	B64 Irrigation and Water Resources Engineering 3:0	Elective 1 3:0	Elective 2 3:0	B67 Highways Lab 0:1	B68 Design and Drawing 0:1	
5th (25)	B51 Numerical Methods 4:0	B52 Wastewater Engineering 3:0	B53 Structural Analysis 2 4:0	B54 Structural Design 2 4:0	B55 Hydrology 3:0	B56 Geotechnical Engineering 1 4:0	B57 Geotechnical Engineering Lab 0:1	B58 Environmental Engineering Lab 0:1	B59 CAD 0:1
4th (24)	B41 Probability and Statistics 4.0	B42 Water Supply Engineering 3:0	B43 Structural Analysis 1 4:0	B44 Structural Design 1 4:0	B45 Hydraulics and Hydraulic Machinery 3:0	B46 Ecology 2:0	B47 Survey Lab II 0:1	B48 Fluid Mechanics Lab 0:1	B49 Professional Communication 1:1
3rd (22)	B31 Engineering Mathematics – 3 4:0	B32 Strength of Materials 2 3:0	B33 Surveying 4:0	B34 Fluid Mechanics 3:0	B35 Data Structures 3:0	B36 Concrete Technology 3:0	B37 Survey LabI 0:1	B38 Concrete Lab 0:1	
2nd (23)	B21 Engineering Mathematics -2 4:0	B22 Strength of Materials 1 3:0	B23 Engineering Geology 3:0	B24 Computers and Programming 3:0	B25 Materials Science 3:0	B26 Construction Maerials & Technology 4:0	B27 Strength of Materials Lab 0:1	B28 Computer Programming Lab 0:1	B29 Workshop 0:1
1st (25)	H11 Engineering Mathematics – 1 4:0	H12 Physics 3:0	H13 Chemistry 3:0	H14 English 3:0	H15 Basics of ME and CE 4:0	H16 Basics of EEE 4:0	H17 Physics Lab 0:1	H18 Chemistry Lab 0:1	H19 Engineering Graphics 0:2

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SUBJECTS OF STUDY
(For the candidates admitted from 2008-2009 onwards)

FOURTH SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
B 41	Probability and Statistics	BS	4	-	-	4
B 42	Water Supply Engineering	DC	3	-	-	3
B 43	Structural Analysis – I	DC	4	-	-	4
B 44	Structural Design- I	DC	4	-	-	4
B 45	Hydraulics and Hydraulic Machinery	DC	3	-	-	3
B 46	Ecology	ES	2	-	-	2
PRACTICAL						
B 47	Survey Lab- II	P	-	-	1	1
B 48	Fluid Mechanics & Machinery Lab	P	-	-	1	1
B 49	Professional Communication	HSS	1	-	2	2
Total			**21**	**-**	**4**	**24**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
DC : Department Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture/Tutorial is equivalent to 1 credit
2/3 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2008-2009 onwards)

FOURTH SEMESTER

S.No.	Sub. code	Name of the subject	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	B 41	Probability and Statistics	3	50	50	100	25	50
2	B 42	Water Supply Engineering	3	50	50	100	25	50
3	B 43	Structural Analysis I	3	50	50	100	25	50
4	B 44	Structural Design I	3	50	50	100	25	50
5	B 45	Hydraulics and Hydraulic Machinery	3	50	50	100	25	50
6	B 46	Ecology	3	50	50	100	25	50
PRACTICAL								
7	B 47	Survey Lab II	3	50	50	100	25	50
8	B 48	Fluid Mechanics& Machinery Lab	3	50	50	100	25	50
9	B 49	Professional Communication	3	50	50	100	25	50

* CA evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

Sub code	Lectures	Tutorial	Practical	Credit
B41	4	0	-	4

B41 Probability and Statistics 4:0

Preamble:

An engineering student needs to have some basic mathematical tools and techniques. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraises him the complete procedure for solving different kinds of problems that occur in engineering. Based on this the course aims at giving adequate exposure in the theory and applications of Statistics, Probability and Sampling.

Program Outcomes addressed

a. Graduates will demonstrate knowledge of Mathematics, Science and Engineering.
b. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
c. Graduates will develop confidence for self education and ability for life-long learning.

Competencies

At the end of the course the student should be able to

1. Understand the basic concepts of Probability.
2. Express the probability distributions arising in the study of Engineering problems and their applications.
3. Construct the various tests essentially needed for testing of samples for testing for different attributes.

Assessment Pattern

	Bloom's category	Test 1	Test 2	Test 3 / End Semester Examinations
1	Remember	10	10	0
2	Understand	30	30	30
3	Apply	60	60	70
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Syllabus

Introduction to Probability

Sample spaces and events, counting, probability, The Axioms of Probability, Some elementary theorems, Conditional Probability, Baye's theorem, Mathematical Expectation and Decision Making

Probability distributions

Random variables, Discrete and Continuous distributions- Binomial, Poisson, Geometric and Hyper Geometric distributions, Uniform, Exponential, Gamma, Beta, Weibull, Log-normal and Multinomial distributions

Test of Hypothesis

Population and samples, the sampling distribution of mean (σ known), the sampling distribution of mean (σ unknown), the sampling distribution of variance, hypotheses concerning one mean, inferences concerning two means, Randomization and pairing, the estimation of variances, hypotheses concerning one variance, hypotheses concerning two variances, estimation of proportions, Bayesian estimation, hypotheses concerning one proportion, hypotheses concerning several proportions, analysis of r x c tables, goodness of fit.

Non Parametric Tests

Introduction, Sign test, Rank-Sum Test, Tests of Randomness, Kolmogorov Smirnov and Anderson Darling Tests.

Curve Fitting

Method of least square, Inferences based on the Least squares estimations, curvilinear regression, multiple regression, Correlation, multiple linear regressions.

Statistical Quality Control

Introduction to quality control, control charts for measurements, control charts for attributes

Text Books

1. Richard A.Johnson , "Miller & Freund's Probability and Statistics for Engineers, Seventh Edition, Prentice- Hall of India Private Limited, New Delhi 2004

References

1. S.C Gupta and V.K.Kapoor, "Fundamentals of mathematical statistics", Sultan chand & Co, 2002
2. Veerarajan .T "Probability and Random Processes" TMH , 2006.
3. Ronald E.Walpole, Raymond H.Myers, Sharon L.Myers, Keying Ye,"Probability and statistics for Engineers, Scientists", Eighth edition, Pearson Education,2007

Course content and lecture schedule

No	**Topic**	**No.of Lectures**
1	**Introduction to Probability**	
1.1	Sample spaces and events, counting, probability, The Axioms of Probability,	2
1.2	Some elementary theorems, Conditional probability	2
1.3	Baye's theorem, Mathematical Expectation and Decision Making	2
2	**Probability Distributions**	
2.1	Random variables, Discrete and Continuous distributions	1
2.2	Binomial distribution, Poisson distribution	2
2.3	Geometric and Hyper Geometric distributions, Uniform distribution	3
2.4	Exponential, Gamma ,Weibull distributions	2
2.5	Normal distributions, lognormal and Multinomial distributions	2
3	**Testing Hypothesis**	
3.1	Population and samples	1
3.2	the sampling distribution of mean (σ known), the sar distribution of mean (σ unknown),	2
3.3	the sampling distribution of variance	2

3.4	hypotheses concerning one mean	2
3.5	inferences concerning two means, Randomization and pairir	2
3.6	The estimation of variances, hypotheses concerning variance.	2
3.7	Hypotheses concerning two variances, estimation of proport	2
3.8	Estimation of proportions, Bayesian estimation.	2
3.9	hypotheses concerning one proportion, hypotheses conc several proportions	2
3.10	Analysis of r x c tables, goodness of fit.	2
4.	**Non Parametric test**	
4.1	Introduction, Sign test,	1
4.2	Rank-Sum Test,	1
4.3	Tests of Randomness,	1
4.4	Kolmogorov Smirnov and Anderson Darling Tests.	1
5	**Curve fitting**	
4.1	Method of least square, Inferences based on the Least sc estimations	2
4.2	Curvilinear regression, multiple regression	2
4.3	Correlation, multiple linear regressions.	2
5	**Statistical Quality Control**	
5.1	Introduction to quality control	1
5.2	Control charts for measurements	2
5.3	control charts for attributes	2

Course Designers

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Sub code	Lectures	Tutorial	Practical	Credit
B42	3	0	-	3

B42 – Water Supply Engineering 3.0

Preamble:

This course work aims at imparting the knowledge on various stages of works involved in planning, designing and execution of protected water supply to a community. Starting from demand estimation, identification of sources, studying the quality aspects of water at these sources, evolving a suitable treatment method to bring the quality to the permissible standards and finally to the distribution of this treated water to the individual dwelling units are well addressed.

Program outcomes addressed

a. Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
b. Graduates will identify, formulate, research literature and solve complex engineering problems, reaching substantiated conclusions using first principles of mathematics and engineering sciences.
c. Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
d. Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
e. Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the End of the Course, the student should be able to

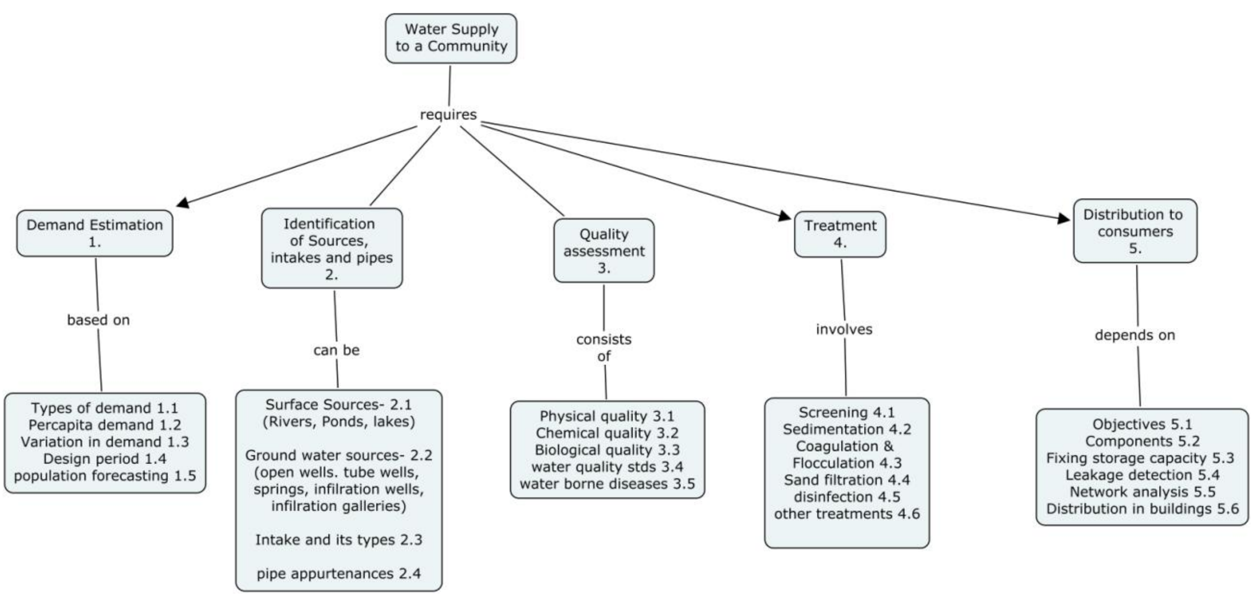
1. Make the total water demand estimation for a community.
2. Identify suitable water sources to meet the demand
3. Design the conduits for transportation of water from the source to treatment plant.
4. Measure the physical, chemical and biological characteristics of water available at the source and compare them with standards
5. Suggest and design a specific treatment system for the water quality available at the source.
6. Understand the salient features of a good distribution system.

7. Plan and design a good water distribution system for an individual building and for a community.

Assessment Pattern

S.No	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	20
2	Understand	30	30	30
3	Apply	50	40	40
4	Analyze	0	10	10
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
1	**Demand Estimation**	
1.1	Importance and need for planned water supply, Water demand – Types.	1
1.2	Per capita demand & factors affecting, variation in demand	1
1.3	Design period, Population forecasting – different methods	1
1.4	Problems in Population forecasting	1
2	**Identification of sources, Intakes and Pipes**	
2.1	Sources of water – surface sources – ponds, lakes, streams, rivers	1
2.2	Ground water sources – occurrence. Types of aquifers	1
2.2.1	Wells – open wells, tube wells. Spring and their types	1
2.2.2	Infiltration wells, Infiltration Galleries	1
2.3	Intakes and their types	1
2.4	Pipe materials, Pipe joints, Pipe appurtenances and testing of pipe line	1
3	**Quality Assessment**	
3.1	Quality of water – Physical quality	1
3.2	Chemical quality of water	2
3.3	Biological quality of water – its determination	1
3.4	Water borne diseases and water quality standards	1

4	**Treatment of Water**	
4.1	Treatment of water – objectives, Screening - Types	1
4.2	Sedimentation – theory & types, Stokes Law	2
4.3	Design of sedimentation tanks	1
4.4	Coagulation – theory, chemicals used. Flocculation and Jar test	1
4.5	Filtration –Filter media – removal mechanisms	1
4.5.1	Filter materials – Slow sand filters	1
4.5.2	Rapid sand filters and pressure filters	1
4.5.3	Design of filters	2
4.6	Disinfection of water – different methods. Chlorination – action, factors influencing	1
4.6.1	Chlorination types – free, combined chlorination	1
4.7	Water softening	1
4.8	Desalination	1
4.9	Treatment practices in rural areas	1
5	**Water Distribution**	
5.1	Distribution system – objectives, components & layouts	1
5.2	Distribution methods, pressure in the system, distribution reservoirs	1
5.3	Storage capacity – mass curve method – problem. Leak detection	2
5.4	Net work analysis – Hardy Cross method - Problems	2
5.4.1	Equivalent pipe method - problems	1
5.4.2	Computer applications in network analysis	1
5.5	Water supply in buildings – connection, Pipe fixtures. Storage tanks and piping systems	1
5.6	Water management – conservation, recycling & water pricing	1

Syllabus

Importance and need for planned water supplies. Water demand – Types, per capita demand, factors affecting per capita demand. Variation in demand – Design periods. Population forecasting – Different methods, Sources of water: Surface sources: ponds, lakes, streams, rivers; Ground water sources: occurrence, aquifers and their types: Wells: open wells, Tube wells, springs and their types. Infiltration galleries, Infiltration wells
Intakes and their types. Pipe materials, pipe joints, pipe appurtenances, testing of pipe line. Pumps for lifting water – types. Quality of water – Physical quality, chemical quality, Biological quality, Water borne diseases, Water quality standards. Treatment of water – Screening. Sedimentation – theory, types of settling, Stokes law, design. Coagulation – theory, chemicals used, flocculation, Jar test. Filtration – removal mechanisms, filter materials, types, slow sand, rapid sand and pressure filters, filter design. Disinfection – methods. Chlorination – action, factors influencing, free chlorination, combined chlorination – water softening –Desalination– water treatment practices in rural areas. Distribution systems – requirements, layouts, methods. Distribution reservoirs – storage capacity, mass curve method. Leak detection. Analysis of distribution network- Hardy Cross method, equivalent pipe method, computer applications in net work analysis. Water supply system in buildings – house connection, pipe fittings, storage tanks, piping systems – water management.

Text Book

1. Garg S.K "Water Supply Engineering", Khanna Publishers, 12th Edition, New Delhi 2004.

Reference Books

1. Steel E.W., "Water Supply and sewerage", Mc Graw Hill Publishers, New Delhi. 1979
2. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", McGraw Hill Publishers, New Delhi. 1985
3. Birdie G.S and Birdie J.S "Water Supply and Sanitary Engineering" Dhatpat Rai Publishing Company New Delhi, 1998
4. Gilbert M. Masters , " Introduction to Environmental Engineering and Science", Second Edition, 2004

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 43	4	0	0	4

B43 Structural Analysis – I 4:0

Preamble:

This course offers the basic modules of structural analysis such as articulated structures, frames, suspension cables and bridges and arches. This course aims at determination of the member forces of articulated structures and calculation of bending moment and shear forces of determinate beams, suspension bridges and arches.

Program outcomes addressed

a. Graduates will demonstrate an ability to identify, formulate and solve structural analysis problems
b. Graduates will be able to communicate effectively in both verbal and written form
c. Graduates will develop confidence for self education and ability for life long learning
d. Graduates who can participate and succeed in competitive examinations

Competencies

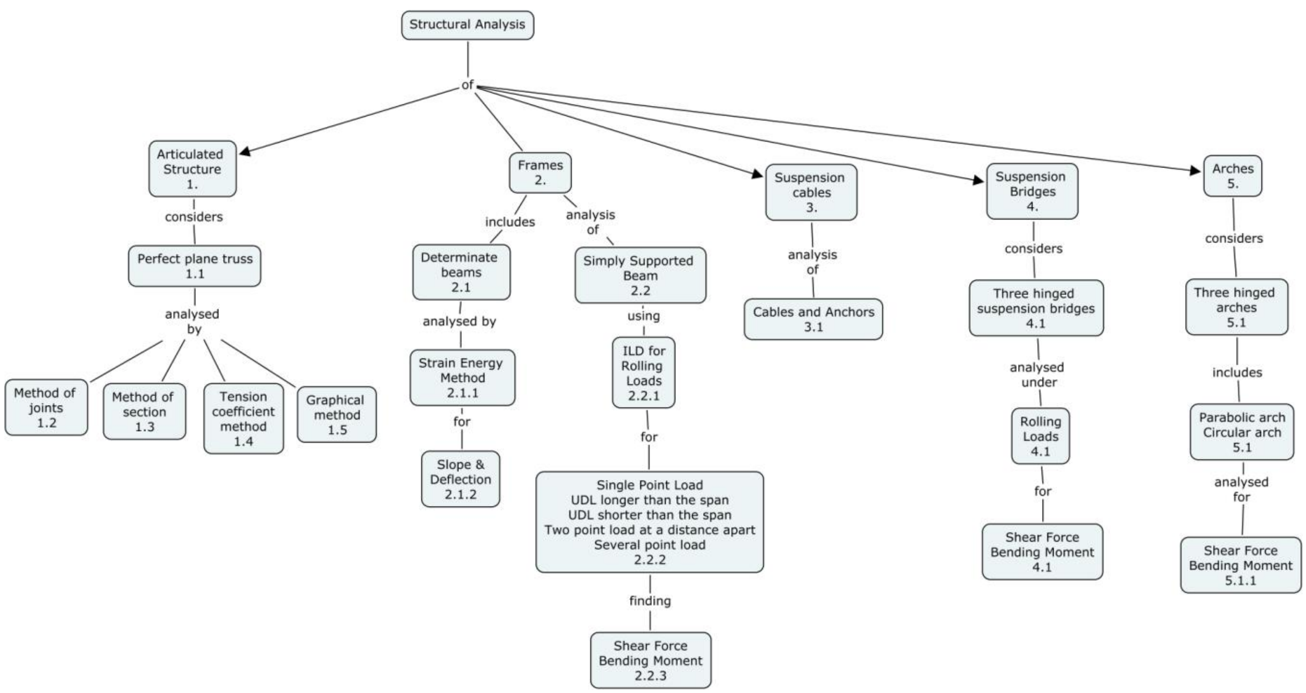
At the end of the course, the students will be able to

1. Determine forces in members of trusses by method of joints, method of sections and by graphical method
2. Calculate the strain energy stored due to axial, shear forces and bending moment
3. Draw influence line diagram for reaction, shear force and bending moment of determinate structures
4. Determine the stresses in anchors, cables and suspension bridges
5. Calculate shear force and bending moment in stiffening girders
6. Analyze determinate arches subjected to different loading

Assessment Pattern

S.No	Bloom's Category	Test 1	Test 2	Test 3 / End Semester Examination
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyze	-	-	-
5	Evaluate	-	-	-
6	Create	-	-	-

Concept map



Course content and Lecture schedule

S.NO	TOPICS	PERIODS
	Articulated structures	
1	Introduction to determinate and indeterminate structures	1
1.1	Articulated structures - Internally and externally determinant, Analysis of Pin jointed perfect truss	1
1.2	Method of joints	2
1.3	Method of sections	2
1.4	Tension coefficient Method	2
1.5	Graphical methods	3
	Frames	
2	Introduction to Framed structures	2
2.1	Introduction to strain energy method for determinate beams – axial force, shear force and bending moment	2
2.1.1	Description of Castigliano's theorem-I , Slope and deflection for determinate beams under point load and udl	3
2.1.2	Slope and deflection for portal frames under point load and udl	2
2.2	Influence line diagram for simply supported beams	2
2.2.1	Bending moment and shear force for a beam subjected to concentrated load – using ILD	2
2.2.2	Bending moment and shear force for a beam subjected to Uniformly distributed load- using ILD	2
2.2.3	Bending moment and shear force for a beam subjected to Two and several concentrated loads- using ILD	3
	Suspension Cables	
3	Introduction to suspension bridges and Cable tension- anchor cable and towers	4
3.1	Cable subjected to point loads, Uniformly distributed load	3
	Suspension bridges	
4	Suspension bridges , Three hinged stiffening girder	2
4.1	Influence line diagram for moving loads on the stiffening girders –point load and udl	2
	Arches	
5	Types of arches and the state of forces , Linear arch- Eddy's theorem	4
5.1	Three hinged arch – parabolic and circular	3
5.1.1	Influence line diagram for moving loads on arches under point load and udl. Determination of BM and SF	3
	Total	50

Syllabus

Trusses- Introduction of Determinate and indeterminate structures – Internally and externally determinate trusses – Analysis of plane trusses – Methods of joints, Method of sections, Tension co-efficient method and graphical method

Strain Energy-Strain energy due to axial force – shear force – bending moment - Castigliano's theorem-I – slope and deflection of simply supported beams, cantilever beams and overhanging beams subjected to point load, UDL.

Influence Line Diagram(ILD)-Definition – uses – ILD for shear force – ILD for B.M at a section of a simply supported beam.

Rolling Loads – ILD for shear force and bending moment at a section - ILD for max. shear force and bending moment - single concentrated load – UDL longer than the span – UDL shorter than the span – Two point loads separated by a distance apart - several point loads.

Cables and Suspension Bridges-Parts of suspension bridges – Analysis of cable – anchor cable – towers – suspenders – cable with UDL – forces on cables – stiffening girders – three hinged stiffening girders – ILD for moving loads on girders (only point load and udl)

Arches – Types - Linear arch – Eddy's theorem – three hinged circular arch, parabolic arch – ILD for moving loads on arches (point load and udl)

Text Books

1. Rajput., Strength of materials, S.Chand publishers, 4th edition, 2007
2. Punmia, B.C., Arun Kumar, Ashok Kumar., Theory of structures, Laxmi Publications, New Delhi, 2002.

Reference:

1. Junnarkar, S.B. & Shah, H.J.., Mechanics of structures, vol.I, II, Charotar Publishing House, India, 1999.
2. Reddy, C.S., Basic Structural Analysis, Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1981.
3. Negi,L.S, Jangid,R.S., Structural Analysis, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.
4. Timoshenko,S.P, Young, D.H., Theory of Structures, Second Edition, McGraw-Hill Book Company, Singapore, 1965.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 44	4	0	0	4

B44 Structural Design -I **4:0**

Preamble:

The primary concern of an engineer is design. Structural design consists conceptualization, idealization, analysis, design, construction and maintenance. Conceptualization is required to arrive at the final shape and size of the structure. Idealization involves reducing the conceived structure into primary elements. By analysis internal forces like bending moments, shear, torsion, compression and tension in each and every element is determined. Design assigns every element a particular material and size. Construction involves putting all the elements together to perform like the originally conceived structure. Maintenance is needed to keep the performance of the structure without deterioration.

In this course, designs of structural elements, like beam, walls and columns, made of specific materials like masonry and steel are dealt with. Further the elements are designed for internal forces like tension, compression, bending moment and shear.

Program out comes addressed

a. Graduates will demonstrate knowledge of mathematics, science and engineering.
b. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
c. Graduates will develop confidence for self education and ability for life long learning.
d. Graduates will be able to participate and succeed in competitive examinations.

Competencies

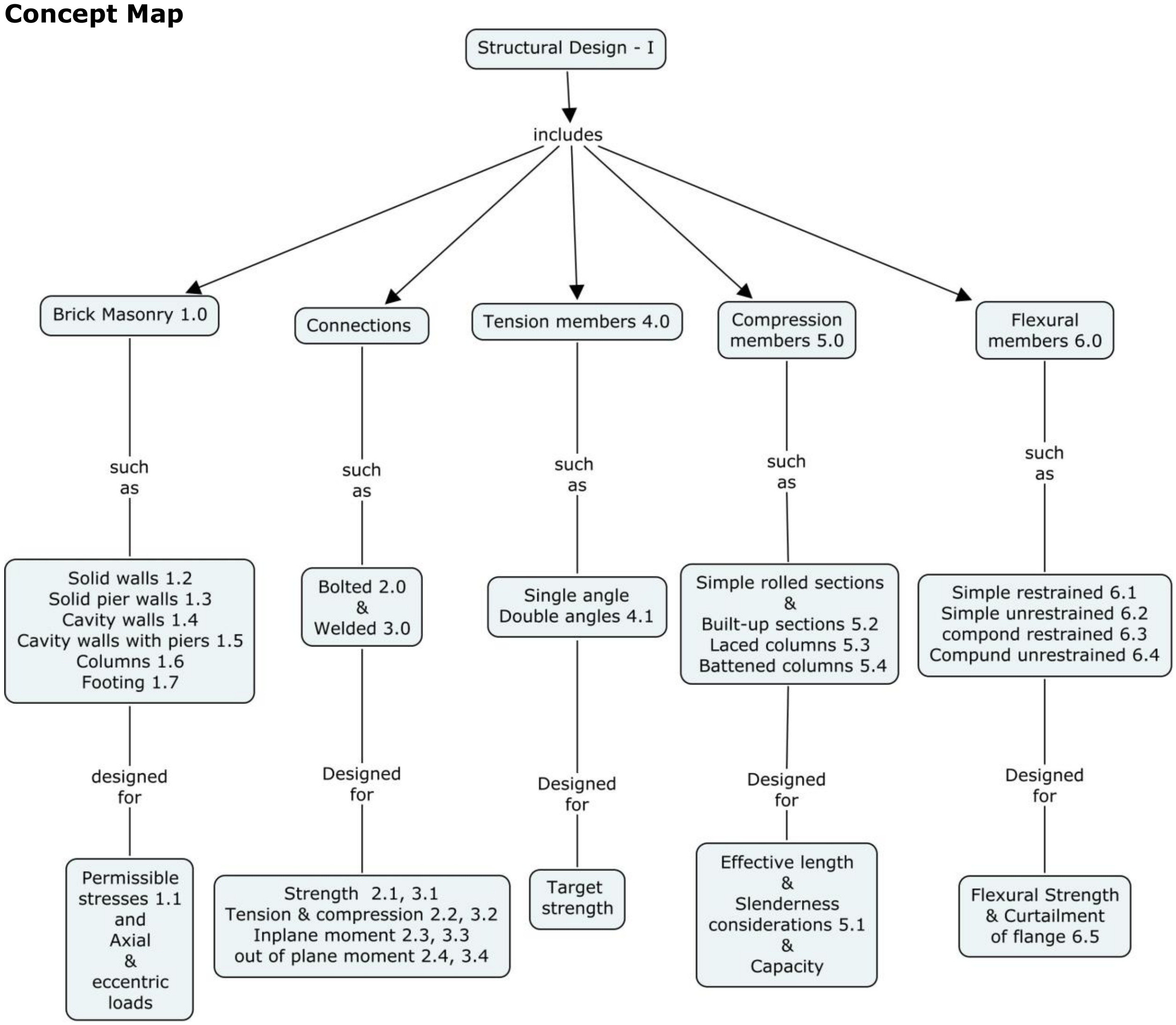
At the end of the course the students will be able to

1. Determine the dimensions of the walls and columns of brick masonry.
2. Determine the strength of bolted and welded connections.
3. Analyse and Design steel tension members
4. Determine the Capacity of steel column of rolled steel and built up sections
5. Determine flexural strength of simple and compound steel beams for different conditions.

Assessment pattern

S.No	Bloom's category	Test1	Test2	Test3/End Semester Examination
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyze	-	-	-
5	Evaluate	-	-	-
6	Create(Design)	-	-	-

Concept Map



Course contents and lecture schedule

Lecture schedule		
No	**Topic**	**No of Lectures**
1	**Brick masonry**	
1.1	Permissible stresses	1
1.2	Design of solid walls - axial and eccentric loads	2
1.3	Design of solid pier walls – axial and eccentric loads	2
1.4	Design of cavity walls - axial and eccentric loads	2
1.5	Design of cavity walls with piers - axial and eccentric loads	2
1.6	Design of masonry columns - axial and eccentric loads	2
1.7	Design of masonry footings	2
2	**Bolted connection in steel Structures**	
2.1	Type of connections, Force transfer mechanism, failure mechanism	1
2.2	Design of connection – direct tension and compression	2
2.3	Design of connection - Moment in plane of the bolt	2
2.4	Design of connection - Moment perpendicular to the bolt	2
3	**Welded connection in steel structures:**	
3.1	Type of welds, accepted criteria for welded joints, strength of weld	2
3.2	Design of connection – direct tension and compression	2
3.3	Design of connection - moment in plane of the weld	2
3.4	Design of connection - moment perpendicular to the weld	2
4	**Steel tension members:**	
4.1	Behaviour of tension member, Design strength of tension member –single angle, double angle	3
5	**Steel compression members:**	
5.1	Type of Column sections, Effective length, maximum slenderness ratio	1

5.2	Design of compression member – rolled steel section – simple and built up section.	3
5.3	Design of compression member - laced columns	2
5.4	Design of compression member – battened columns	3
6	**Steel flexure members**:	
6.1	Behaviour of steel beams, Limit state of serviceability, Design of simple beams fully restrained along compression flange	2
6.2	Design of compound beams fully restrained along compression flange	2
6.3	Lateral torsional buckling of beams, Factors affecting lateral stability Design of simple beams unrestrained along compression flange	3
6.4	Design of compound beams unrestrained along compression flange	2
6.5	Curtailment of flange plates	1

Syllabus

Brick masonry: Permissible stresses, Design of solid masonry walls, solid pier walls, cavity walls with piers and columns for axial and eccentric loads. Design of masonry footings **Bolted connection in steel structures:** Type of connections, Force transfer mechanism, failure mechanism. Design of connection in direct tension, compression, moment in plane of the bolt, moment perpendicular to the bolt. **Welded connection in steel structures:** Type of welds, accepted criteria for welded joints, strength of welds. Design of connection in direct tension, compression, moment in plane of the weld, moment perpendicular to the weld. **Steel tension members:** Behaviour of tension member, Design strength of tension members with single angle, double angle. **Steel compression members:** Type of Column sections, Effective length, maximum slenderness ratio, Design of compression member with rolled steel section, simple and built up section - laced and battened columns. **Steel flexure members**: Behaviour of steel beams, Limit state of serviceability, Design of simple and compound beams with fully restrained, Lateral torsional buckling of beams, Factors affecting lateral stability, Design of simple and compound beams unrestrained along compression flange, Curtailment of flange plates.

Text Books

1. Dayaratnam. P., (1987) "Brick and Reinforced Brick Structures", Oxford IBH publishing Co .Pvt Ltd,New Delhi.
2. Teaching Resource for Structural Steel Design, Vol. 1,2,3 (2000), INSDAG- Institute for Steel Development and Growth, Kolkatta.
3. Subramanian, N., (2008), Design of Steel Structures, oxford university press, USA,.

Indian Standard Codes

4. IS: 800 – 2007, Code of Practice for general construction in steel, BIS, New Delhi
5. IS: 800 – 1984, Code of Practice for general construction in steel, BIS, New Delhi
6. SP 6 (1) – Structural steel sections
7. IS: 1905 – 1987, Code of practice for structural use of unreinforced masonry
8. IS: 816 - 1969, Code of practice for use of metal arc welding for general construction in mild steel

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Sub Code	Lectures	Tutorial	Practical	Credit
B 45	3	0	0	3

B45 Hydraulics and Hydraulic Machinery 3.0

Preamble:

This subject aims at an experimental way of studying the fluid flow, which deals with design, measurement and behavior of flow in open channels. Further it also involves Dimensional analysis, model testing and design of hydraulic machines at an optimum cost.

Program outcomes addressed

a. Graduates will demonstrate knowledge of Mathematics, Science, and Engineering.
b. Graduates will demonstrate an ability to identify, formulate and solve complicated engineering problems.
c. Graduates will demonstrate skills to use modern engineering tools, sophisticated equipments to analyse engineering problems.

Competencies

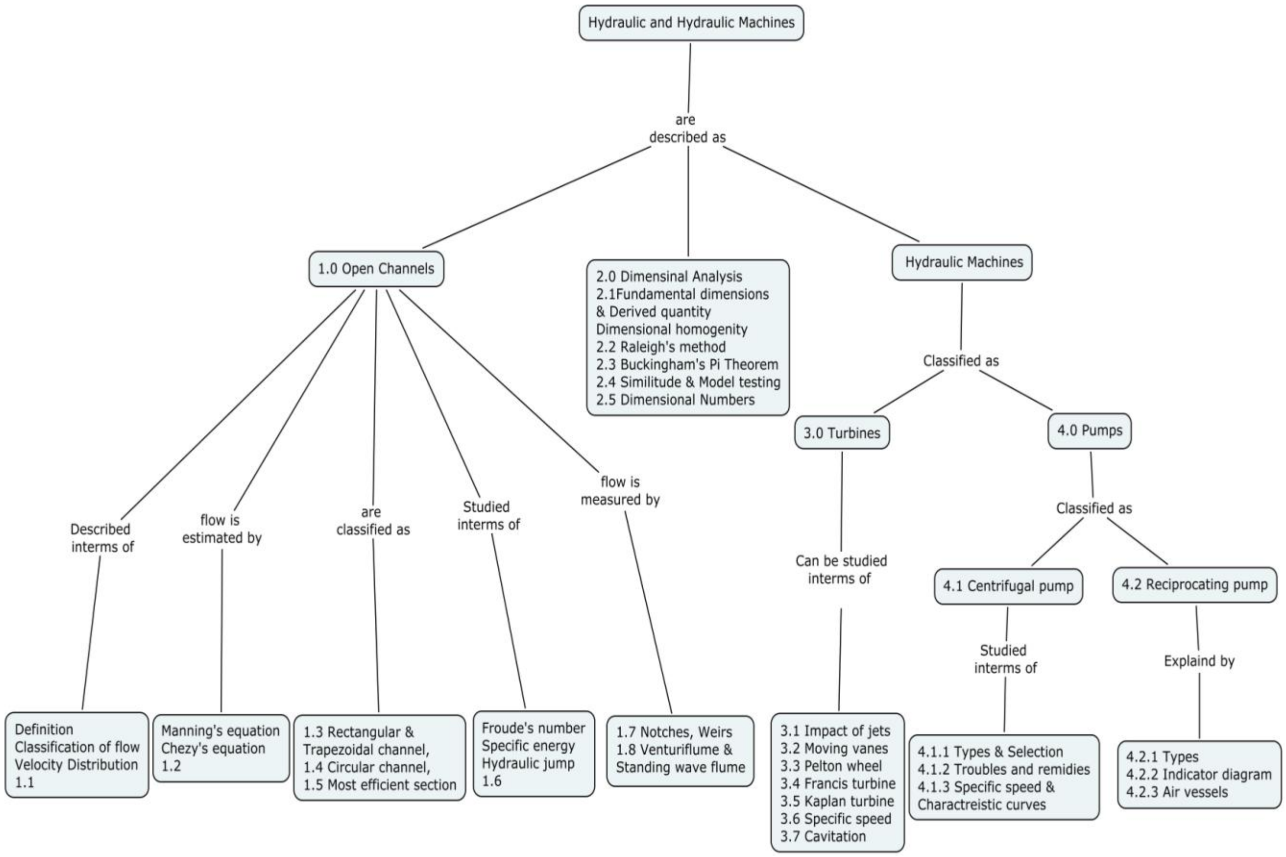
At the end of the course the student should be able to

1. Understand the various types of open channel flow
2. Determine cross sections of different types of channels
3. Understand the creation of hydraulic jump and its advantages
4. Apply the dimensional analysis on hydraulic engineering problems
5. Understand the behavior of turbines and pumps
6. Determine the parameters of turbines and pumps
7. Determine the performance of turbines and pumps under different operating conditions

Assessment Pattern

S.No.	Bloom's Category	Test 1	Test 2	Test 3/ End- semester Examination
1	Remember	20	20	20
2	Understand	20	20	20
3	Apply	60	60	60
4	Analyse	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Concept Map



Course content and Lecture schedule

No	Topic	No. of Lectures
1.0	**Open channel flow**	
1.1	Definition, classification, and velocity distribution in open channels	1
1.2	Chezy's and Manning's equation	1
1.3	Flow through rectangular and trapezoidal channels	2
1.4	Flow through Circular channels	1
1.5	Most efficient channel section	2
1.6	Froude's number, Specific energy diagram, Hydraulic jump	3
1.7	Flow measurement by Notches & Weirs,	2
1.8	Venturiflume and Standing wave flume	2
2.0	**Dimensional Analysis**	
2.1	Fundamental dimensions, derived quantity, and Dimensional homogeneity	1
2.2	Rayleigh's method	2

2.3	Buckingham's ∏-Theorem	2
2.4	Similitude & Model testing	2
2.5	Dimensionless numbers	2
3.0	**Hydraulic Turbines**	
3.1	Impact of jets on vanes	1
3.2	Moving vanes	1
3.3	Pelton wheel	2
3.4	Francis turbine	2
3.5	Kaplan turbine	1
3.6	Specific speed of turbines	1
3.7	Cavitation in turbines	1
4.0	**Pumps**	
4.1	**Centrifugal Pump**	
4.1.1	Types of centrifugal pumps, Selection of pumps,	1
4.1.2	Troubles and remedies, Multistage pumps	1
4.1.3	Characteristics curves and Specific speed	1
4.2	**Reciprocating Pump**	
4.2.1	Types of Reciprocating pump	1
4.2.2	Indicator diagram	1
4.2.3	Slip and Air vessels	1
4.2.4	Submersible and jet pumps	2

Syllabus

Open channel flow: Definition, classification, and velocity distribution in open channels. Chezy's and Manning's equation. Flow through rectangular, Trapezoidal and Circular channels. Hydraulically most efficient channel section. Froude's number, Specific energy diagram, Hydraulic jump, Notches, Weirs, Venturi flume and Standing wave flume. **Dimensional Analysis:** Fundamental dimensions and derived quantity, Dimensional homogeneity, Rayleigh's method and Buckingham's ∏-Theorem, Similitude, Model testing, Dimensionless number. **Impact of jets:** Impact of jets on vanes. **Hydraulic turbines:** Historical development of turbines and classification, Pelton wheel, Francis turbine, Kaplan turbine, specific speed and Cavitation. **Pumps:** Types of centrifugal pumps, Selection of pumps, Troubles and remedies, Multistage pumps, Characteristics curves, Specific speed. Single and double acting reciprocating pump, Multicylinder pump, Indicator diagram, Slip and Air vessels, submersible and jet pumps.

Text Book

1. Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics" Standard Book House, New Delhi, 2005

References

1. Bansal R.K, "Fluid Mechanics and Hydraulic Machines" Laxmi Publications, New Delhi, 2008
2. Rajput. R.K, "A Text book of Fluid Mechanics", S.Chand and Company, New Delhi, 2009
3. Subramanya K, "Flow in open channels", Tata McGraw-Hill Publishing Company, 2004
4. Ramamrutham S and Narayanan R "Hydraulics and Fluid Mechanics and Fluid Machines", Dhanpat rai Publishing Co (P) Ltd, New Delhi 2000
5. Robert W.Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics" Fourth Edition, John Willey & sons, New York, 1995
6. Kumar.K.L, "Engineering Fluid Mechanics" S.Chand and Company Ltd, New Delhi, 2004

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 46	2	0	--	2

B46 Ecology **2:0**

(Common to all branches of Engineering B46, C26, D26, E26, G36, T26)

Preamble:

Progress, as majority perceives it, implies increasing energy flow through the society. Increasing energy consumption means increasing entropy, which is nothing but pollution and disorder. With exponentially increasing population and per capita consumption, single most concern of all people across the world ought to be the threat to the sustainability of life we know of. World Commission on Environment and Development issued a report in 1987 entitled "Our Common Future" which concluded that then existing trends of economic development and the accompanying environmental degradation were unsustainable. It clearly emphasized that the health of global environment is essential for the future of every one. Therefore, engineers, who through their technological activities greatly influence the health of global environment, need to be sensitive about what keeps the ecosystem sustainable for humans. This course aims to achieve this sensitization.

Program outcomes addressed

a. An ability to apply knowledge of engineering, information technology, mathematics, and science
b. An ability to identify, formulate and solve engineering problems
c. An ability to engage in life-long learning
d. An ability to consider social, environmental, economic and ethical impact of engineering activities in a given context.
e. An ability to consider issues from global and multilateral views.

Competencies:

At the end of the course the student should be able to

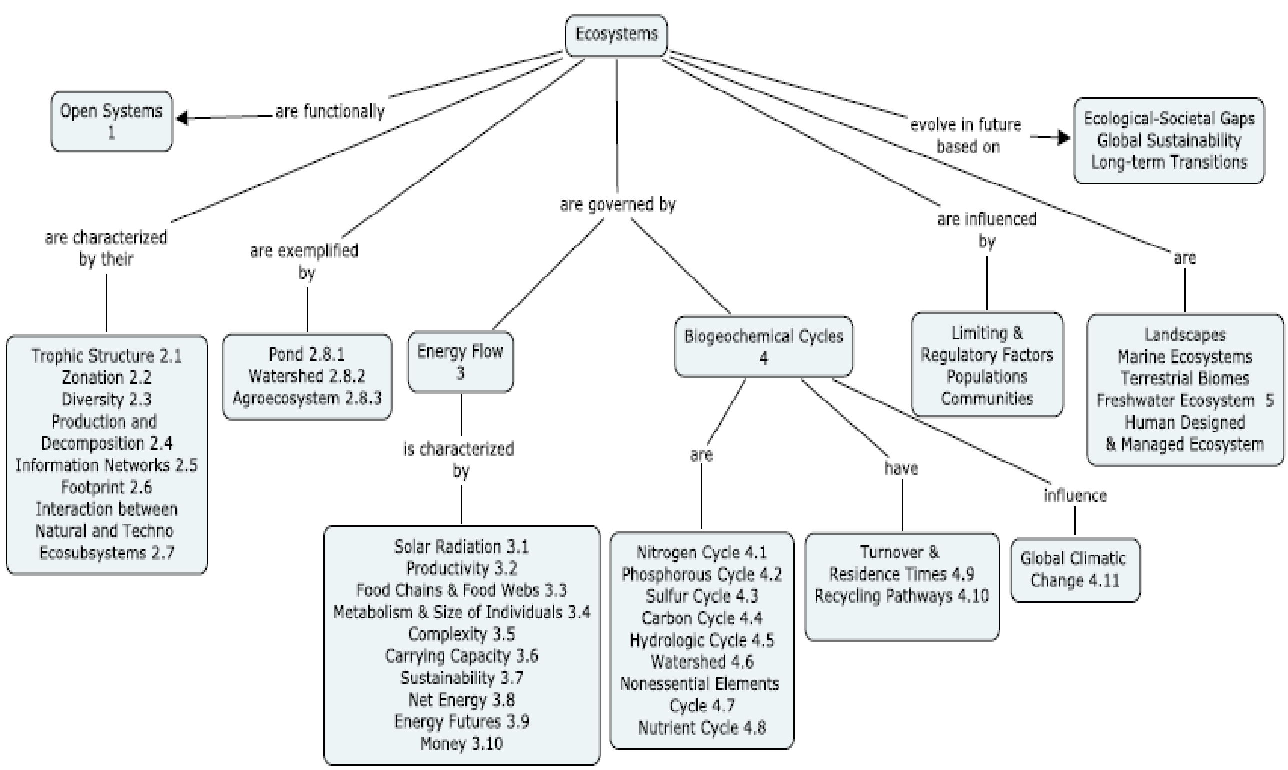
1. Explain why an ecosystem is an open system
2. Explain how an ecosystem is characterized by trophic structure, zonation, diversity, production and decomposition, information networks, footprint, interaction between natural and techno ecosubsystems.
3. Analyze specific ecosystems like a pond, watershed and agroecosystem.
4. Trace the energy flows through an ecosystem by way of solar radiation, productivity, food chains and food webs, metabolism and size of individuals, carrying capacity, complexity, sustainability, net energy, energy futures and money.

5. Trace how an ecosystem is governed by different biogeochemical cycles, including nitrogen, phosphorous, sulfur, carbon, hydrologic, non-essential elements and nutrient cycles, and watershed.
6. Analyze the biogeochemical cycles in terms of turnover and residence times and recycling pathways.
7. Explain how global climatic changes occur.
8. Analyze the fresh water ecosystem

Assessment Pattern

	Bloom's Category	Test 1	Test 2	Test3/End semester examination
1	Remember	30	20	10
2	Understand	50	40	40
3	Apply	10	20	20
4	Analyze	10	10	20
5	Evaluate	0	10	10
6	Create	0	0	0

Concept Map



Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Ecosystem as an Open System**	1
2	**Characterization of Ecosystems**	
2.1	Trophic structure and Zonation	1
2.2	Diversity and Ecological Footprint	1
2.3	Production and Decomposition	1
2.4	Information Networks	1
2.5	Interaction between Natural and Techno Ecosubsystems	1
2.6	Examples of Ecosystems	
2.6.1	Pond / Watershed / Agroecosystem	2
3	**Energy Flow in Ecosystem**	
3.1	Solar radiation , Productivity	1
3.2	Food Chains and Food Webs	1
3.3	Metabolism and Size of Individuals	1
3.4	Carrying Capacity and Complexity	1
3.5	Sustainability	1
3.6	Net Energy, Energy Future and Money	2
4.	**Biogeochemical Cycles**	
4.1	Nitrogen Cycle	1
4.2	Phosphorous Cycle	1
4.3	Sulfur Cycle	1
4.4	Carbon Cycle	1
4.5	Hydrologic Cycle	1

No.	Topic	No. of Lectures
4.6	Non-essential Elements Cycle and Nutrient Cycle	1
4.7	Watershed	1
4.8	Turnover, Residence Times and Recycling Pathways	1
4.9	Global Climatic Change	1
5.	**Fresh Water Ecosystem**	**2**

Syllabus

Ecosystem as an Open System; Characterization of Ecosystems: Trophic structure, Zonation, Diversity, Production and Decomposition, Information Networks, Ecological Footprint, Interaction between Natural and Techno Eco-subsystems, Examples of Ecosystems: Pond, Watershed, Agro-ecosystem **Energy Flow in Ecosystem:** Solar Radiation, Productivity, Food Chains and Food Webs, Metabolism and Size of Individuals, Carrying Capacity, Complexity, Sustainability, Net energy, Energy Futures, Money **Biogeochemical Cycles:** Nitrogen Cycle, Phosphorous Cycle, Sulfur Cycle, Carbon Cycle, Hydrologic Cycle, Non-essential Elements Cycle, Nutrient Cycle, Watershed, Turnover and Residence Times, Recycling Pathways, Global Climatic Change **Fresh Water Ecosystem**

Text Book

1. Odum E.P. and Barret G. W."Fundamentals of Ecology", Thomson Brooks/Cole, 2005

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5. K. Radha **krchem@tce.edu**

Sub Code	Lectures	Tutorial	Practical	Credit
B 47	0	0	1	1

B47 SURVEY LAB II **0.1**

Objectives: This subject is designed to train the students in linear measurements, angular measurements, heights and distances of various objects and also be familiar with handling modern surveying instruments.

LIST OF EXPERIMENTS

(any twelve experiments are to be conducted)

1. Measurement of Horizontal Angle - Repetition method
2. Measurement of Horizontal Angle – Reiteration method
3. Measurement of Vertical angle for various objects.
4. Measurement of distance between two objects – Stadia Tachometry
5. Measurement of distance between two objects – Tangential Tachometry
6. Measurement of distance between two objects
7. Determination of gradient of the line joining two - objects at different levels.
8. Determination of the R.L. of inaccessible object – Single Plane method
9. Determination of the R.L. of inaccessible object – Double Plane method
10. Determination of the gradient of the line joining the instrument station and a target of subtense bar.
11. Determination of the gradient of the line joining the staff station and target of subtense bar
12. Setting of curves by the Theodolite.
    A) Serpentine curve.
    B) Simple curve.
13. Center line marking for buildings
14. Study of Total station and taking observations using Total station.
15. Determination of heights and distances using Total station
16. Data downloading and calculations of required parameters.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 48	0	0	1	1

B48 Fluid Mechanics and Machinery Lab **0:1**

Objective:

This laboratory is used in conjunction with the Fluid Mechanics course in reinforcing the fundamentals of fluid mechanics by hands-on experiments. The experiments to demonstrate the principles such as application of Bernoulli equation, frictional head loss in pipes, fluid measurement and performance test on pumps and turbines are included.

List of Experiments

(any twelve experiments are to be conducted)

1. Determination of coefficient of discharge of small orifice
2. Discharge measurement through pipe by using Orificemeter
3. Discharge measurement through pipe by using Venturimeter
4. Discharge measurement in channels by using notches
5. Determination of friction co-efficient of pipes
6. Verification of Bernoulli's theorem
7. Metacenter and Metacentric height of a floating body
8. Determination of minor losses in pipe flow.
9. Reynold's experiment
10. Performance test on Pelton wheel turbine
11. Performance test on Francis turbine
12. Impact of jet on vanes
13. Performance test on Centrifugal pump
14. Performance test on Multi-stage pump
15. Performance test on Reciprocating pump

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Sub Code	Lectures	Tutorial	Practical	Credit
B49	1	0	1	2

PROFESSIONAL COMMUNICATION **1:1**

(Common to ALL branches of B.E)

Subject codes: B49, C49, D49, E49, G49, IT49

Preamble:

Professional communication aims to develop Listening, Speaking, Reading and Writing skills in Engineering students' professional development contexts such as projects, competitive exams, organizational communication and soft skills.

Competencies:

At the end of the course the students should be able to

Listening:

1. Listen and understand the project presentations, competitive exam exercises, organizational communication activities
2. Listen to the lectures on soft skills for practice.

Speaking:

1. Present project reports, self introduction
2. Participate in GD and interview in work context.

Reading:

1. Read and collect information for project report writing.
2. Read and understand the comprehension passages given in competitive examinations.
3. Read and understand the company profile

Writing:

1. Write a project report adhering to proper format
2. Create a paragraph and essay using their own ideas
3. Write circulars, minutes of the meetings, and curriculum vitae

Assessment Pattern:

S.No	Bloom's Category	Internal(50)	External (100)
1	Recall	10	10
2	Understand	10	20
3	Application	10	20
4	Analysis	10	30
5	Evaluation	5	10
6	Creation	5	10

Course Content:

1. Listening:

1.1 Attention, understanding and responding

1.2 Project report writing, competitive exam exercises, organizational communication and soft skills practice

2. Speaking:

2.1 Planning, preparation and presentation

2.2 Project report, self introduction, GD and interview

3. Reading:

3.1 Rapid reading and reference skills

3.2 Project reports, competitive exam exercises and company profiles

4. Writing:

4.1. Structure

4. 1.1 Sentence structure

4.1.2 Abstract writing

4.1.3. CV writing

4.1.4. Project report writing

4.2 Organizational Communication

4.2.1 Circulars

4.2.2 Minutes of the meeting

Syllabus:

Listening: Listening to Project presentation: Asking Questions, Listening test as conducted in TOEFL and BEC, Listening in the context of Organizational communication and Soft skill practice.

Speaking: Project presentation skill, Speaking in the context of Group Discussion, Interview, TOEFL and BEC Exam Spoken Test, Speaking in the work Contexts : Self introduction, Mini Presentation

Reading: Reference Skills for Project Report Writing: Topic selection, Data Collection. Rapid Reading, Reading comprehension tests conducted in CAT, TOEFL, GRE and BEC, Reading skills in work situation: Company Profile

Writing: Project Report Writing : Format, Abstract, Bibliography, Structure : Sentence structure, CV Writing, Writing in Work context : Circulars, Minutes of the meeting

References

1. Tony Lynch: Study Listening. Cambridge, Cambridge University Press, 2007
2. Sangeeta Sharma and Binod Mishra: Communication Skills for Engineers and Scientists. New Delhi, PHI Learning Pvt. Ltd. 2009.
3. Hari Mohan Prasad and Uma Rani Sinha: Objective English for Competitive Examination. New Delhi, Tata McGraw – Hill, 2005
4. Bob Dignen, Steeve Flinders et. al.: Work and Life: English 365. Students Book 1,2 & 3. New Delhi, Cambridge, 2004.

List of Lecture sessions:

Listening:

1. Effective listening skills
2. Nature of listening tests in competitive examinations
3. Introduction of soft skills

Speaking:

1. Introduction of Presentation skills
2. Suggestions for speaking tests in competitive exams
3. How to participate in GD
4. Interview techniques

Reading:

1. Rapid reading techniques
2. Reference skills

3. Suggestions for reading tests in competitive exams

Writing:

1. Format of project report
2. Abstract of the project
3. Sentence structure
4. Organizational communication like sending circulars, writing minutes of the meetings
5. CV writing

List of Practice Sessions:

Listening:

1 Messages, descriptions, conversations and lectures

Speaking:

1. Self Introduction
2. Mini Presentation
3. GD
4. Interview

Reading:

1. Rapid reading practices
2. Comprehension exercises
3. Topic selection and data collection for project report

Writing:

1. Sentence structure
2. Abstract writing
3. Project Report Writing
4. Circulars
5. Minutes of the meeting
6. Model test

Course Designers

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

FIFTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

Phone: 0452 – 2482240, 41
Fax: 0452 2483427
Web: www.tce.edu

Department of Civil Engineering

Graduating Students of BE program of Civil Engineering will be able to

1. Survey, map and plan layouts for buildings, structures and alignments for canals and roads
2. Specify, design, supervise, test and evaluate foundations and superstructures for residences, public buildings, industries, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.
3. Specify, design, supervise and evaluate water conveying systems.
4. Specify, select and formulate environmental engineering systems
5. Specify, design/select and operate hydraulic machines and surge systems
6. Analyze water resources hydrological systems to estimate safe and assured withdrawals.
7. Work in a team using common tools and environments to achieve project

   Objectives.

Thiagarajar College of Engineering, Madurai-625015

Department of Civil engineering

Scheduling of Courses

Semester	Theory Courses							Practical / Project	
8th (21)	Elective 6 3:0	Elective 7 3:0	Elective 8 3:0					B88 Project 0:12	
7th (22)	B71 Management Theory and Practice 3:0	B72 Remote Sensing and GIS 3:0	Elective 3 3:0	Elective 4 3:0	Elective 5 3:0		B77 GIS Laboratory 0:1	B78 Project 0:6	
6th (24)	B61 Accounting and Finance 3:0	B62 Transportation Engineering 1 4:0	B63 Geotechnical Engineering 2 4:0	B64 Structural Engineering 4.0	Elective 1 3:0	Elective 2 3:0	B67 Highways Lab 0:1	B68 Design and Drawing 0:1	B69 CAD 0:1
5th (24)	B51 Numerical Methods 4:0	B52 Wastewater Engineering 3:0	B53 Structural Analysis 2 4:0	B54 Design of Steel Structures 4:0	B55 Irrigation and Water Resources Engineering 3:0	B56 Geotechnical Engineering 1 4:0	B57 Geotechnical Engineering Lab 0:1	B58 Environmental Engineering Lab 0:1	
4th (24)	B41 Probability and Statistics 4.0	B42 Water Supply Engineering 3:0	B43 Structural Analysis 1 4:0	B44 Structural Design 1 4:0	B45 Hydraulics and Hydraulic Machinery 3:0	B46 Ecology 2:0	B47 Survey Lab II 0:1	B48 Fluid Mechanics Lab 0:1	B49 Professional Communication 1:1
3rd (22)	B31 Engineering Mathematics – 3 4:0	B32 Strength of Materials 2 3:0	B33 Surveying 4:0	B34 Fluid Mechanics 3:0	B35 Data Structures 3:0	B36 Concrete Technology 3:0	B37 Survey LabI 0:1	B38 Concrete Lab 0:1	
2nd (23)	B21 Engineering Mathematics -2 4:0	B22 Strength of Materials 1 3:0	B23 Engineering Geology 3:0	B24 Computers and Programming 3:0	B25 Materials Science 3:0	B26 Construction Materials & Technology 4:0	B27 Strength of Materials Lab 0:1	B28 Computer Programming Lab 0:1	B29 Workshop 0:1
1st (25)	H11 Engineering Mathematics – 1 4:0	H12 Physics 3:0	H13 Chemistry 3:0	H14 English 3:0	H15 Basics of ME and CE 4:0	H16 Basics of EEE 4:0	H17 Physics Lab 0:1	H18 Chemistry Lab 0:1	H19 Engineering Graphics 0:2

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SUBJECTS OF STUDY

(For the candidates admitted from 2008-2009 onwards)

FIFTH SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week			credits
			L	T	P	
THEORY						
B 51	Numerical Methods	BS	4	-	-	4
B 52	Wastewater Engineering	DC	3	-	-	3
B 53	Structural Analysis - II	DC	4	-	-	4
B 54	Design of Steel Structures	DC	4	-	-	4
B 55	Irrigation and Water Resources Engineering	DC	3	-	-	3
B 56	Geotechnical Engineering - I	DC	4	-	-	4
PRACTICAL						
B 57	Geotechnical Engineering Lab	P	-	-	3	1
B 58	Environmental Engineering Laboratory	P	-	-	3	1
Total			**22**	**-**	**6**	**24**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
DC : Department Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture/Tutorial is equivalent to 1 credit
2/3 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2008-2009 onwards)

FIFTH SEMESTER

S.No.	Sub. code	Name of the subject	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	B 51	Numerical Methods	3	50	50	100	25	50
2	B 52	Wastewater Engineering	3	50	50	100	25	50
3	B 53	Structural Analysis II	3	50	50	100	25	50
4	B 54	Design of Steel Structures	3	50	50	100	25	50
5	B 55	Irrigation and Water Resources Engineering	3	50	50	100	25	50
6	B 56	Geotechnical Engineering - I	3	50	50	100	25	50
PRACTICAL								
7	B 57	Geotechnical Engineering Lab	3	50	50	100	25	50
8	B 58	Environmental Engineering Laboratory	3	50	50	100	25	50

* CA evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

Code	Lectures	Tutorial	Practical	Credit
B 51	4	0	-	4

B51 Numerical Methods **4:0**

(Common to D51, B51, G51)

Preamble: An engineering student needs to know some basic mathematical tools and techniques. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraises him the complete procedure for solving different kinds of problems that occur in engineering. Based on this, the course aims at giving adequate exposure in the numerical solutions in the field of polynomial and transcendental equations, simultaneous equations, interpolation, differentiation and integration, ordinary and partial differential equations.

Program Outcomes addressed

a. Graduate will demonstrate an ability to apply knowledge of Engineering and Information Technology in mathematics and Science.
b. Graduate will demonstrate an ability to identify, formulate and solve engineering problems.
c. Graduate will develop confidence for self education and ability to engage in life-long learning.

Competencies

At the end of the course the student should be able to

1. Differentiate between the analytical and numerical / approximate solutions for the problems in engineering and technology.
2. Apply the concept of solutions of algebraic and transcendental equations in engineering problems by formulating such equations.
3. Apply the different techniques for getting the solution of a system of simultaneous equations using direct and iterative methods.
4. Identify the importance of Eigen values for a matrix and calculate those using different techniques.
5. Interpolate and extrapolate the given data using different methods of interpolation with the help of various operators.
6. Apply the process of Numerical Integration to related problems of engineering and technology for getting approximate values of the given integral .
7. Formulate and Give Numerical solutions using various techniques for ODEs modeled in engineering and technology.
8. Formulate and Give Numerical solutions using various techniques for PDEs modeled in engineering and technology.

Assessment Pattern

	Bloom's category	Test 1	Test 2	Test 3 / End Semester Examination
1	Remember	10	10	0
2	Understand	30	30	30
3	Apply	60	60	70
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course level learning objectives

Understand

1. Compare the exact solution and approximate solution of equations
2. Discuss the various techniques for the approximate solution of Algebraic and transcendental equations.
3. List the various methods for obtaining the approximate solution of system of simultaneous equations stating the basic principles used.
4. Discuss the various methods to interpolate and extrapolate the given data using various methods of interpolation.
5. Interpret the importance and significance of the process of numerical integration.

Apply

1. Solve the following system of equations by Gauss Jacobi method

   $8x + y + z = 8$; $2x + 4y + z = 4$; $x + 3y + 3z = 5$.

2. Using Newton's method find the root of $x^3 - 4x^2 + x + 6 = 0$; $x_0 = 5$ correct to 4 decimal places

3. Using Lagrange's formula for interpolation find $y(9.5)$ given:

x	:	7	8	9	10
y	:	3	1	1	9

4. The following data gives the velocity of the particle for 2 seconds at an interval of 5 seconds. Find the acceleration at 5 seconds

Time	:	0	5	10	15	20
Velocity	:	0	3	14	69	228

5. Compute $\int_0^6 \frac{dx}{1+x}$, using Simpson's $\frac{1}{3}rd$ and $\frac{3}{8}th$ rule.

6. Find the value of $y(0.2)$ *and* $y(0.4)$ using Runge-Kutta method of fourth order with h=0.2 given that $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$; $y(0) = 1.$

7. Solve : $u_t = u_{xx}$ given $u(0,t) = 0$; $u(x,0) = x(1-x)$; $u(1,t) = 0$; assume h=0.1 and choose suitable k so that u(i,j) is found out for i=0,0.1…1 and j=k,2k,3k.

Course contents and lecture schedule

No	Topic	No. of Lectures
1	**Solution of transcendental and polynomial equations**	
1.1	Bisection , Regulafalsi , Newton- Raphson method	3
1.2	Iterative method	2
1.3	Horner's method	3
1.4	Graffe's root squaring method	2
2	**Solution to system of equations**	
2.1	Gauss elimination and Gauss Jordan methods	2
2.2	Crout's method	2
2.3	Gauss Jacobi and Gauss siedal methods.	2
2.4	Inversion by Gauss Jordan and Crout's methods.	2
2.5	Power method and Jacobi method for finding eigen values	2
3	**Interpolation, Differentiation and integration**	
3.1	Newton Gregory's forward and backward difference interpolation formulae	2
3.2	Gauss's and Lagrange's interpolation formulae	2
3.3	Newton's forward formulae for derivatives	2
3.4	Trapezoidal, Simpson's 1/3rd & 3/8th Rules	2
3.5	Gauss quadrature ,1 point , 2 point and 3 point formulae	2
4	**Ordinary Differential equations**	
4.1	Introduction – Initial value problems	2
4.2	Runge- Kutta Methods-second and fourth order	2
4.3	Predictor corrector methods-Milne and Adams	2
4.4	Boundary value problems Finite difference method.	2
4.5	Numerov's method	2
5	**Partial Differential equations**	

5.1	Introduction, Classification of PDEs.	2
5.2	Solution of parabolic equations-Implicit and explicitmethods, Bender Schmidt method, Crank Nicholson Method	3
5.3	Solution of hyperbolic equations by explicit scheme.	3
5.4	Solution of elliptic equations - Leibmann's process	2
	Total	**50**

Note: Students are required to submit one assignment in application oriented problems using MATLAB

Syllabus

Solution of Transcendental and Polynomial Equations: Bisection, Regula falsi, Newton-Raphson, Iterative Methods, Horner's Method, Giraeffes Root Squaring Method.

Solution to System of Equations: Gauss Elimination, Gauss Jordan, Crouts, Gauss Seidel, Gauss Jacobi, Inversion by Gauss Jordan and Crout's Method.

Eigen Values: Power method, Jacobi Method.

Interpolation and Differentiation: Newton's forward difference interpolation and differentiation formula and backward difference interpolation and differentiation formula, Gauss's Forward difference interpolation and differentiation formula and backward difference interpolation formula, Lagrange's Interpolation formula. Newton's formulae for derivatives.

Integration:
Trapezoidal, Simpson's $1/3$rd , $3/8$th rules, Gauss quadrature 1point, 2point, 3point formula

Ordinary Differential Equations:
Initial value Problem - Runge-Kutta Method, Predictor-Corrector Methods -Milne's, Adams - Boundary Value Problem - Finite difference Method- Numerov's method

Partial Differential Equations:
Classification: Parabolic (Schmidt)-Hyperbolic- Elliptic- Implicit and Explicit methods, Crank Nicholson method.

Text Book: Jain.M.K.,Iyengar.S.R.K.,JainR.K., "Numerical Methods for Scientific and Engineering Computation"-Fifth edition, New Age International Publishers, New Delhi-2009.

Reference Books:

1. Robert.J Schilling, Sandra L.Harris "Applied Numerical Methods for Engineers using Matlab and C" Thomson Books/cole,1999

2. Sastry S.S "Introductory Methods of Numerical Analysis" Prentice Hall of India -2006

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 52	3	0	0	3

B52-Wastewater Engineering **3:0**

Preamble

This course offers the basic principles of operation of the processes that are normally used for wastewater treatment. It provides information on methods of collection of sewage, design of sewers, possible methods of treatment and its safe disposal without endangering the environment.

Program outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will identify, formulate, research literature and solve complex engineering problems, reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the end of the course, the student should be able to

1. Understand the characteristics of sewage.
2. Understand the different methods of safe disposal of sewage
3. Understand the design criteria for various treatment units.
4. Estimate the quantity of sewage generated from a community.
5. Estimate the storm runoff from a specified area.
6. Design the sewers for transportation of sewage and storm water.
7. Select an appropriate sewage treatment system for given situations
8. Design a sewage treatment system as per requirements.
9. Plan the drainage system and sanitary fittings used for a building.

Assessment Pattern

S.No	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	0
2	Understand	50	20	30
3	Apply	30	30	30
4	Analyze	0	10	10
5	Evaluate	0	0	10
6	Create	0	20	20

Course Level Learning Objectives

Remember

1. Define Dry weather flow
2. Define self cleaning velocity
3. What is Co-efficient of runoff?
4. Define BOD and COD
5. What is Population equivalent?
6. What are the objectives of sewage treatment?
7. What is an “Activated sludge”?
8. Define (F/M) ratio.
9. Define organic loading rate on a trickling filter.
10. Define Bacteria – Algae symbiosis.
11. What is self purification of streams?
12. Define sewage sickness.

Understand

1. What are the demerits of combined sewerage?
2. Why sewers are designed for partially flowing full conditions?
3. How could a newly laid sewer line be tested?
4. Why and when do sewage need pumping?
5. Why anaerobic decomposition of sewage is to be discouraged?
6. What are the uses of oxygen sag curve?
7. Explain, how eutrophication of lakes are caused?
8. What are the precautions to be taken while practicing sewage farming?
9. What is the need for recirculation of sludge in activated sludge process?
10. Explain the working principle of a high rate trickling filter with a help of a neat sketch.
11. Explain the process of self purification of streams indicating the different stages in it.
12. How do anti-siphonage pipes usage in plumbing system become so important?

Apply

1. A district consists of 20% of area with runoff coefficient 0.9,20% of area with runoff coefficient 0.85,5% of area with 0.80,15% of area with 0.40 runoff coefficient, 35% of area with runoff coefficient 0.10 and remaining area with runoff efficient 0.05; determine the co-efficient of runoff for the area. If the total area of the district is 36 hectares and the maximum rain intensity is taken as 5cm/hr; what is the total runoff for the district? If the density of population is 250 per hectare and the rate of water supply is 200lit/day/capita. Calculate the quantity of sewage for which the sewer of a separate system is to be designed.
2. A 30cm dia sewer having an invert slope of 1 in 150 was flowing full. What would be the velocity of flow and discharge. N=0.013. Is the velocity self cleansing? What would be the velocity and discharge when the same is flowing at 0.20 and 0.80 of the full depth.
3. The 7 days 20°C BOD of a sample of sewage is 300mg/L and its 3days 20°C BOD is 210mg/L. find out the value of de-oxygenation constant k and then estimate its 5 days 30°C BOD.
4. The sewage discharge of a city is 85m3/s in the river having a minimum discharge of 930 l/s with a velocity of 0.12m/s. the BOD at 20°C of the sewage is 325mg/L. the BOD of the river is zero. Determine the quantity and point of critical DO deficit.
5. Design a standard rate trickling filter for the following:
   Average incoming flow=350m3/hr
   BOD of primary effluent=210mg/L
   No of units=4
   Make suitable assumptions for any missing data.
6. Design a septic tank for the following data:
   No of people=100
   Sewage/capita/day=120L
   Desludging period=1yr
   L:B=4:1
7. A sedimentation tank treating 4.5 million liters of sewage per day containing 275mg/L of suspended solids. The tank removes 50% suspended solids. Calculate the quantity of sludge produced per day in volume basis & weight basis, if (i) moisture content is 98% (ii) moisture content is 96%

Analyze:

1. Why do sewers are designed for partially flowing conditions even at peak rate of flow?
2. How do “population equivalent” become an important tool in expressing the strength of the sewage?
3. Why do usage of septic tanks to be discouraged to the possible extend? When do its usage becomes mandatory?
4. Why do we go for anaerobic treatment of sewage? Analyze the performance of different anaerobic treatment system?
5. How do velocity of flow of sewage controls the hydraulic design of sewers?
6. How do various sewer appurtenances bring up efficient performances of sewer system?

Evaluate:

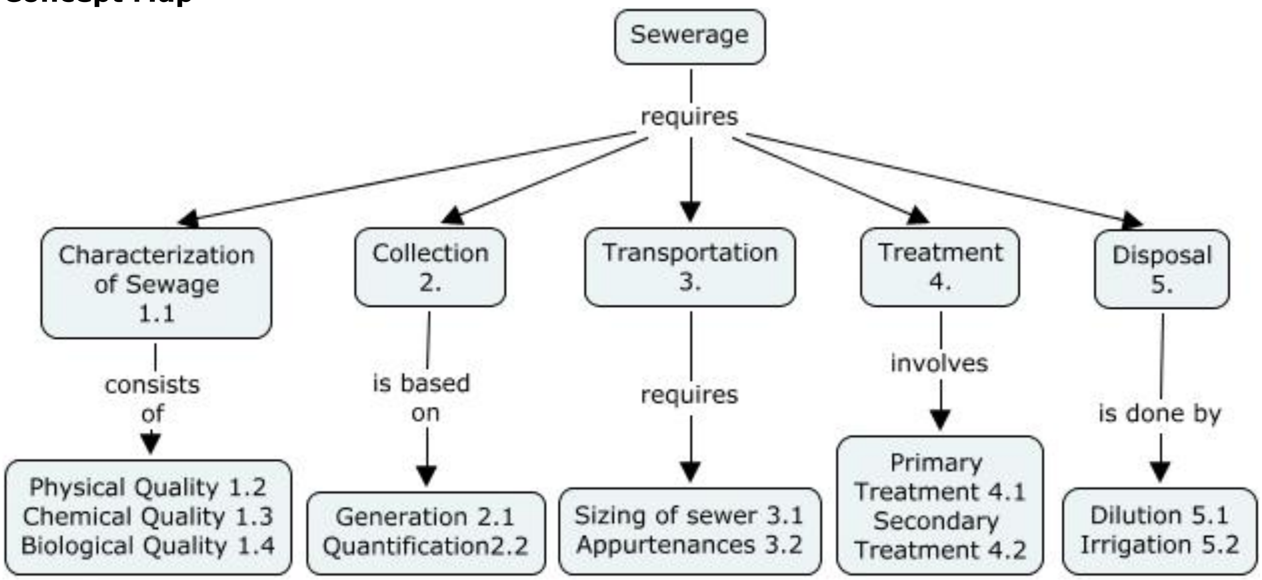
1. Compare separate system with combined system, bring out the merits and demerits of each system. How would you choose the system for a city?
2. What are the advantages of Trickling filter over activated sludge process?
3. Under What circumstances land treatment of sewage disposal is preferred over dilution method.
4. Compare the three types of plumbing system are in use in the field and come out with a logical conclusion.
5. Conservancy system of sanitation is to be eradicated – Justify the statement with your own evaluation.
6. Why do circular shaped sewers are used most commonly then other sections?

Create:

1. Design a grit chamber system for a town with a population of 1.0 Lakh. Assume necessary design parameters appropriately.
2. Design a septic tank unit for a housing colony with 100 persons. Also design the suitable effluent percolation unit.
3. A city with a population of 2.0 Lakhs is to be provided with a secondary treatment facility. Suggest a treatment system and make a complete design.
4. Suggest a suitable sewage collection system for a town with a population of 5.0 Lakhs. This town is very old with narrow lay- out of roads and streets.
5. Suggest a disposal system for a town where the water scarcity is very high.

6. With a help of a neat sketch, propose a wastewater collection system for a house with 2 bed rooms, 1 Hall, 1 sit-out, 1 kitchen etc.

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Characterization of sewage	
1.1	Characteristics and aerobic & Anaerobic decomposition of sewage	1
1.2	Physical quality of sewage & chemical quality of sewage	1
1.3	BOD and their testing & BOD equation	1
1.4	Problems in BOD and Population equivalent	2
	Sewage Collection	
2.1	Generation of sewage	1
2.1.1	Systems of sanitation	1
2.2	Quantification of sewage	1

2.2.1	Systems of sewerage	1
Transportation of sewage		
3.0	Sizing of sewer	1
3.1	Hydraulic design of sewers	1
3.1.1	Use of Nomo grams and Charts & Uses of soft wares	2
3.2	Sewer materials & Sewer appurtenances	1
3.2.1	Laying and testing of sewers	1
3.2.2	Maintenance of sewer	1
3.2.3	Pumping of sewage	1
Treatment of sewage		
4.1	Primary treatment- Screening & Grit chamber, Design of grit chamber	2
4.1.1	Skimming tanks & Primary sedimentation tanks	1
4.2	Secondary treatment of sewage - Introduction	1
4.2.1	Activated sludge process – Mechanism & Methods of aeration	1
4.2.1.1	Design considerations in ASP & Design	2
4.2.1.2	Modifications in ASP	1
4.2.2	Trickling filters- process Mechanism & types - Design considerations in trickling filter & Design	2
4.2.3	Oxidation Ponds and lagoons	1
4.2.4	Sludge digestion	1
4.2.4.1	Design of Digestion tanks	1
Disposal of Sewage		
5.1	Disposal by dilution – introduction	1
5.1.1	Self purification & oxygen sag curve	1
5.1.2	Streeter phelps equation – Problems	2
5.1.3	Disposal on lakes – eutrophication & sea disposal	1
5.2	Land Irrigation – sewage farming and sickness	1
5.3	Disposal of sewage in isolated buildings- Septic tanks	2

5.4	Plumbing systems	1
5.5	Sanitary practices in rural areas	1
		40

Syllabus

Characteristics of sewage, decomposition – aerobic and anaerobic decomposition- physical and chemical quality of sewage – BOD and their testing– BOD equation – problems – population equivalent.Systems of sanitation– Estimating quantity of sewage – dry weather flow – estimating storm run off by rational formula – Sewerage – separate, combined and partially separate system – hydraulic design of sewer, use of nomograms, charts and softwares.

Sewer materials - laying and testing of sewer sewer appurtenances, cleaning and ventilation of sewers- pumping of sewage. Primary & secondary treatment of sewage – activated sludge process – process mechanism, design parameters, design – modifications in ASP.

Trickling filters – process mechanism, types, design parameters and design.

Anaerobic systems – UASB and anaerobic filters. Other treatment systems – Ponds and Lagoons. Sludge digestion – characteristics- digestion tanks, design - disposal of digested sludge.

Disposal – disposal of treated sewage – disposal by dilution – disposal on river – self purification – oxygen sag curve – streeter phelps equation – disposal on lakes – Eutrophication – sea disposal, land irrigation – sewage farming, sewage sickness.

Disposal of sewage in isolated buildings, plumbing system – types; Sanitary practices in rural areas.

Text Book

1. Garg S.K.: "Sewage Disposal and Air Pollution Engineering", Khanna Publishers New Delhi 2001.

Reference Books

1. Bridie G.S Birdie J.S, "Water Supply and Sanitary Engineering", Dhanpatrai Publications, New Delhi, 1998.
2. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", McGraw Hill Publishers, New Delhi, 1998.
3. Hussian S.K Water Supply and sanitary Engineering", oxford and IBH publishers publishing co. Pvt Ltd.,New Delhi, 1985.

4. Punmia B.C, Ashok Jain, "Wastewater Engineering", Laxmi publications, New Delhi, 1998.
5. Mark J.Hammer, Mark J.Hammer,Jr, "Water and Wastewater Technology",Prentice Hall of India Pvt.Ltd.,New Delhi,2002.
6. Duggal K.N, "Elements of environmental Engineering", S.Chand & Company Ltd, New Delhi, 2000.
7. Manual on sewerage and sewage treatment, CPHEEO, ministry of urban affairs & employment, Govt.of India, New Delhi,2001

Course designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 53	4	0	0	4

B53 Structural Analysis - II 4:0

Preamble

This course offers the analysis for indeterminate beams and portal frames upto three degrees of freedom. it aims at determination of end moment and Bending moment diagrams for the beam and frames.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Determine the moment in indeterminate beams and frames having EI variations and initial yield using slope deflection method
2. Determine the induced forces in indeterminate beams and frames having EI variations and sway using moment distribution method
3. Construct bending moment diagram for continuous beams using Clapeyron's theorem
4. Draw Influence Line Diagram (ILD) for indeterminate beams by Muller breslau's principle
5. Calculate internal forces in indeterminate beams, frames and trusses by energy approach.
6. Verify the adequacy of given designs of indeterminate beams

Assessment Pattern

Bloom's Category	**Test 1**	**Test 2**	**Test 3 / End Semester Examination**
Remember	10	10	10
Understand	10	10	10
Apply	80	80	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course level learning objectives

Remember

1. State Muller Breslau's principle
2. When a structure is considered internally indeterminate?
3. State Castigliano's II theorem
4. Define degree of redundancy
5. What is meant by distribution factor?
6. Define Stiffness

Understand

1. Draw a ILD for a reaction of a propped cantilever
2. Compare Castigliano's I and II theorem
3. Explain internally and externally indeterminate structures
4. How the concept of strain energy is used to analyze a frame?
5. Compare the behavior of rigid and yielding support with example for each
6. Draw the elastic curve for a two span continuous beam of equal length subjected to UDL throughout
7. Draw the elastic curve for a portal frame when subjected to horizontal point load at the beam level.

Apply

1. Determine the influence line for the bending moment at D, the midpoint of span AB of a continuous beam shown in Fig-1. Compute the ordinates at 1m intervals.

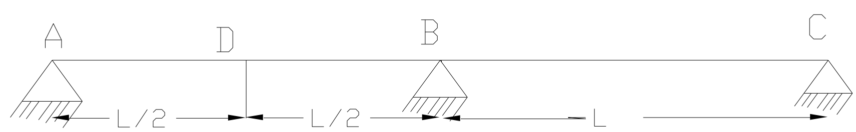


Figure-1

2. For a continuous beam shown in Fig-2., draw the influence lines for the reaction at A, B and C. Indicate the values at every quarter of each span.

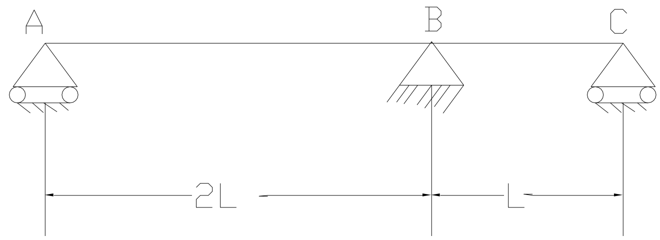


Figure-2

3. Using Castigliano's Theorem of minimum energy, analyze the frame shown in Fig-3. EI is constant for the whole frame.

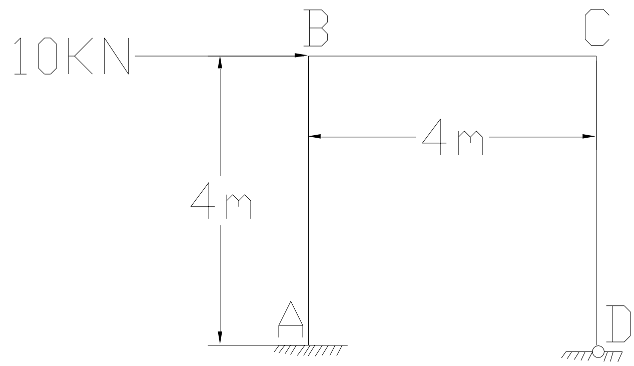


Figure-3

4. Fig-4. shows a two span portal frame with the columns fixed at the ends A, E & F and carries UDL of w kN/m along BD. The stiffness ratios of the members are shown in the diagram and all the members are of equal length. Determine the bending moment throughout the frame and sketch the bending moment diagram using Moment Distribution Method.

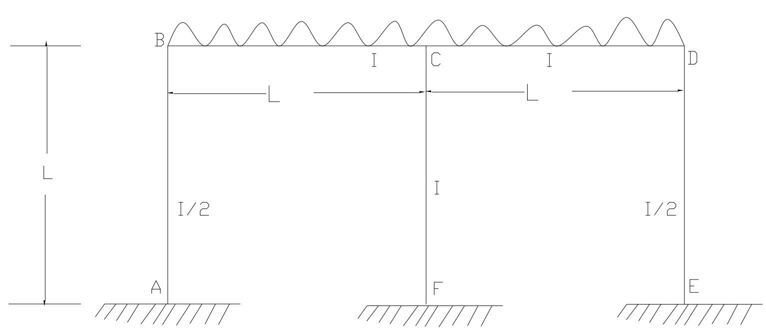


Figure-4

5. A continuous beam ABCD is fixed at ends A and D, and is loaded as shown in Fig-5. Span AB, BC and CD is having moment of inertia of I, 1.5I and I respectively and are of the same material. Determine the moments at the supports and plot the bending moment diagram using Moment Distribution Method.

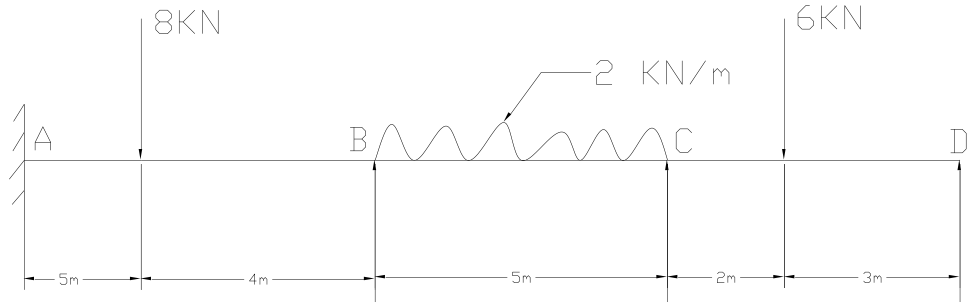


Figure-5

6. Draw the bending moment diagram and sketch the deflected shape of the frame shown in Fig-6. All the members are of the same material.

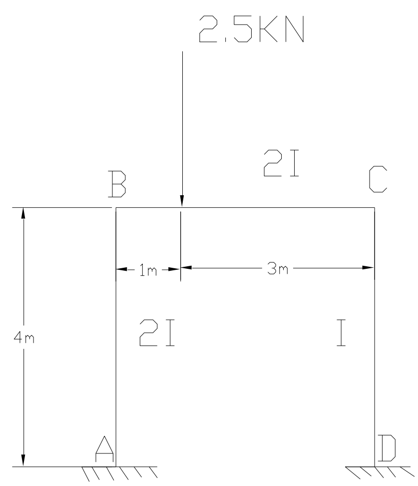


Figure-6

7. A fixed beam AB of span L carries a UDL of w / unit length and is propped at a distance L/3 from A. If the deflection of the beam at this point is kR where R is the load on the prop, determine the magnitude of R.
8. A beam ABCD, 16 m long is continuous over three spans; AB = 6m, BC = 5m & CD= 5m. The support B sinks by 0.5 cm. There is a UDL of 20kN/m over BC. On AB there is a point load of 80 kN at 2m from A and CD there is a point load of 60kN at 3m from D. Take I = 9300 cm^4 and E = 2.1 x 10^5 N/mm^2. Calculate the moments and reactions at the support.

9. Fig-7. shows a two span portal frame with the columns fixed at the ends A, E & F and carries UDL of 5kN/m along BD. The stiffness ratios of the members are shown in the diagram and all the members are of equal length of 6m. Determine the bending moment throughout the frame and sketch the bending moment diagram using Kani's Method

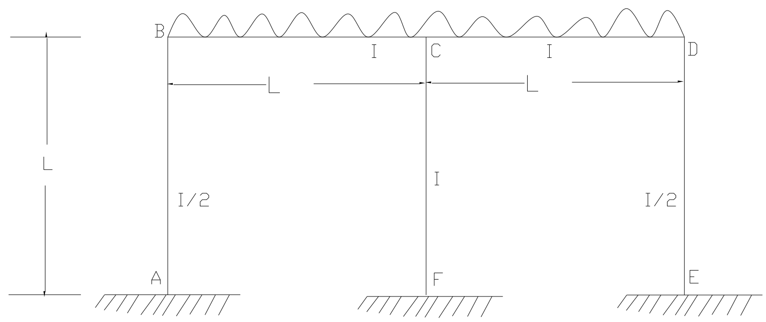
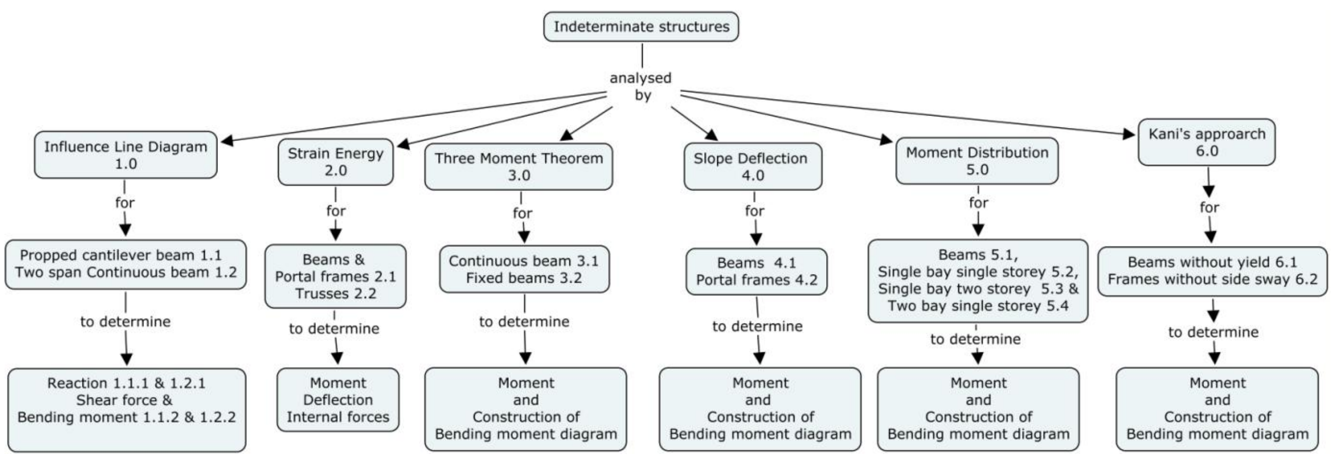


Figure-7

Concept Map



Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	ILD for forces in indeterminate beams	
1.0	Introduction to ILD for forces in indeterminate beams	1
1.1	Muller Breslau's principle - Types of indeterminate beams – propped cantilever,	1

1.2	Muller Breslau's principle - Types of indeterminate beams – Two span continuous beams	1
1.1.1	ILD for reaction for propped cantilever beams	1
1.1.2	ILD for shear force& bending moment for propped cantilever beams	1
1.2.1	ILD for reactions of two span continuous beams	1
1.2.2	ILD for shear force& bending moment for two span continuous beams	2
	Energy methods for beams and trusses	
2.0	Introduction to strain energy methods	1
2.1	Analysis of indeterminate beams and frames by Strain Energy methods	3
2.2	Analysis of indeterminate trusses by Strain Energy methods	3
2.2.1	Degree of redundancy(internal &external redundancy)	1
2.2.2	Analysis of externally indeterminate trusses by Strain Energy methods	2
2.2.3	Analysis of trusses due to Lack of fit	1
2.2.4	Analysis of trusses due to change in temperature	1
	Three Moment Equation Method	
3.0	Introduction to Clapeyron's theorem of three moment	1
3.1	analysis of continuous beam with or without support yield	3
3.1.1	analysis of continuous beam with or without EI variation	2
3.2	analysis of fixed beams	2
	Slope Deflection Method	
4.0	Derivation of slope deflection method	1
4.1	Analysis of continuous beams without support yielding	2

4.1.1	Analysis of continuous beams with support yielding	2
4.2	Analysis of portal frames(single storey and single bay only)	2
	Moment Distribution Method	
5.0	Definition of stiffness, carryover factor, distribution factor	1
5.1	Analysis of continuos beams without support yielding	2
5.1.1	Analysis of continuos beams with support yielding	1
5.2	Analysis of portal frames(single storey and single bay only)	2
5.3	Analysis of portal frames(single storey and two bay only)	3
5.4	Analysis of portal frames(two storey and single bay only)	3
	Kani' s Method	
6.0	Concept of Kani's method, Stiffness, and distribution factor	1
6.1	Relationship between bending moment, deformation and displacement	1
6.2	Analysis of continuous beams without support yield	1
6.3	Analysis of portal frames without side sway	1
	Total	50

Syllabus

ILD for forces in indeterminate beams - Muller Breslau's principle - ILD for reaction - ILD for shear force& bending moment for propped cantilever beams - ILD for reactions of two span continuous beams - ILD for shear force& bending moment for two span continuous beams

Energy methods for beams and trusses - Introduction to strain energy methods - Analysis of indeterminate beams by Strain Energy methods - Degree of redundancy(internal &external redundancy) - Analysis of externally indeterminate trusses by Strain Energy methods - Analysis of trusses due to change in temperature - Analysis of trusses due to Lack of fit - Analysis of indeterminate trusses by Strain Energy methods

Three Moment Equation Method - analysis of continuous beam with or without support yield - analysis of continuous beam with or without EI variation - analysis of fixed beams - Introduction to Clapeyron's theorem of three moment

Slope Deflection Method - Derivation of slope deflection method - Analysis of continuous beams with or without support yielding - Analysis of portal frames(single storey and single bay only)

Moment Distribution Method - Definition of stiffness, carryover factor, distribution factor - Analysis of continuos beams without support yielding - Analysis of continuos beams with support yielding - Analysis of portal frames(single storey and single bay only) - Analysis of portal frames(two storey and single bay only) - Analysis of portal frames(single storey and two bay only)

Kani's Method – Concept – Relationship between bending moment, deformation and displacement – analysis of beams without yield and frames without side sway.

Text Books:

1. Punmia B.C.,Ashok Kumar Jain Arun Kumar Jain,"Strength of materials and theory of structures, vol I &II",Laxmi Publications, New Delhi, 2005
2. Junarkar.S.B. Shah.H.J. " Mechanics of structures" ,vol II, Charotar publishing house,Anand, 2000

Reference Books:

1. Wang., C.K.,"Indeterminate Structures" McGraw Hill Book Co., Newyork,1994
2. Reddy,C.S.,"Basic Structural Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi.2001
3. Sterling Kinney.J., "Indeterminate Structural Analysis", Addition-Wesley Publishing Company, Sydney. 1992
4. Thandavamoorthy, "Analysis of Structures", Oxford &IBH Publishers, New Delhi.2008
5. Jindal, R.L, 'Indeterminate Structures, S.Chand and Company Ltd., New Delhi - 2000

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Sub Code	Lectures	Tutorial	Practical	Credit
B 54	4	0	0	4

B54 Design of Steel Structures **4:0**

Preamble

This course offers the design of steel structures as per limit state method. This course follows the recommendation of IS: 800 – 2007. It aims at determination of safe as well as economical steel section for various industrial and framed structures

Program outcomes addressed

- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Determine the maximum load effects and fatigue effects on a gantry girder and also section properties
2. Design a Plate girder using the IS800-2007 Provisions
3. Determine the nominal strength of the beam column
4. Design a roof truss using rolled steel sections
5. Design a light loaded roof truss using tubular sections.
6. Design simple beam-to-column, and beam-to-beam connections
7. Design column splices

Assessment Pattern

	Bloom's Category	**Test 1**	**Test 2**	**Test 3 / End Semester Examination**
1	Remember	10	10	10
2	Understand	20	10	10
3	Apply	50	40	30
4	Analyse	-	-	-
5	Evaluate	-	-	-
6	Create	20	40	50

Course level learning objectives

Remember

1. What is the difference between plate girder and beam?
2. Where are plate girders used?
3. State the minimum web thickness provisions of a IS 800-2007.
4. State some advantages and disadvantages of plate girders over trusses.
5. What are the main functions of a longitudinal stiffener?
6. What is the range of the minimum thickness of the web that is usually adopted in practice?
7. List few types of cranes.
8. List the loads that should be consider while designing a gantry girder.
9. List the various steps involved in the design of gantry girder.
10. What is the advantage of using a second order analysis method over first order elastic method in the interaction equations?
11. Define efficiency of joint?

Understand

1. How are bending moments introduced in columns?
2. How can load deflection effects be considered in the design of beam columns?
3. write short notes on
    a. Bolted moment end plate connection
    b. Flange angle connection
    c. Split beam T connection
    d. Beam to beam connection
    e. Beam splices
    f. Column splices.
4. Why are simply supported girders preferred to two span gantry girders?
5. Write short notes on rigid, simple and semi-rigid joints.
6. What are the advantages of butt joints over lap joints?

Apply

1. Determine the buckling resistance moment for a welded plate girder consisting of 500 x 25 mm flange plates and a 1250 x 12 mm web plate in grade 410 steel. Assume a laterally unbraced span of 5.5 m.
2. Determine the moments and forces due to the vertical and horizontal loads acting on a simply supported gantry girder given the following data:

i. Simply supported span = 6 m
ii. Crane's wheel centres = 3.6 m
iii. Self weight of the girder (say) = 1.5 KN/m
iv. Maximum crane wheel load (static) = 220 KN
v. Weight of crab/ trolley = 60 KN
vi. Maximum hook load = 200 KN
vii. Calculate also the serviceability deflection (working load)

3. A 20 m long plate girder has to support a u.d.l and concentrated loads at one third points. The uniform load consists of 18KN/m dead load and 30KN/m live load. Each concentrated load consists of a 125 KN dead load and 225KN live load. There is lateral support at the ends and at the points of concentrated load. Using grade 410 steel determine the following:

i. mid section.
ii. the location and size of intermediate stiffeners.
iii. suitable bearing stiffeners at the supports and beneath loading points.
iv. welds for all the elements.

Create

1. Design a welded plate girder for a simply supported bridge deck beam with clear span of 20 m subjected to the following:

i. Dead load including self weight = 20 KN/m
ii. Imposed load = 10 KN/m
iii. Two moving loads = 150 KN each spaced 2 m apart

Assume that the top compression flange of the plate girder is restrained laterally and prevented from rotating. Use mild steel with fy=250 MPa. Design as an unstiffened plate girder with thick webs and also redesign same with intermediate stiffeners
utilizing tension field action.

2. Design a gantry girder without lateral restraint along its span, to be used in an Industrial building carrying over head traveling crane for the following data:

i. Centre to centre distance between columns = 6 m (span of the gantry girder)
ii. Crane capacity = 50 KN
iii. Self weight of the crane girder excluding trolley = 40 KN

iv. Self weight of the trolley, electric motor, hook etc., = 10 KN
v. Minimum hook approach = 1 m
vi. Wheel centres = 3 m
vii. Centre to centre distance between gantry rails = 12 m (span of crane)
viii. Self weight of rail section = 100N/m
ix. Yield stress of steel = 250 MPa.

3. Design a roof truss, rafter bracing, purlin, tie runner, side-runner and eave girder for an industrial building located at Guwahati with a span of 20m and a length of 50m. The roofing is galvanized iron sheeting. Basic wind speed is 50m/s and the terrain is an open industrial area. Building is class B building with a clear height of 8m at the eaves.
4. A beam column of length 5 m is subjected to a compression of 800 KN and a major axis moment of 4.5 KNM. The weaker plane of the column is strengthened by bracing. If the effective length factor is 0.8, design the beam column, assuming Fe 410 grade steel.
5. An industrial building is shown in fig. the frames are at 5m centres and the length of the building is 40m. The purlin spacing of the roof is as shown in figure-1. The Building is situated in Delhi. Assume live and wind loads as per IS875 (part 2 and Part 3) and the roof is covered with GI sheeting. Design the roof truss using angle members and gusseted joints. The truss is to be fabricated using welded joints in two parts for transport and assembled at site using bolted joints at A,B and C as shown in figure-1(b).

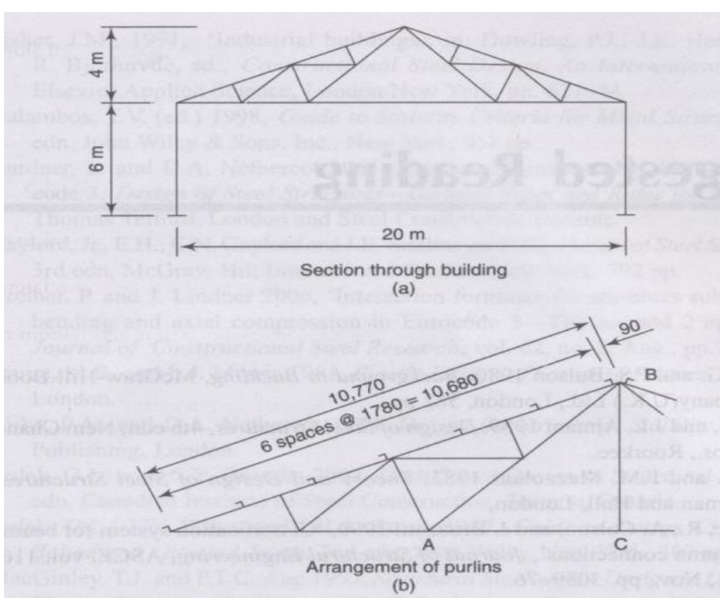


Figure-1

6. Design the members of the truss of the previous problem using tubular members.
7. Design a seat-angle connection between a beam MB300 and column SE200 for a reaction of beam 100kN using M20 bolts of property class 4.6. Take Fe410 grade steel (fy =250MPa). Refer fig.

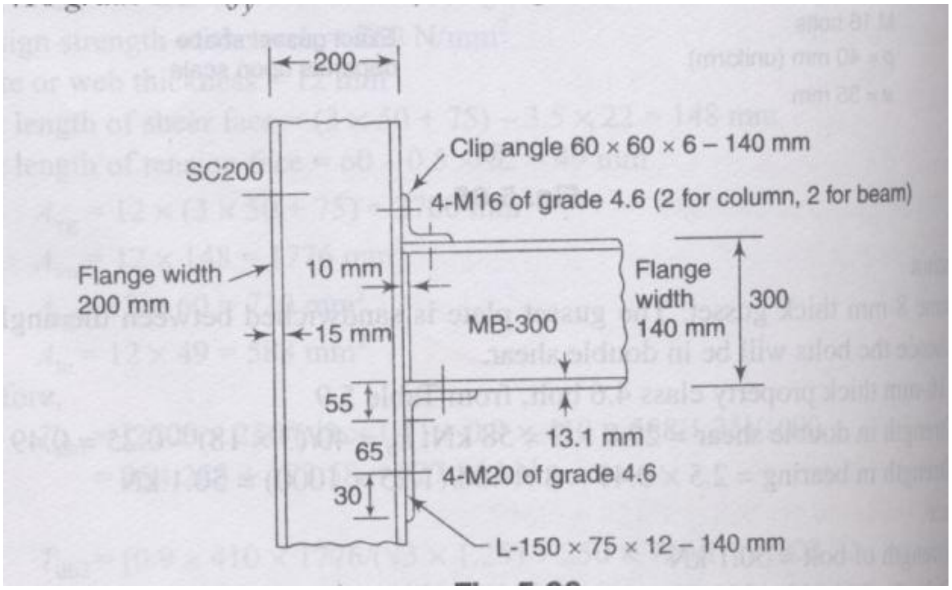
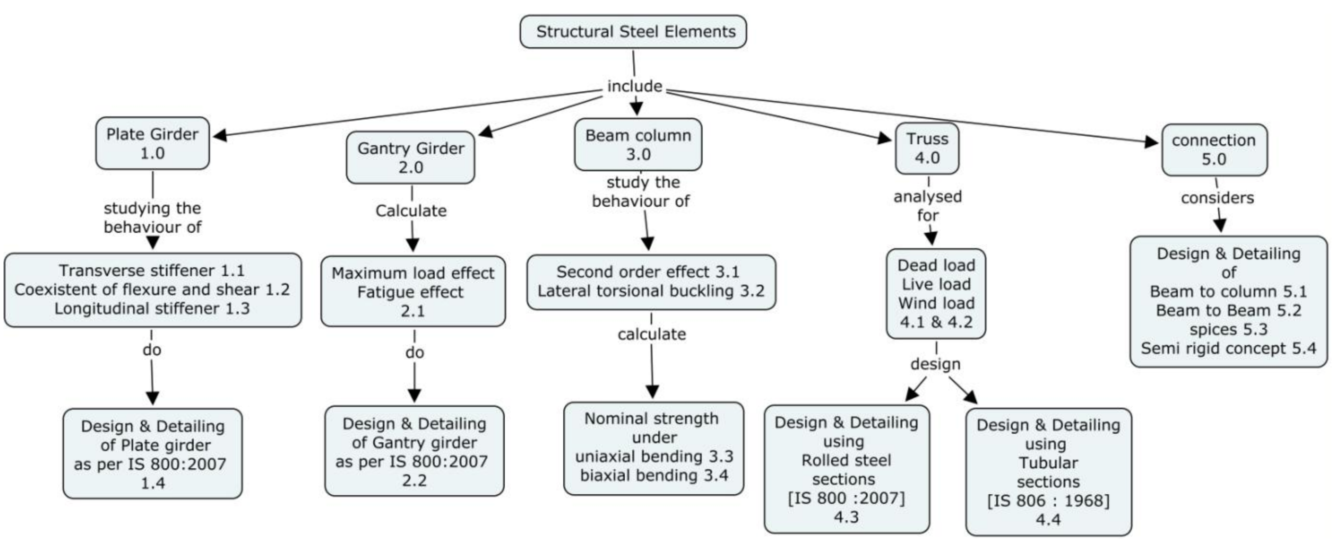


Figure-2

Concept Map



Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	Plate girder (according to IS 800 :2007 provision)	
1.0	Introduction and distribution of stress in plate girder	1
1.1	Shear resistance of transversely stiffened plate girder	1
1.2	Shear resistance of web, web subjected to co-existent bending and shear	1
1.2.1	Ultimate behavior of transverse web stiffener	2
1.3	Behavior of longitudinally stiffened girders	1
1.4	Design of mid section of plate girder	2
1.4.1	Design of transverse web stiffener of plate girder	2
1.4.2	Design of longitudinal web stiffener of plate girder	1
1.4.3	Connection of stiffeners to web of plate girder	1
	Gantry girder(according to IS 800 :2007 provision)	
2.0	Introduction and load considerations	1
2.1	Maximum load effects and Fatigue effects	1
2.1.1	Determination of maximum bending moment and shear force due vertical component of crane wheel load	2
2.1.2	Determination of maximum bending moment and shear force due horizontal component of crane wheel load and longitudinal effect of wheel load	1
2.2	Design of gantry girder	2
2.2.1	Connection in gantry girder	1
	Beam – Column(according to IS 800 :2007 provision)	
3.0	Introduction to the behaviour of Beam-column	1
3.1	second order moment in beam-column	1
3.2	Elastic torsional buckling of beam columns	2
3.3	Nominal strength in beam column in uniaxial bending	2
3.4	Nominal strength in beam column in biaxial bending	2
	Design of Truss	
4	Introduciton and evaluation of design dead load, live load	1

4.1	Evaluation of wind load	1
4.2	Analysis of trusses	2
	Design of Truss using Rolled steel sections	
4.3	Design of Truss using Rolled steel sections	2
4.3.1	Design of purlins and Design of members	2
4.3.2	Design of supports	1
	Design of Truss using tubular sections	
4.4	Design of Truss using tubular sections	2
4.4.1	Design of purlins and Design of members	2
4.4.2	Design of supports	1
	Design of Connection	
5.0	Introduction to connection behaviour	1
5.1	web angle connection	1
5.1.1	clip and seat Connection	1
5.1.2	End plate Connection	1
5.2	Beam to Beam Connection	1
5.3	Beam Splices	1
5.3.1	Column Splices	1
5.4	Concept of semi rigid Connection	1
	Total	50

Syllabus

Plate girder- Introduction - Distribution of stress in plate girder - Shear resistance of transversely stiffened plate girder; Shear resistance of web, web subjected to co-existant bending and shear - ultimate behavior of transverse web stiffener - behavior of longitudinally stiffened girders - Design of plate girder using IS800-2007 provisions – problems.

Gantry girder - Introduction - load considerations - max load effects - Fatigue effects - Design of gantry girder using IS800-2007 provision - problems.

Beam – Column - Introduction - behavior of beam-column - second order moment in beam-column – Elastic torsional buckling of beam columns - Nominal strength in beam column in uniaxial bending - Biaxial bending.

Design of Truss - Evaluation of design dead load, live load and wind load. Analysis of trusses. Design of Truss using Rolled steel sections – Purlins – truss members – Supports. Design of Truss using tubular sections – Purlins – truss members – supports.

Design of Connection - Introduction – web angle connection – clip and seat Connection – End plate Connection – Beam to Beam Connection – Beam Splices – Column Splices – Concept of semi rigid Connection.

Text Book:

1. Teaching Resource for Structural Steel Design Volume – I to III – INSDAG, Kolkata (2000)
2. Design of Steel Structures, N.Subramanian, Oxford University press,(2008)

Codes:

1. IS 800-2007 – Code of practice for general Construction in steel
2. SP6 (1) – Hand book for Structural Engineers – Part I :Structural Steel Sections, BIS
3. IS 875 (1-5) - 1987 Code of practice for Design Loads (Other than Earthquake) for Buildings and Structures, BIS
4. IS 816 :1969 - Code of practice for Metal Arc Welding for general Construction in Mild Steel, BIS
5. IS 1161 :1998 – Steel tubes for structural purposes – specifications, BIS.
6. IS 806 : 1968 – Code of practice for use of steel tubes in general building construction, BIS

Web site

www.steel-insdag.org

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 55	3	0	0	3

B55 Irrigation and Water Resources Engineering 3:0

Preamble

This subject helps in knowing about irrigation practices, and methods adopted in our country. Also to know the irrigation water requirements in order to design the structures like dams, weirs and canals. This subjects also deals with the study of planning of water resources projects.

Program outcomes addressed

- An ability to apply knowledge of engineering, information technology, mathematics and science.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
- Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
- Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
- Graduate who can participate and succeed in competitive examinations

Competencies

At the end of the course the student should be able to

1. Explain quantitatively the hydrological cycle
2. Explain how water resources are distributed in India and particularly in Tamilnadu
3. Explain how water resources can be managed.
4. Understand the irrigation practices and methods in India.
5. Explain the components of irrigation systems.
6. Determine the storage capacity of reservoirs
7. Determine the forces acting on dams
8. Explain the failures of dams and remedies
9. Determine the dimensions of the weirs based on Bligh's, Lanes and Khosla's theory
10. Estimate the dimensions of canals using Lacey's and Kennedy's theory

Assessment Pattern:

	Bloom's Category	Test 1	Test 2	Test 3/End-semester examination
1	Remember	30	30	10
2	Understand	50	50	50
3	Apply	20	20	40
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course level learning objectives:

Remember

1. Why irrigation is essential in our country?
2. Distinguish temporary and permanent wilting point.
3. List out the equipments used for lift irrigation.
4. What are the objectives of river training works?
5. What is meant by cross drainage works?
6. What is the objective of studying the irrigation efficiency?
7. What are the assumptions made in Bligh's theory?
8. Differentiate silt excluder and silt ejector.
9. What are the advantages of canal lining?

Understand

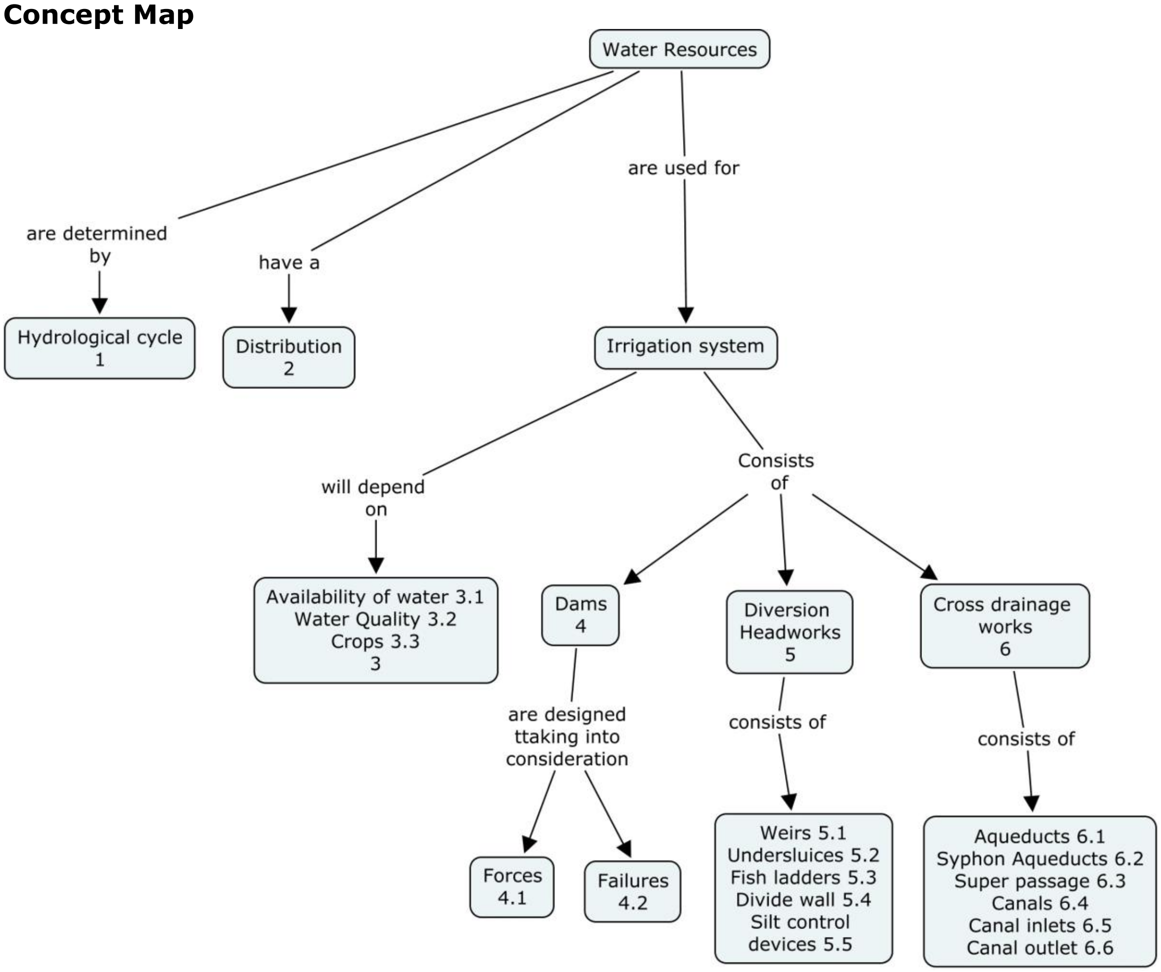
1. How the irrigation water is classified based on salt concentration?
2. What are the benefits and ill effects of irrigation?
3. How will you select a site for reservoirs?
4. Explain the storage zones of reservoir with neat sketch.
5. How will you control the sedimentation in reservoirs?
6. Compare Blligh's theory and Lanes weighted creep theory.
7. How the canals are classified?
8. Differentiate aqueduct and siphon aqueduct
9. Discuss briefly the causes of failures of weirs and their remedies

Application

1. Discuss the benefits of water resources developments projects in our country.
2. What are the objectives of irrigation water management? Discuss the components of water management in detail.

3. Interlinking of Indian rivers – Discuss critically the merits and demerits of such project.
4. How will you fix the storage capacity of a reservoir for fulfilling the given demand?
5. How a canal is designed based on Kennedy's theory?
6. What are the forces acting on gravity dam? Explain in detail how these forces are calculated in gravity dam.
7. Design an irrigation channel for a discharge of 40 cumecs, Lacey's silt factor = 1.0, side slope = ½:1. Determine also the bed slope.
8. What do you understand by elementary profile of a gravity dam? Derive safe base width for such dams.
9. What is the role of formers and government agencies in developing the water resources projects in our country?

Concept Map



Course contents and Lecture schedule:

S. No	Topics	No. of Periods
1. Importance of Water resources		
1.1	Hydrological cycle and its importance	1
1.2	Status of water resources in India and Tamilnadu	1
1.3	National water policy, Requirements of water for various use	2
1.4	Need for water conservation, water harvesting technique	2
1.5	Economy in water resources project – cost-benefit ratio	1
1.6	Planning of water resources projects	1
2. Water Resources Planning		
2.1	Surface and Groundwater Resources- Rivers, lakes and tanks- Estimation of Groundwater.	1
2.2	Site selection for reservoir, classification of reservoirs	1
2.3	Determination of Storage capacity	1
2.4	Reservoir sedimentation, methods of controlling the sedimentation	2
2.5	Reservoir losses	1
3. Irrigation		
3.1	Need for irrigation	1
3.2	Crop water Requirement	1
3.3	Types of irrigation and methods of irrigation	2
3.4	Irrigation efficiencies, Concept of Adequacy, Irrigation water quality	2
4. Dams		
4.1	Dam and their classifications	2
4.2	Forces acting – failures and remedies	2
4.3	Design of gravity dam	2
4.4	Elementary profile of gravity dam	2
4.5	Drainage galleries in dams	1
5. Diversion Head works		
5.1	Types of weirs, failures and Remedies	1
5.2	Bligh's theory, Lanes weighted creep theory, Khosla's theory	2
5.3	Divide wall, Fish ladder, Under sluices, Head regulator	2

5.4	Silt control at head works	2
5.5	Silt excluder and silt ejector	1
5.6	River training works - types of works	1
6. Cross drainage works		
6.1	Functions of Aqueduct, Syphon aqueduct, Level crossing, inlet and outlet, Canal outlets	2
6.2	Design of canal by Lacey's theory, Kennedy's theory	2
6.3	Canal regulators - Water logging,	2
6.4	Canal lining and Canal maintenance	1

Syllabus

Water resources: Importance and necessity of water resources – Status of water resources in India and Tamilnadu – National water policy – requirement of water for various use – need for water conservation – water harvesting technique – economy in water resources project – cost-benefit ratio – planning water resources projects.

Water Resources Planning: Surface and Groundwater Resources- Rivers, lakes and tanks- Estimation of Groundwater -Reservoir types – fixing storage capacity of reservoirs – reservoir sedimentation – reservoir losses.

Irrigation: Need for irrigation – Crop water Requirement - methods of irrigation – irrigation efficiencies – concept of Adequacy - irrigation water quality.

Dams: Types of dams – forces on gravity dam – modes of failure – elementary profile of gravity dam – design of gravity dam – galleries in dams.

Diversion headwork: Weirs – types – failures – design of weirs by creep theory and potential theory – undersluices – fish ladder – divide wall – silt control measures and devices at diversion headworks – river training works.

Cross drainage works: types and objectives – design of canals - Kennedy's theory – Lacey's theory – canal lining – water logging – causes and ill effects.

Text books:

1. Santhosh Kumar Garg, **"Irrigation Engineering and Hydraulic Structures",** Khanna Publishers – New Delhi. 2008.
2. Punmia, B.C and Pande B.B. Lal, **"Irrigation and Water Power Engineering",** Lakshmi Publications (P) Ltd, New Delhi. 2007

Reference Books:

1. Sharma, R.K and Sharma, T.K, **"Irrigation Engineering (Including Hydrology)",** S.Chand & Co Ltd, New Delhi. 2009
2. Dilip Kumar Mujumdar, **"Irrigation Water management – principles & practice"**, Prantice Hall of India (P) Ltd, New Delhi. 2005
3. Linsey R.K and Franzini J. B, **"Water Resources Engineering"**, McGraw Hill. 2000
4. Douglas J.L and Lee R.R, **"Economics of Water Resources Planning"**, Tata McGraw Hill. 2000.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 56	4	0	--	4

B56 Geotechnical Engineering - I **4:0**

Preamble

This course is a branch of Civil Engineering which deals with the application of laws of Mechanics and Hydraulics to Engineering problems related with soils like Permeability, stresses within soils, Shear strength and compressibility of soils and stability of sloping ground. These form the basis for the computation of discharge through earthen dams, shear strength parameters required for determining the bearing capacity of soils, settlement of buildings and slope stability analysis.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science, and engineering.
- Graduates will demonstrate an ability to identify, formulate and solve complicated Engineering problems.
- Graduates will demonstrate skills to use modern engineering tools, equipments to analyze engineering problems related to soil.

Competencies

At the end of the course the student will be able to

1. Understand the basic properties of soils and classify the Soil according to IS.
2. Determine the Permeability of Cohesive and Cohesionless soils.
3. Understand the concept of Effective stress and its significance.
4. Compute the Shear Strength of soils based on the parameters obtained from shear tests.
5. Compute the consolidation settlement of foundations.
6. Compute the stresses within soils due to applied loads.
7. Understand the concept and significance of compaction and slope stability analysis.

Assessment Pattern

S.No.	**Bloom's Category**	**Test 1**	**Test 2**	**Test 3/End semester Examination**
1	Remember	20	10	10
2	Understand	40	40	40
3	Apply	40	50	50
4	Analyse	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives:

Remember

1. What is a three phase diagram?
2. What are loess deposits?
3. Define Liquid Limit.
4. What is effective stress?
5. List out the factors affecting permeability of soil.
6. Write the Mohr's equation for shear strength of soils?
7. What are the draw backs of Direct Shear test?
8. Mention the assumptions in the Terzaghi's one dimensional Consolidation Theory.
9. Define theoretical maximum dry density.
10. What are the different types of slope failures?

Understand

1. Distinguish between Index and Engineering properties.
2. Obtain a relationship between Dry density, Void ratio and Specific gravity of soil solids using a three phase diagram.
3. Explain Quick sand condition in soil.
4. Describe the different stages of a shear test.
5. Explain Mohr-Coulomb failure criterion.
6. Explain the concept of consolidation with the help of a spring and dashpot system.
7. Explain the step by step procedure of constructing the Newmark's influence chart.
8. Explain the procedure of constructing an isobar of intensity 0.1Q. Where 'Q' is the intensity of point load acting at the ground surface.
9. Differentiate compaction and consolidation.
10. Explain the method of checking the compaction in the field using proctor needle.
11. Describe method of slices of slope stability analysis.
12. Explain the reasons for failure of slopes

Apply

1. An imaginary soil mass is contained in a container measuring 10cm x 10cm x 10cm. The soil consists of spherical grains of size 1cm in diameter. Determine the maximum possible void ratio and percentage solids.

2. The wet unit weight of a soil sample is 19.2kN/m^3. Its water content is 12%. Determine the void ratio, porosity, Percentage air voids, degree of saturation, saturated unit weight, dry unit weight and submerged unit weight of the sample. Take G= 2.67.
3. Following are the results of a field density test by sand replacement method for a compacted embankment.
   i) Mass of empty calibrating can = 944 gm
   ii) Mass of calibrating can + sand = 2483 gm
   iii) Volume of calibrating can = 1000 c.c
   iv) Mass of soil excavated from the hole dug in the embankment= 925 gm
   v) Mass of sand pouring cylinder + sand before test = 5332 gm
   vi) Mass of sand pouring cylinder + sand after filling the hole = 4152 gm
   vii) Mass of sand filling the pouring cone = 432 gm
   Determine the bulk density of the soil.
4. A constant head permeability test was conducted on a sample of sand 10cm in diameter and 20cm in height. The head of water was maintained at 40cm. If 110cm^3 of water is collected in 1minute and 20 seconds, compute the coefficient of permeability of the sand in mm/hour.
5. In a falling head permeability test if equal time intervals are noted for the drops in head from h_1 to h_2 and again from h_2 to h_3, obtain a relationship between h1, h_2 and h_3.
6. Water table is lowered from a depth of 3m to a depth of 6m in a deposit of silt. The silt deposit has a water content of 20%. Its degree of saturation above water table is 65%.Estimate the increase in effective stress at a depth of 10m due to lowering of the water table. Assume G=2.7.
7. Consolidated Undrained triaxial tests are performed on two identical specimens of saturated, remoulded clay with pore pressure measurements. The observations are recorded in the table below

Test No.	Cell pressure at failure (kN/m^2)	Deviator stress at failure (kN/m^2)	Pore pressure at failure (kN/m^2)
1.	250	179	101
2.	350	242	145

Determine the values of the shear strength parameters in terms of total and effective stresses. If in the consolidated undrained test, an identical specimen is first consolidated under a cell pressure of 400 kN/m^2, what would be the deviator stress at failure?

8. Borings at a site show the following subsurface condition:

Depths	Material	Properties
0 to 2m	Silt	ρ = 1.44 gm/cc
2m to 12m	Sand	ρ_{sat} = 1.9 gm/cc
12m to 18m	clay	ρ_{sat} = 1.78 gm/cc, c = 20kN/m^2, Φ= 18^0

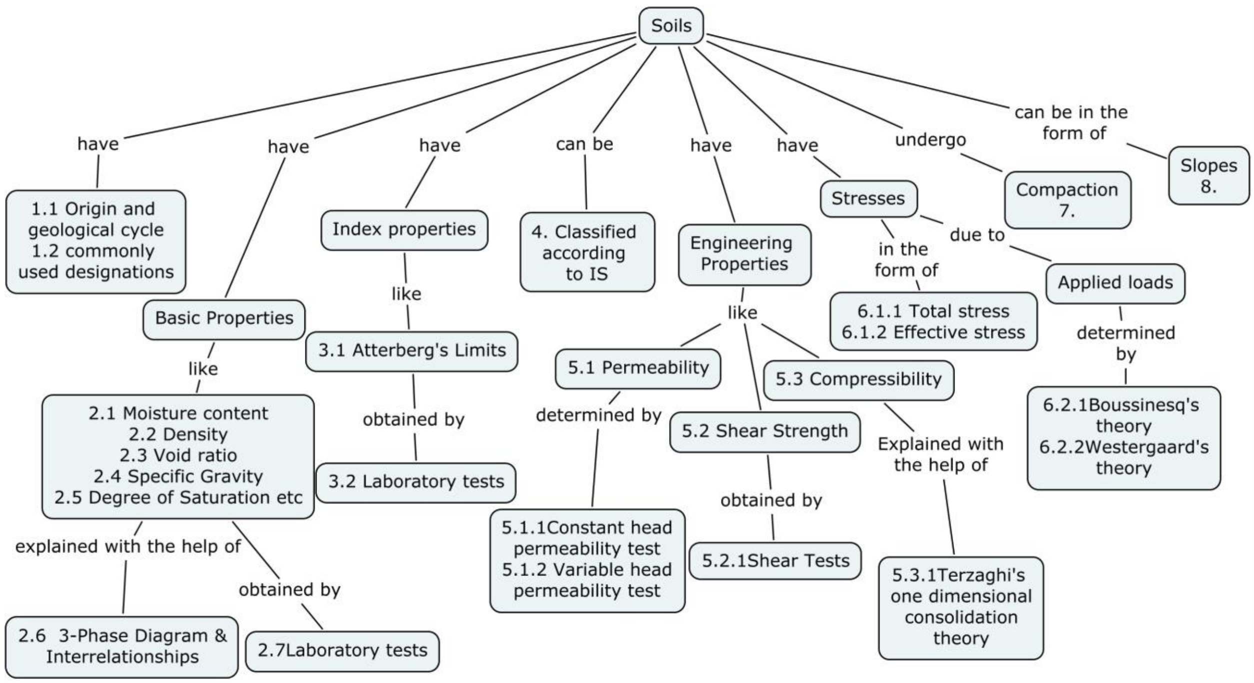
   Ground water table is at a depth of 2m below the ground surface. Estimate the shear strength along a plane at a depth of 16m below the ground surface.

9. In an oedometer test 2 cm thick sample of clay reached 40% consolidation in 5minutes.What will be the time required for a clay layer 4m thick in field to reach the same degree of consolidation? Sample and the clay layer in field have same drainage conditions (double drainage).
10. A square footing 2m x 2m resting on the surface of a soil exerts a pressure of 150kN/m^2. Determine the stress at a point which is at a depth of 5m below the center of the footing using Boussinesq's theory.
11. Following are the results of Standard Proctor Compaction test performed on a soil sample

Water Content (%)	5	10	14	20	25
Bulk density (g/c.c)	1.77	1.98	2.1	2.18	2.16

   Plot the water content – dry density curve and obtain the optimum moisture content and maximum dry density. Calculate the water content necessary to completely saturate the sample at its maximum dry density, assuming no change in the volume. Take G = 2.7.

Concept Map



Course content and Lecture schedule:

S.No	Topic	No. of Lectures
1.	**Origin and types of soils**	
1.1	Geological cycle	1
1.2	Commonly used soil designations	
2.	**Physical Properties of soils**	
2.1	Basic soil properties	2
2.2	3 Phase Diagram and interrelationships	1
2.3	Laboratory tests for determining basic soil properties	2
2.4	Sieve Analysis including hydrometer Analysis	2
2.5	Field identification of soils	1
3.	**Consistency Limits**	
3.1	Determination of consistency limits and their significance to the field behavior of soil	2
4.	**Soil Classification**	
4.1	IS Soil Classification system	1

5.	**Engineering Properties**	
5.1	Permeability	
5.1.1	Darcy's law and its validity	3
5.1.2	Determination of permeability in laboratory for cohesive and cohesionless soils	
5.1.3	Factors affecting permeability	1
5.1.4	Permeability of layered soil deposits	1
5.2	Shear Strength	
5.2.1	Shear and normal stress at a point	1
5.2.2	Mohr's circle of stresses	
5.2.3	Mohr's Strength Theory	1
5.2.4	Mohr-Coulomb failure criterion	
5.2.5	Classification of shear test based on drainage conditions	2
5.2.6	Direct shear test, Unconfined compression test	
5.2.7	Triaxial test and Vane Shear test	3
5.3	Compressibility	
5.3.1	Terzaghi's theory of one dimensional consolidation	1
5.3.2	concept of consolidation	1
5.3.3	Determination of coefficient of consolidation from consolidometer test data by square root of time method and log time method	2
5.3.4	Calculation of consolidation settlement	2
6.	**Stresses in soils**	
6.1	Total stress and Effective stress in soils	
6.1.1	Concept of Effective Stress in saturated soils deposits	1
6.1.2	Seepage flow, seepage pressure, Quick sand condition and critical hydraulic gradient	2
6.2	Stress due to applied loads	
6.2.1	Boussinesq's theory for point load, circular load area and square loaded area	2
6.2.2	Concept of pressure bulb, Westergaard's theory for point load	1
6.2.3	Approximate methods	1
6.2.4	Newmark's influence chart	1
7.	**Soil Compaction**	
7.1	Concept of Compaction	1

7.2	Standard Proctor Compaction Test	1
7.3	Modified Proctor Compaction Test	1
7.4	Factors affecting Compaction	1
7.5	Zero air voids curve	1
7.6	Field Compaction control	
8.	**Stability of Slopes**	
8.1	Types of slope failures	1
8.2	Different Factors of safety	1
8.3	Stability Analysis of Finite slopes	2
8.4	Taylor's stability number	1
8.5	Stability Analysis by method of slices	1
8.6	$Ø_u$=0 Analysis	1

Syllabus

Origin and types of soils: Geological cycle - commonly used soil designations. **Physical Properties of soils:** Basic soil properties - 3 Phase Diagram – interrelationships - Laboratory tests for determining basic soil properties - Sieve Analysis including hydrometer Analysis - Field identification of soils. **Consistency limits:** Determination of consistency limits and their significance to the field behavior of soil – **Soil Classification:** IS Soil classification system - **Permeability:** Darcy's law and its validity - Determination of permeability in laboratory - Factors affecting permeability - Permeability of layered soil deposits. **Shear Strength:** Shear and normal stress at a point - Mohr's circle of stresses - Mohr's Strength Theory - Mohr-Coulomb failure criterion - Classification of shear test based on drainage conditions - Direct shear test - Unconfined compression test - Triaxial test and Vane Shear test. **Compressibility:** Terzaghi's theory of one dimensional consolidation - concept of consolidation - Determination of coefficient of consolidation from consolidometer test data by square root of time method and log time method - Calculation of consolidation settlement **Effective Stress:** Concept of Effective Stress in saturated soils deposits - Seepage flow and seepage pressure - Quick sand condition and critical hydraulic gradient. **Stress due to applied loads:** Boussinesq's theory for point load - circular load area and square loaded area - Westergaard's theory for point load - Concept of pressure bulb - Approximate methods - Newmark's influence chart. **Soil Compaction:** Concept of Compaction - Standard Proctor and Modified Proctor Compaction Tests - Factors affecting Compaction - Zero air voids curve - Field Compaction control. **Stability of Slopes:** Types of slope failures - Different Factors of safety - Stability Analysis of Finite slopes - Taylor's stability number - Stability Analysis by method of slices and $\varnothing_u=0$ Analysis.

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1. Dr. Arora. K.R, "Soil Mechanics and Foundation Engineering (Geotechnical Engineering)", Standard Publishers Distributors, Nai Sarak, Delhi, 2009.
2. Venkatramaiah. C, "Geotechnical Engineering", New Age International (P) Ltd., Publishers, Daryaganj, New Delhi, 2009.
3. Murthy. V.N.S, "A Text book of Soil Mechanics and Foundation Engineering", Kripa Technical Consultants, Bangalore, 1992.
4. Dr. Punmia. B.C, Ashok Kumar Jain, Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd., Daryaganj, New Delhi, 2007.
5. Gopalranjan and Rao. A.S.R, "Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi, 1997.
6. Donald P. Coduto, "Geotechnical Engineering – Principles and Practices", Prentice Hall of India (P) Ltd., New Delhi, 2002.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 57	0	0	1	1

B57 Geotechnical Engineering Lab 0:1

Objective:

To impart hands on training in Soil testing for the determination of Index and Engineering Properties of soils.

List of Experiments:

1. a. Determination of specific Gravity of soil using Pycnometer and Density bottle.
   b. Determination of Relative Density of sand.

2. a. Determination of Soil Moisture content by oven drying method and by using volumetric flask.
   b. Determination of Shrinkage factors of soil.

3. a. Determination of Liquid limit of the soil by Casagrande's Apparatus.
   b. Determination of Plastic limit of the soil.

4. Particle size distribution analysis – By sieve analysis and Sedimentation analysis.

5. Determination of field density of soil by sand replacement method.

6. Constant Head Permeability test on coarse grained soil.

7. Variable Head permeability test on fine grained soil.

8. One Dimensional consolidation Test for the determination of Coefficient of consolidation (C_v).

9. Standard Proctor Compaction test on soil (Light compaction).

10. Direct Shear test on cohesionless soil.

11. Unconfined compression test on clay.

Course Designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 58	0	0	1	1

B58-Environmental Engineering Laboratory **0:1**

Objective:

This laboratory course work is intend to impart hands on training in evaluating the water quality parameters, wastewater characteristics and ambient air quality status measurement. This will form the basic input data for arriving at a solution/treatment system for upkeep of the environment and promoting public health.

List of Experiments:

1. Determination of Hardness, Alkalinity and Chlorides in water samples.
2. Determination of Sulphate in water sample – Turbiditymetric analysis.
3. Determination of Nitrates in water & wastewater – Spectro photometric analysis.
4. Optimum coagulant dosage for turbidity removal.
5. Estimation of chlorine dosage for disinfection of water.
6. Determination of COD of wastewater samples.
7. Determination of Oil & greasy matters in wastewater samples.
8. Determination of Fluorides in drinking water – spectro photometric analysis.
9. Determination of Dissolved oxygen in drinking water.
10. Determination of Iron in water samples – Spectro photometric analysis.
11. Determination of Total solids, suspended solids, Dissolved solids, Organic solids & Inorganic solids in water & wastewater samples.
12. Measurement of Ambient air quality parameters – SPM, SO_2 & NOx

Demonstration Experiments:

1. Determination of BOD of wastewater.
2. Heavy metals measurement using AAS (Lead, Chromium & Zinc).
3. Sodium & potassium measurement using flame photometer & % Sodium, SAR Calculation.
4. Characterization of municipal solid waste & volatile component Estimation.

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SIXTH SEMESTER – ELECTIVE

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6A	3	0	0	3

B6A FINITE ELEMENT ANALYSIS 3.0

PREAMBLE

This course provides an introduction to the finite element analysis, from engineering rather than a purely mathematical point of view.

PROGRAMME OUTCOMES ADDRESSED

- Graduates will develop confidence in finite element method solutions of different field problems in engineering
- Graduates will understand the significance of the versatile tool finite element method
- Graduates will commit to develop computer aided programs using finite element analysis

COMPETENCIES

At the end of the course, the students will be able to

1. formulate basic energy, weak formulation and weighted residual techniques
2. differentiate global, local and natural coordinates
3. handle one dimensional line elements having linear and quadratic shape functions
4. originate truss elements capable of solving two dimensional truss problems
5. formulate two dimensional elements (triangular and isoparametric)
6. understand Gaussian numerical integration technique

ASSESSMENT PATTERN

Sl.No.	Bloom's Category	Test 1	Test 2	Test 3 / End semester examination
1.	Remember	10	10	10
2.	Understand	20	20	20
3.	Apply	70	70	70
4.	Analyze	-	-	-
5.	Evaluate	-	-	-
6.	Create	-	-	-

COURSE LEVEL LEARNING OBJECTIVES:

Remember

1. Explain boundary value and initial value problems with examples.
2. What do you mean by shape function? What are the shape functions of a line element?
3. Write the properties of Global Stiffness Matrix K in case of a one dimensional line element.
4. Write the element body force and element traction force matrices.
5. Give the constitutive matrix in case of a plane strain problem
6. Give the weights and Gauss points in case of one point formula and two point formula

Understand

1. What is the significance of integration by parts?
2. The coordinates of two nodes of a truss element are (0,0) and (7,4). Determine the length and direction cosines.
3. The coordinates of points of a triangular element are (1,2), (3,7) and (5,4). Obtain the Jacobian matrix.
4. Derive the element stiffness matrix and element body force matrices of a line element.
5. Derive the Jacobian of transformation of a triangular element.
6. Derive from basic principles the shape functions and the element stiffness of a four node quadrilateral element.

Apply

1. Consider the bar shown in Fig.1. Axial force P=20N is applied as shown. Determine the nodal displacement, stresses in each element and reaction forces.($E=2\times10^5$ N/mm^2)

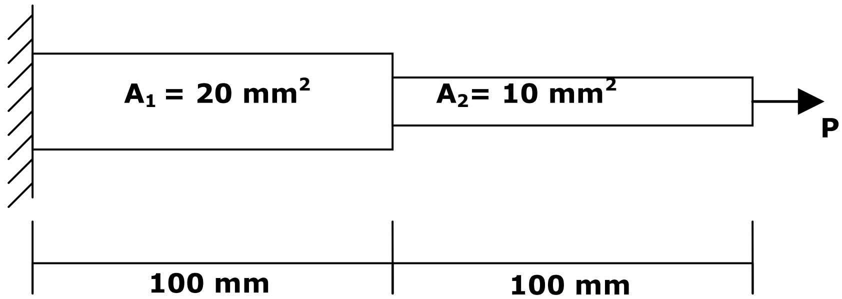


Fig.1

2. Evaluate the integral $\int 3e^x + x^2 + \frac{1}{x+2}\,dx$ using one point and two point Gauss quadrature formula.
3. Determine the forces in the members of the truss shown in Fig.2 by finite element method. Take E = 200 GPa.

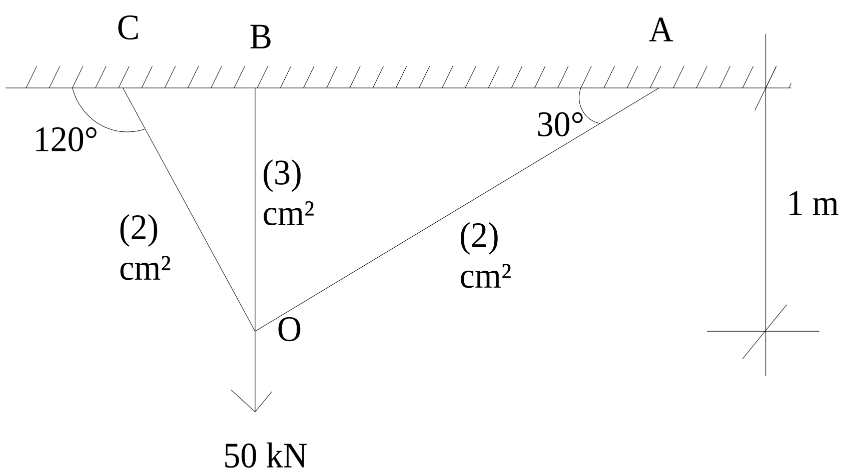


Fig.2

4. For the two-dimensional loaded plate shown in Fig. 3, determine the displacements of nodes 1 and 2 and the element stresses using plane stress conditions. Body force may be neglected in comparison with the external forces.

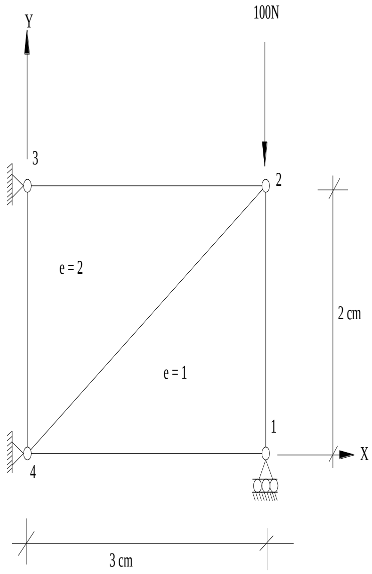


Fig.3

5. If a displacement field is described by

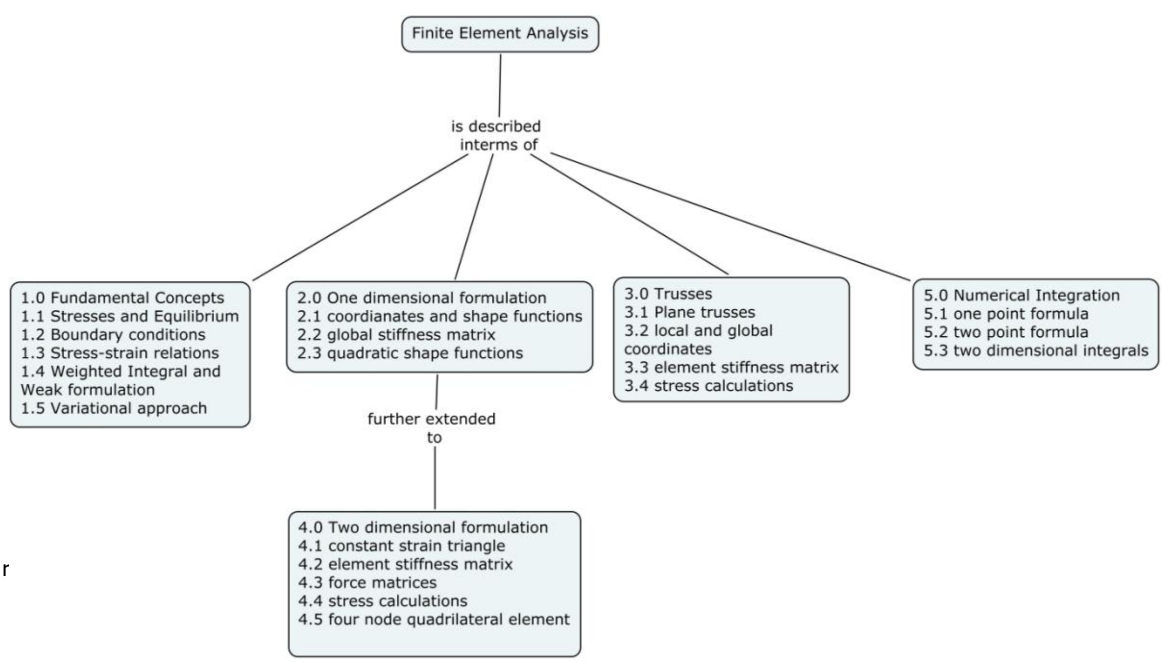
   $u = (-x^2 + 2y^2 + 6xy)\ 10^{-4}$

   $v = (3x + 6y - y^2)\ 10^{-4}$

   determine direct strain at x and y and shear strain at the point x = 1, y=0

6. Taking a differential equation, explain the step by step procedure of obtaining weak form and also explain the various boundary conditions.

Concept Map



Boar

Course contents and Lecture schedule:

S.NO	TOPICS	NO. OF PERIODS
1	**Fundamental Concepts**	
1.1	Introduction	1
1.2	Stresses and equilibrium	1
1.3	Boundary conditions – strain displacement relations	1
1.4	Stress – strain relations – potential energy and equilibrium	1
1.5	Weighted Integral and Weak formulation	2
1.6	Variational Approach	1
1.7	Rayleigh Ritz method	1
2	**One dimensional formulation**	
2.1	Introduction – Finite Element Modelling, coordinates and shape functions	1
2.2	The Potential Energy approach	1
2.3	Assembly of Global Stiffness Matrix and Load Vector	1
2.4	Properties of K, finite element equations and treatment of boundary conditions	1
2.5	One dimensional problems	3
2.6	Quadratic shape functions	1
3	**Trusses**	
3.1	Introduction – Plane trusses	1
3.2	Local and global coordinate systems	1
3.3	Element stiffness matrix	1
3.4	Stress Calculations	1
3.5	Problems in finding stresses in truss members	3
3.6	Introduction to three dimensional trusses	1
4	**Two dimensional formulation**	
4.1	Introduction - Finite Element Modeling of two dimensional problems	1
4.2	Constant strain triangle – Isoparametric representation	1
4.3	Potential energy approach – Element stiffness matrix	1

4.4	Potential energy approach – Force terms	1
4.5	Stress calculations	1
4.6	Problems in two dimensional stress field	3
4.7	Isoparametric elements	1
4.8	Four node quadrilateral – shape functions and element stiffness matrix	1
4.9	Four node quadrilateral – element force vectors	1
5	**Numerical Integration**	
5.1	One point formula	1
5.2	Two point formula	1
5.3	Two dimensional integrals	1
5.4	Problems in numerical integration using Gauss quadrature formula	2

Syllabus

Fundamental Concepts

Stresses and equilibrium – Boundary conditions – strain displacement relations – stress-strain relations – potential energy and equilibrium – weighted integral and weak formulation – variational approach – Rayleigh Ritz method

One dimensional formulation

Finite element modeling – coordinates and shape functions – Assembly of global stiffness matrix and global load vector – properties of K – finite element equations – treatment of boundary conditions – quadratic shape functions – temperature effects

Trusses

Plane trusses – local –global transformation - stiffness matrix – stress calculations

Two dimensional formulation

Finite element modeling – constant strain triangle – problem modeling and boundary conditions - stress calculations – Isoparametric elements – four node quadrilateral and nine node quadrilateral elements

Numerical Integration

One point formula and two point formula – two dimensional integrals

Text Book

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, "Introduction to finite elements in engineering", Prentice Hall of India, New Delhi, 2007.

Reference Books

1. Reddy, J.N, “An Introduction to the finite element method”, McGraw Hill International Edition, New York, 2008.
2. Krishnamoorthy,C.S, “Finite Element Analysis Theory and Programming”, Tata McGraw Hill Publishing Co.Ltd. New Delhi 2004.
3. Rajasekaran,S “Finite Element Analysis in Engineering Design”, A.H. Wheeler publishing company, New Delhi 2003.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6B	3	0	0	3

B 6B Computational Methods of Structural Analysis 3:0

Preamble

This course deals with matrix method of analysis of beams, frames and trusses up to three degrees of freedom covering the fundamental concepts of indeterminacy, measurement of displacements, energy theorems etc.. Flexibility method, Stiffness method and Direct stiffness methods are included in this course. It also aims to determine the member forces and construction of bending moment diagrams.

Program outcomes addressed

- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Know the fundamental concepts of structures and measurement of forces and displacements
2. Apply the knowledge of the energy theorem in solving problems
3. Calculate the moments in beams, frames and trusses having sectional variations and initial yield using stiffness method.
4. Determine the induced forces in beams and frames having sectional variations and sway using flexibility method
5. Calculate the internal forces in beams, frames and trusses with sectional variation using direct stiffness method

Assessment Pattern

	Bloom's Category	**Test 1**	**Test 2**	**Test 3 / End Semester Examination**
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyze	-	-	-
5	Evaluate	-	-	-
6	Create	-	-	-

Course level learning objectives

Remember

1. Define degree of freedom
2. State degree of kinematic indeterminacy
3. What is meant by statically determinate structure?
4. State static indeterminacy
5. What is stiffness matrix?

Understand

1. Find the number of generalized coordinates and the degree of kinematic indeterminacy for each of the structures shown in figure-1 (Ref-P.2.1, P.2.2, P.2.3, and P.2.4)

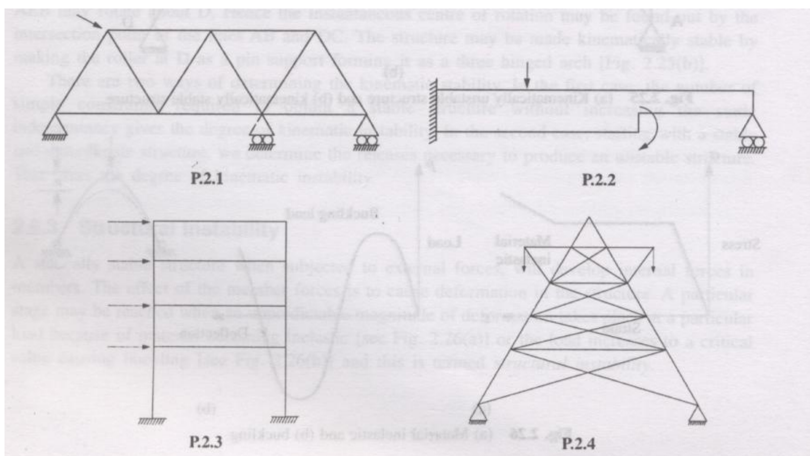


Figure-1

2. Determine the static indeterminacy of each of the structures as shown in figure-2 (Ref: P.3.1, P.3.2, P.3.3, P.3.4) and indicate them if any of them are unstable

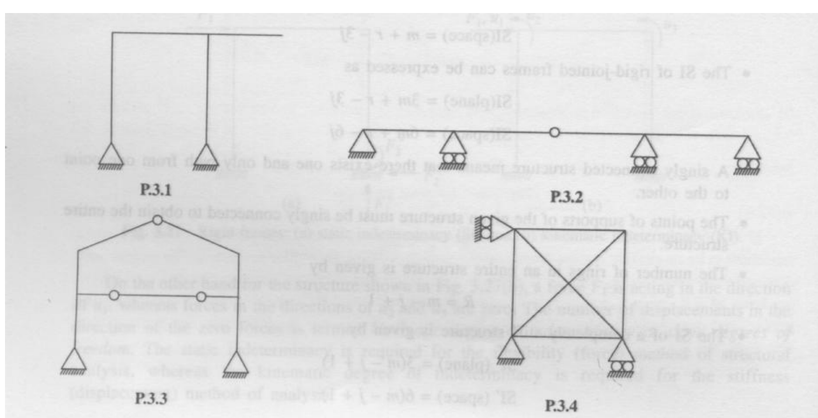


Figure-2

3. Compute the flexibility or stiffness matrix of a frame as shown in figure-3 (d, e)of the using the principle of superposition.

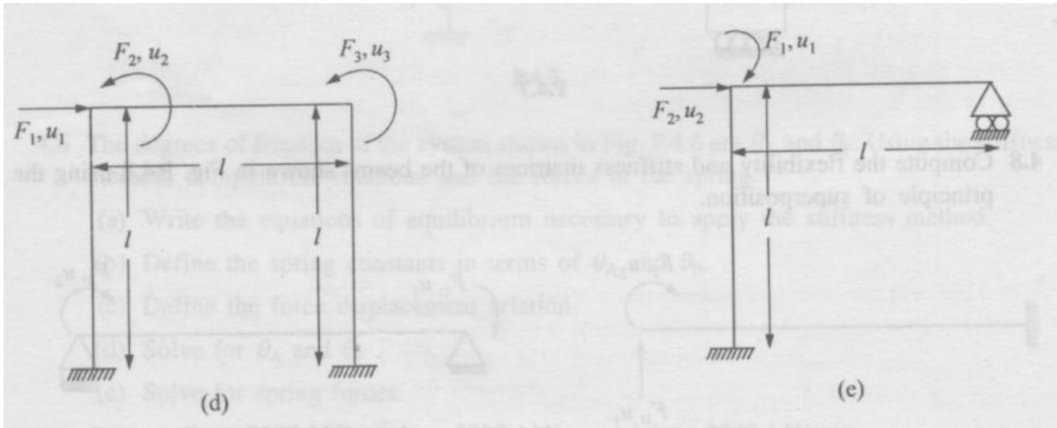


Figure-3

4. Find the stiffness matrix for the continuous beam as shown in figure-4 (Ref: P6.9) by considering the element stiffness

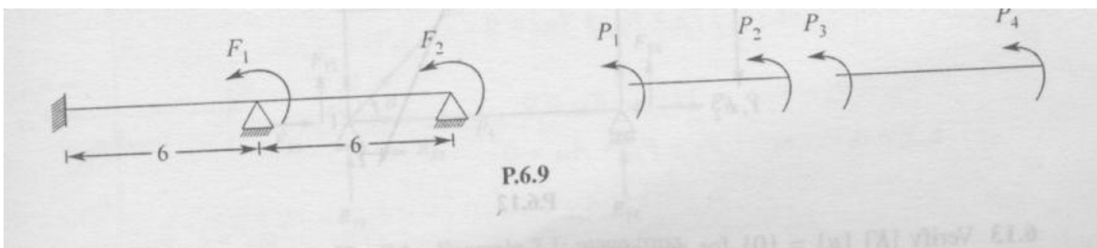


Figure-4

5. Construct and solve the equilibrium equation for the structure shown in figure-5 (Ref: P.7.1(a) , P.7.1(b))

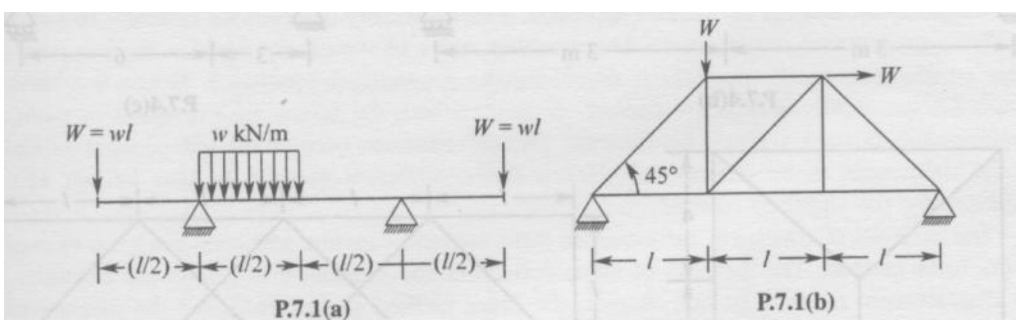


Figure-5

Apply

1. Draw the shear force and bending moment diagrams for the beams shown in figure-6 (Ref: P.8.14 (a) (b)) by force method

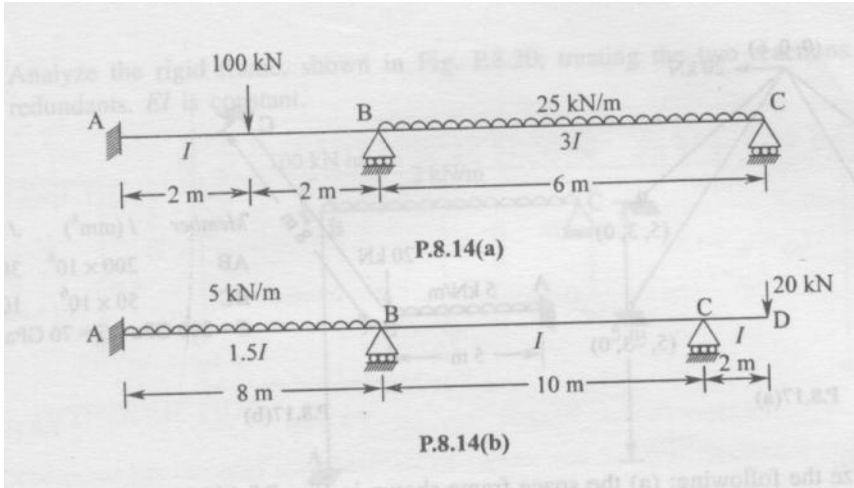


Figure-6

2. Analyse the frame shown in figure-7 (Ref: P.9.14) using stiffness method

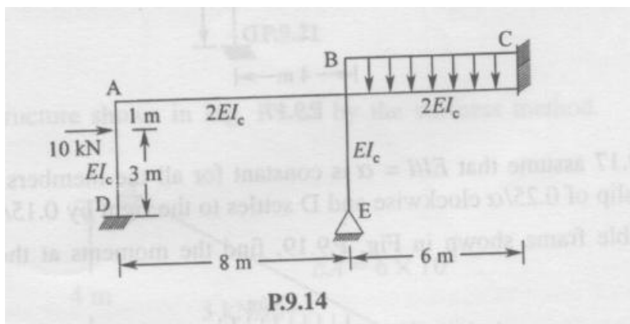


Figure-7

3. Apply the direct stiffness method to solve the truss shown in figure-8 (Ref: p.10.6)

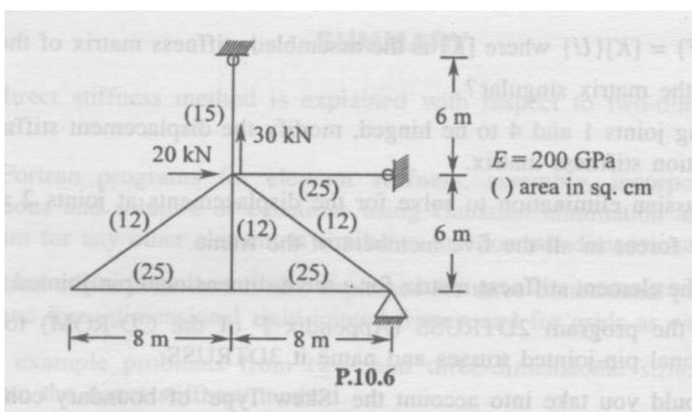
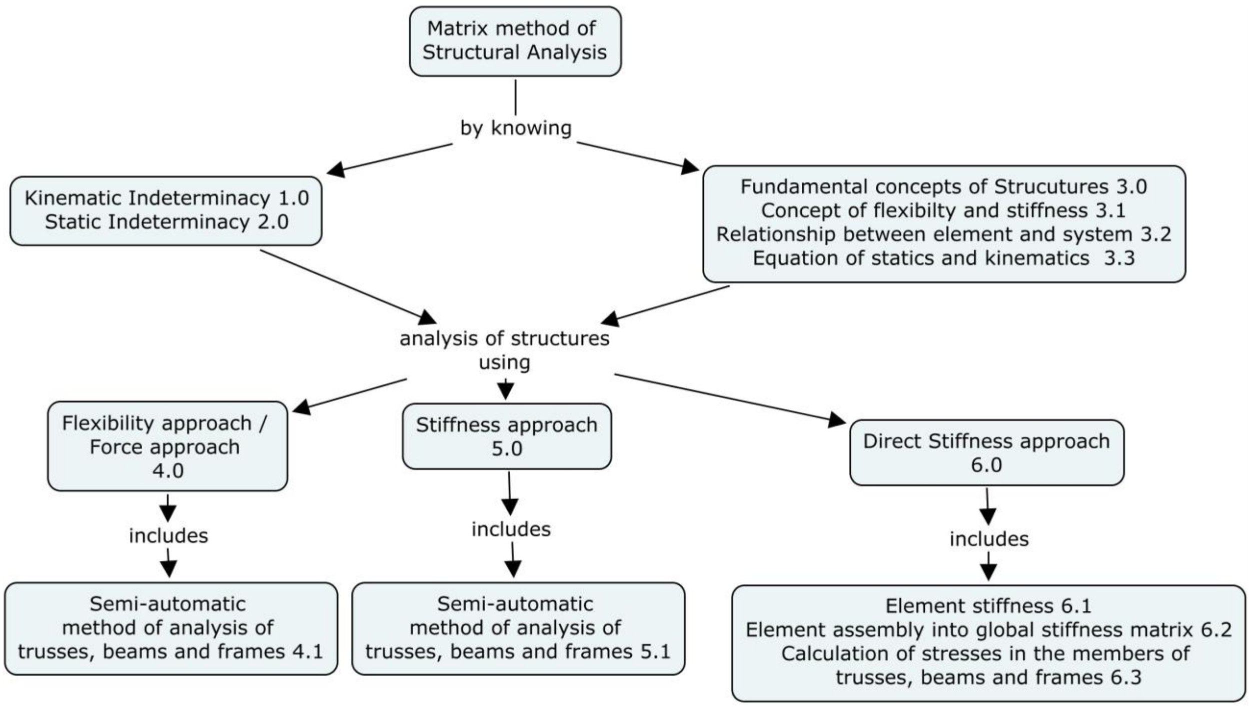


Figure-8

Concept Map



Syllabus

Kinematic indeterminacy – Introduction - Degree of freedom of beams, rigid frames, pinned connected plane frames- **Statical indeterminacy** – Introduction – Degree of static indeterminacy of beams, frames and pinned connected frames – Comparison of statical indeterminacy and kinematic indeterminacy

Fundamental Concepts of Structures – Measure of forces and displacements – Generalized or independent measurement – Constrained or dependent measurement – concept of flexibility and stiffness – concept of equivalent spring – relationship between stiffness and flexibility – Flexibility and stiffness in constrained measurement – Relationship between element and system – equation of statics and kinematics for statically determinate and indeterminate structures

Flexibility method of Force method – concept of force method for trusses, beams and frames – Semi-automatic method of analysis – statically determinate and indeterminate structures – problems

Stiffness method – Concept of stiffness- formation of system stiffness matrix for trusses and frames - Semi-automatic method of analysis – trusses, beams and frames – problems

Direct stiffness method – concept – element stiffness – element assembly into global stiffness matrix – boundary condition – calculation of stresses in the members – trusses, beams and frames - problems

Text Books:

1. Rajasekaran, S., and Sankarasubramanian, G., 'Computational Structural Mechanics", Prentice-Hall of India Pvt. Ltd., NewDelhi (2001)

Reference Books:

1. Reddy,C.S.,"Basic Structural Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi,
2. Streling Kinney.J., "Indeterminate Structural Analysis", Addition-Wesley Publishing Company, Sydney,
3. Thandavamoorthy, "Analysis of Structures", Oxford &IBH Publishers, New Delhi,
4. Ping-Chun Wang, "Numerical and Matrix Methods in Structural Mechanics", John Wiley and Sons New York
5. Manikaselvam, Matrix method of structural analysis, , Khanna Publishers, NewDelhi
6. Wang., C.K.,"Indeterminate Structures" McGraw Hill Book Co., Newyork

Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	Kinematic indeterminacy	
1.0	Introduction to Kinematic indeterminacy, Degree of freedom	1
1.1	Degree of freedom of beams, rigid frames, pinned connected plane frames	1
	Statical indeterminacy	
2.0	Introduction to Statical indeterminacy, Degree of Redundancy	1
2.1	Degree of static indeterminacy of beams, frames and pinned connected frames	1
2.2	comparison of statical indeterminacy and kinematic indeterminacy	1
	Fundamental Concepts of Structures	
3.0	Concept of Structures and Measure of forces and displacements	1
3.1	Generalized or independent measurement	1
3.1.1	Constrained or dependent measurement	1
3.2	Concept of flexibility and stiffness	1
3.2.1	Concept of equivalent spring	2

3.2.2	Relationship between stiffness and flexibility	1
3.3	Flexibility and stiffness in constrained measurement	1
3.3.1	Relationship between element and system	1
3.3.2	Equation of statics and kinematics for statically determinate and indeterminate structures	1
	Flexibility method of Force method	
4.0	Concept of force method for trusses, beams and frames	2
4.1	Semi-automatic method of analysis- Statically determinate and indeterminate structures	4
	Stiffness method	
5.0	Concept of stiffness	1
5.1	Formation of system stiffness matrix for trusses and frames	2
5.2	Semi-automatic method of analysis of trusses, beams and frames	5
	Direct stiffness method	
6.0	Concept of Direct stiffness method	1
6.1	Formation of element stiffness matrix	2
6.2	Element assembly into global stiffness matrix	2
6.2.1	Boundary condition	1
6.3	Calculation of stresses in the members – trusses, beams and frames	5
	Total	40

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6C	3	0	0	3

B6C Structural Dynamics 3.0

Preamble

Develop the ability to formulate the equations of motion of Vibrating systems. Learn how to predict the dynamic response of linear single degree of freedom systems subject to initial excitations, harmonic and arbitrary excitations. Develop an understanding of the dynamic response of linear two degree of freedom systems with regard to natural frequencies and mode shapes. Develop skill in the simulation of the dynamic response of linear systems.

Programme outcome addressed:

- Demonstrate the ability to formulate the equations of motion of Vibrating systems.
- Demonstrate the ability to predict the dynamic response of linear single degree of freedom systems subject to initial excitations& harmonic excitation.
- Demonstrate an understanding of the dynamic response of linear two degree of freedom systems with regard to natural frequencies and mode shapes using linear algebra.

Competencies

Students will be able to

1. Anlayse the Response of single degree of freedom undamped systems to initial excitations
2. Anlayse the Response of single degree of freedom viscously damped systems to initial excitations
3. Anlayse the Response of single degree of freedom systems to harmonic excitations
4. Anlayse the Response of two degree of freedom undamped systems to initial excitations
5. Anlayse the Response of two degree of freedom systems to harmonic excitations
6. Anlayse the Response of Multi degree of freedom systems to harmonic excitations

Assessment Pattern:

Sl NO	Bloom's Category	Test 1	Test II	Test III / End Semester
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyse	-	-	-
5	Evaluate	-	-	-
6	Create	-	-	-

Course level learning objectives:

Remember:

1. State Alembert Principle
2. What is logarithmic decrement?
3. What is displacement transmissibility?
4. What is Quality factor?
5. What is vibration absorber?
6. Write the general form of Lagrange's equation?
7. What is orthogonality principle?
8. What is the use of Rayleigh method in multi degree of freedom system
9. What is modal participation factor?
10. What is coupled modal equations?
11. Differentiate Damped and undamped vibration?
12. Differentiate Linear and Non linear vibration?

Understand:

1. Find the natural frequency of the system shown in fig1. The mass of the beam is negligible in comparison to the suspended mass.

$E = 2x\ 10^5\ N / mm^2$

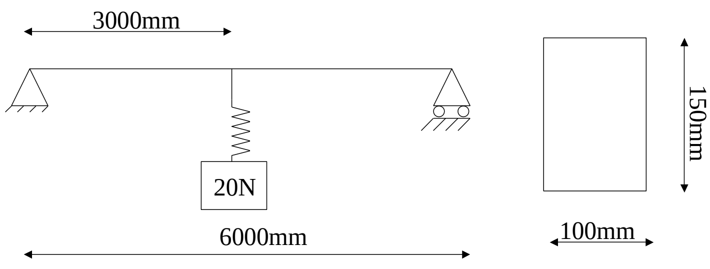
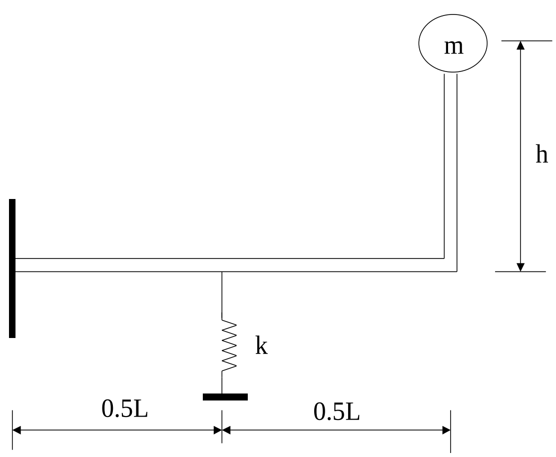


Fig 1

2. An L Shaped mass less rigid member with a mass m at the tip is supported by a spring of stiffness 'K' and hinged at point 'O" as shown in fig2. Find the following
   i. Derive the equation for an angular motion u (t) about O
   ii. Determine natural frequency of the system



3. Derive the expression for Logarithmic decrement and prove that $\delta = 2\Pi\xi$ for damped free vibration
4. Find the natural frequency and amplitude ratio of the system for two degree of freedom system of your choice by using Lagrange,s equation
5. Explain coordinate coupling of two degree of freedom system and derive amplitude ratio and frequencies
6. Derive duhamel integral for an arbitrary forcing function
7. Find undamped response of a system which is subjected to a stepped rectangular forcing function

8. Derive the expression for the response of Multi degree of freedom system for free undamped vibration.

Apply

1. A machine of mass one tonne is acted upon by an external force of 2450N at a frequency of 1500rpm.To reduce the effects of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping (=0.2) are used.

   Determine

   a) the force transmitted to the foundation

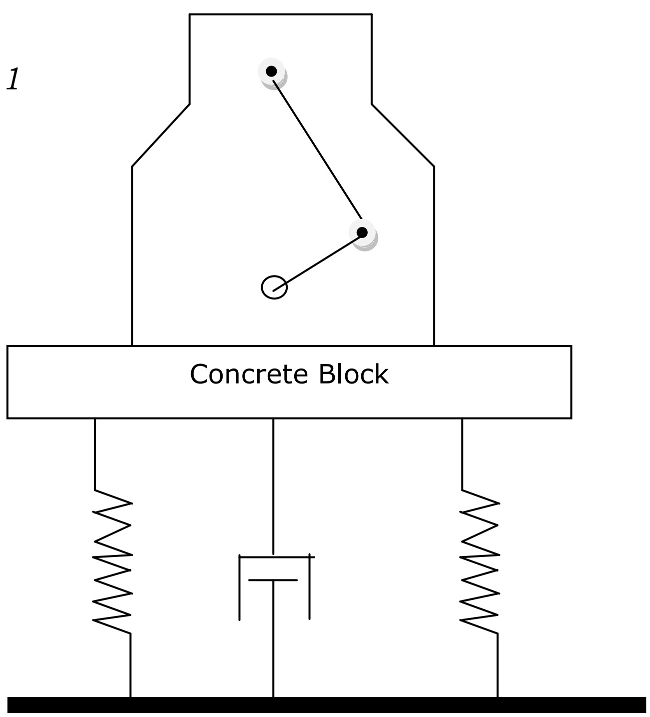
   b) the amplitude of vibration of Machine

2. An engine is mounted on a concrete block which is isolated from the floor as shown in fig1.The unbalanced force of the engine in Newton at r.p.m is given by

   F(t) = 100(n/1000)2 cos (2πnt/60)

   At 1000 rpm it is found that the force transmitted to the floor has an amplitude of 100Newtons.Determine the amplitude of the transmitted force at 1500 r.p.m when the damper is disconnected

Fig 1



3. In an experiment on forced vibration response of a single degree of freedom system, it is found that half power points lie at frequencies 40 and 44 Hz. Find the damping factor of the system

4. Find the natural frequency and amplitude ratio of the system for two degree of freedom system of your choice by using Lagrange,s equation
5. Explain coordinate coupling of two degree of freedom system and derive amplitude ratio and frequencies
6. A two degree of freedom system with masses m1 = 1.5kg and m2 = 0.80kg and stiffnesses are k1 = k2 = 40N/m. Determine the two natural frequencies of vibrations and the ratio of amplitudes of the motion of m1 and m2 for the two modes of vibration
7. Determine the frequency of the system shown in fig 3

   k1=k2=40 N/m

   k=60N/m,m1 =m2=10kg

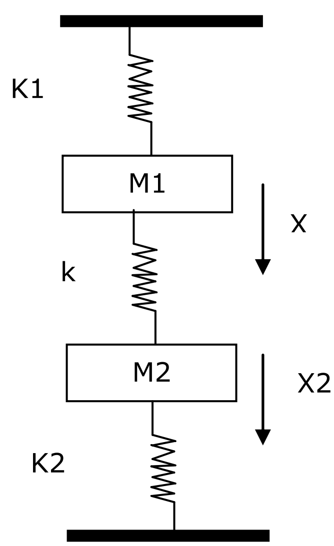


Fig 3

8. Using matrix method, determine the natural frequencies of the system as shown in fig 2

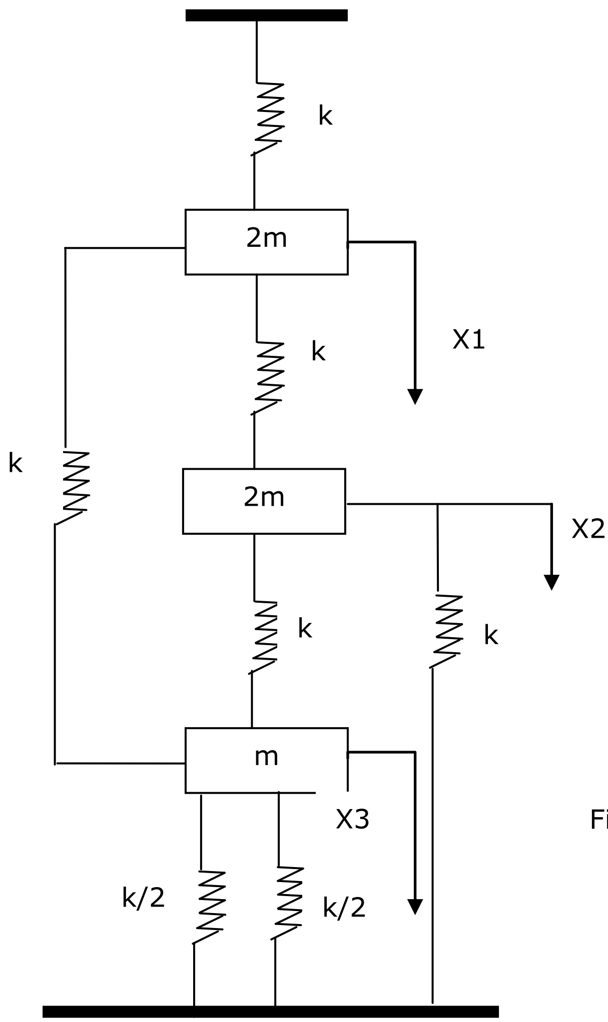
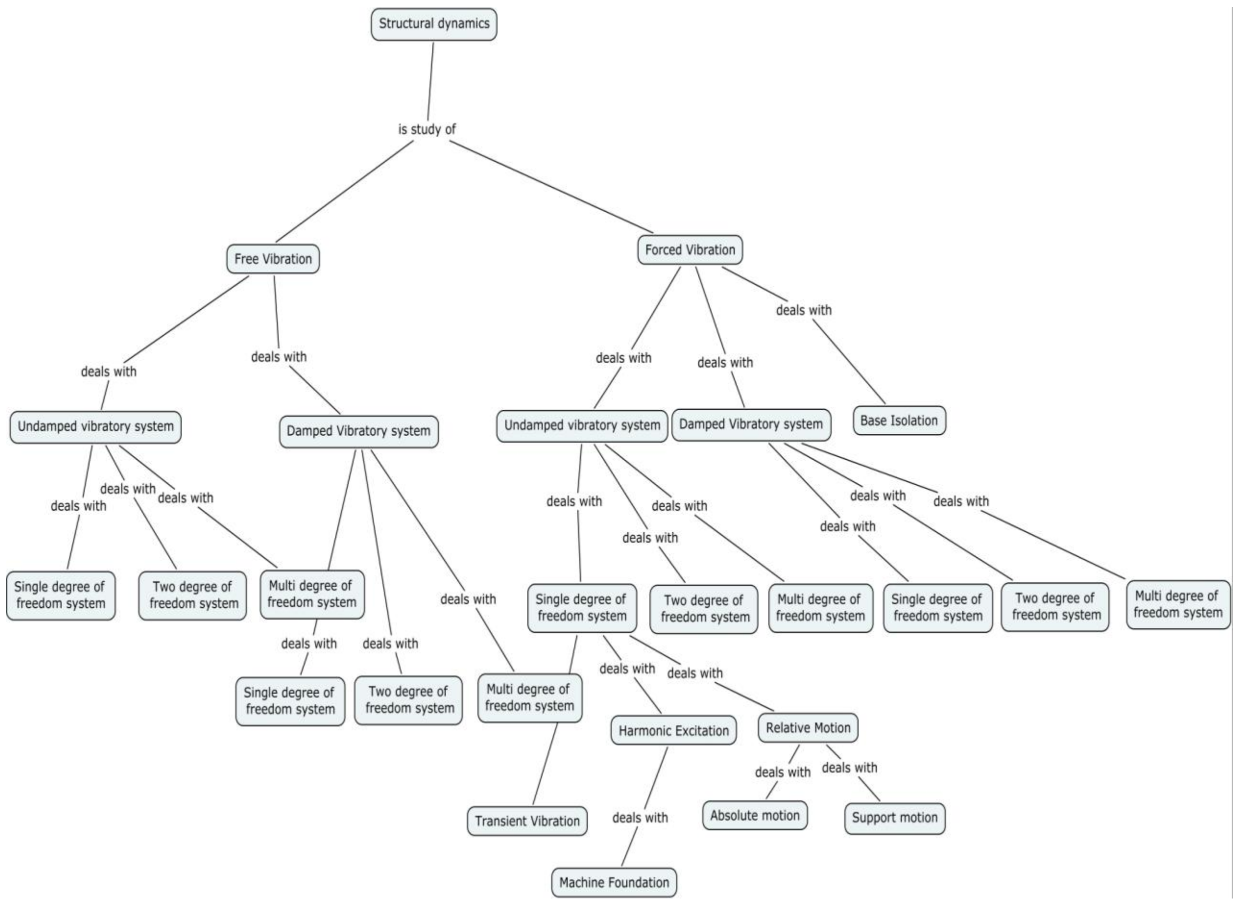


Fig2

Concept Map:



Course Content and Lecture Schedule:

Sl No	Topics	Periods
	Introduction to vibration and Damping	
1	Simple Harmonic motion	01
2	Longitudinal Vibrations Equation of motion, SDOF analysis	01
3	Undamped SDOFs- dynamic equation of motion	01
4	Newtons law of motion, D'Alemberts principle- equivalent stiffness	01

5	Springs are connected in series and parallel, frequency and period, problems	01
6	Amplitude of motion, Energy method for the equation of motion	01
7	Damped SDOFs- underdamped and overdamped	01
8	Damped SDOFs- critically damped	01
9	Logarithmic decrement ,method of determining damping	02
	Forced vibration of single degree of freedom system	
10	Undamped harmonic excitation	01
11	Damped harmonic excitation	01
12	Evaluation of damping at resonance	01
13	Response to support motion	01
14	Torsional vibration	01
15	Dynamic Magnification Factor	01
16	Impulsive loading,	02
17	Numerical evaluation of Duhamel's integral for damped system	02
	Two degrees of freedom	
18	Principle modes of vibration and equation of motion for two degree of freedom	01
19	Two degrees of freedom for torsional system	02
20	Vibrations of undamped Two degrees of freedom	02
21	Forced Vibrations	01
22	Undamped forced vibration for two degrees of freedom	02
23	Orthogonality Principle	01
24	Vibration isolation	01

	Multi degree of freedom system	
25	Equation of motion of multi degree of freedom	01
26	Stiffness, mass and damping matrices	01
27	Influence Coefficient, Eigen vector normalisations, problems	01
28	Matrix Method	01
29	Holzer Method	01
30	Rayleigh Method	01
31	Dunkerleys method	01
32	Modal analysis – damped undamped free vibration	03
	Base Isolation and Machine foundation	
33	Base Isolation techniques, Types of bearings,	01
34	Seismic Instruments	03
35	Introduction to Machine Foundation	01
36	Forces transmitted to the foundations	01
37	Examples on Machine foundation	02
38	Structure to soil interaction	01
39	Introduction to random vibrations	01

Syllabus:

Introduction to vibration and Damping: Simple Harmonic motion-Longitudinal Vibrations Equation of motion- SDOF analysisUndamped SDOFs- dynamic equation of motion Newtons law of motion- D'Alemberts principle- equivalent stiffness Springs connected in series and parallel- frequency and period Amplitude of motion- Energy method for the equation of motion-Damped SDOFs- underdamped and overdamped Damped SDOFs- critically damped Logarithmic decrement ,method of determining damping

Forced vibration of single degree of freedom system: Undamped harmonic excitation

Damped harmonic excitation-Evaluation of damping at resonance-Response to support motion Torsional vibration-Dynamic Magnification Factor

Two degrees of freedom: Principle modes of vibration and equation of motion for two degree of freedom-Two degrees of freedom for torsional system-Vibrations of undamped Two degrees of freedom-Forced Vibrations-Undamped forced vibration for two degrees of freedom Orthogonality Principle

Multi degree of freedom system:

Equation of motion of multi degree of freedom-Stiffness, mass and damping matrices Influence Coefficient-Eigen vector normalisations, problems-Modal co-ordinates, solution of eigen value problems-Matrix Method –Rayleigh Method – Holzer Method - Dunkerleys method -Natural frequencies and mode shapes-Modal analysis – damped undamped free vibration

Base Isolation and Machine foundation

Base Isolation - Types of bearings – case studies on base isolation –Seismic Instruments - Theory of Machine foundation –Forces transmitted to the foundations -Structure to soil interaction - Random Vibrations

Text books

1. Mario Paz, "Structural Dynamics: Theory and Computation", CBS Publications, New Delhi, 1994.
2. Anil K.Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Prentice Hall, Englewood Cliffs, New Jersy, Second Edition, 2001.

Reference books

1. Manicka Selvam K., "Elementary Structural Dynamics", Dhanpatrai and sons, New Delhi.
2. Clough, R.W.and Penzien,J., " Dynamics of Structure",McGraw-Hill,inc.,New York,1993.
3. Hurty.W.C, Rubinstein.M.F,"Dynamic of Structure", Prentice Hall of India Pvt Ltd.New Delhi.
4. Grover.G.K, "Mechanical vibrations, "New Chand and Bros., Roorkee.
5. Cheng, F.Y., "Matrix Analysis of Structure Dynamics", Marcel Dekker, New York, 2001.
6. Berg. Glen v., "Elements of Structure Dynamics" 'Prentice Hall Englewood Cliffs, New Jersy.1989.
7. Warburton, G.B., "The Dynamical Behaviour of Structures", Pergamon Press, New York, 1964.
8. William Thomson, "Theory of Vibration and its applications", George Allen Pub.

Course designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6D	3	0	0	3

B6D Hydrology 3.0

Preamble

It is the science that treats the waters of the earth, their occurrence, circulation and distribution, their chemical and physical properties and their reaction with environment including their relation to living things.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science, and engineering
- Graduates will demonstrate an ability to identify, formulate and solve complicated Engineering problems.
- Graduates will demonstrate skills to use modern engineering tools, sophisticated instruments to analyse engineering problems.

Competencies

At the end of the course the student should be able to

1. Understand the hydrologic cycle
2. Estimate the rainfall over a region
3. Estimate losses by infiltration, evaporation and evapotranspiration in surface water resources
4. Assess the surface and ground water resources in any given region.
5. Explain the measurement of stream flow
6. Suggest ways of augmenting surface and ground water resources.

Assessment Pattern

S.No.	Bloom's Category	Test 1	Test 2	Test 3/End semester Examination
1	Remember	20	20	10
2	Understand	40	40	40
3	Apply	40	40	50
4	Analyse	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. Define hydrologic cycle
2. What are the advantages of recording rain gauge?
3. What is hyetograph?
4. What is watershed?
5. Define runoff.
6. What is synthetic unit hydrograph?
7. List out the assumptions made in the analysis of steady radial flow into well
8. What is meant by overdraft?
9. What are the precautions to be taken in selecting a site for the location of a rain gauge?
10. What is infiltration capacity?

Understand

1. Distinguish between catchment and watershed
2. Describe the principle of working of a tipping bucket type recording rain gauge with a neat sketch. What are its advantages and disadvantages?
3. How is the double mass curve techniques used to check the consistency and adjust the rainfall record at a suspicious station?
4. Explain clearly how various factors will affect the runoff.
5. Under what condition you will adopt SCS method of runoff estimation?
6. Describe the step by step procedure of the derivation of a unit hydrograph from an isolated storm.
7. What do you understand by safe yield of a ground water basin?
8. Distinguish between surface runoff and subsurface runoff
9. Explain why rainfall-runoff relationships are needed.
10. Describe how infiltration capacity rate can be measured using double ring infiltrometer. How is it better than a tube infiltrometer?

Apply

1. A catchment has six rain gauge station. In a year, the annual rainfall recorded by the gauges are given below. For a 10% error in the estimation of the mean rainfall, calculate the optimum number of stations in the catchment.

Station	A	B	C	D	E	F
Rainfall (cm)	120.2	118.6	119.3	125.2	100.2	119.9

2. For a drainage basin of 700 km^2, isohyetals drawn for a storm gave the following data. Estimate the average depth of precipitation over the catchment.

Isohyetals (Interval) (cm)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (km^2)	92	128	120	175	85

3. The annual rainfall at a place for a period of 21 years is given below. Draw the rainfall frequency curve and determine (a) The rainfall of 10-year and 20 year recurrence interval (b) The rainfall which occurs 50% of the times (c) The rainfall of probability of 0.75 (d) The probability of occurrence of rainfall of 75cm and its recurrence interval.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Rainfall in cm	52	62	42	29	32	40	72	62	37	57
1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
42	58	54	44	40	29	42	102	92	46	35

4. A 6h storm produced rainfall intensities of 7, 18, 25, 12, 10, and 3mm/h in successive one hour intervals over a basin of 800 sq.km. The resulting runoff is observed to be 2640 hectare-metres. Determine Φ-index for the basin.
5. Rainfall of magnitude 4cm and 3.5cm occurring on two consecutive 4-h durations on a catchment of area 28 sq.km produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and Φ-index.

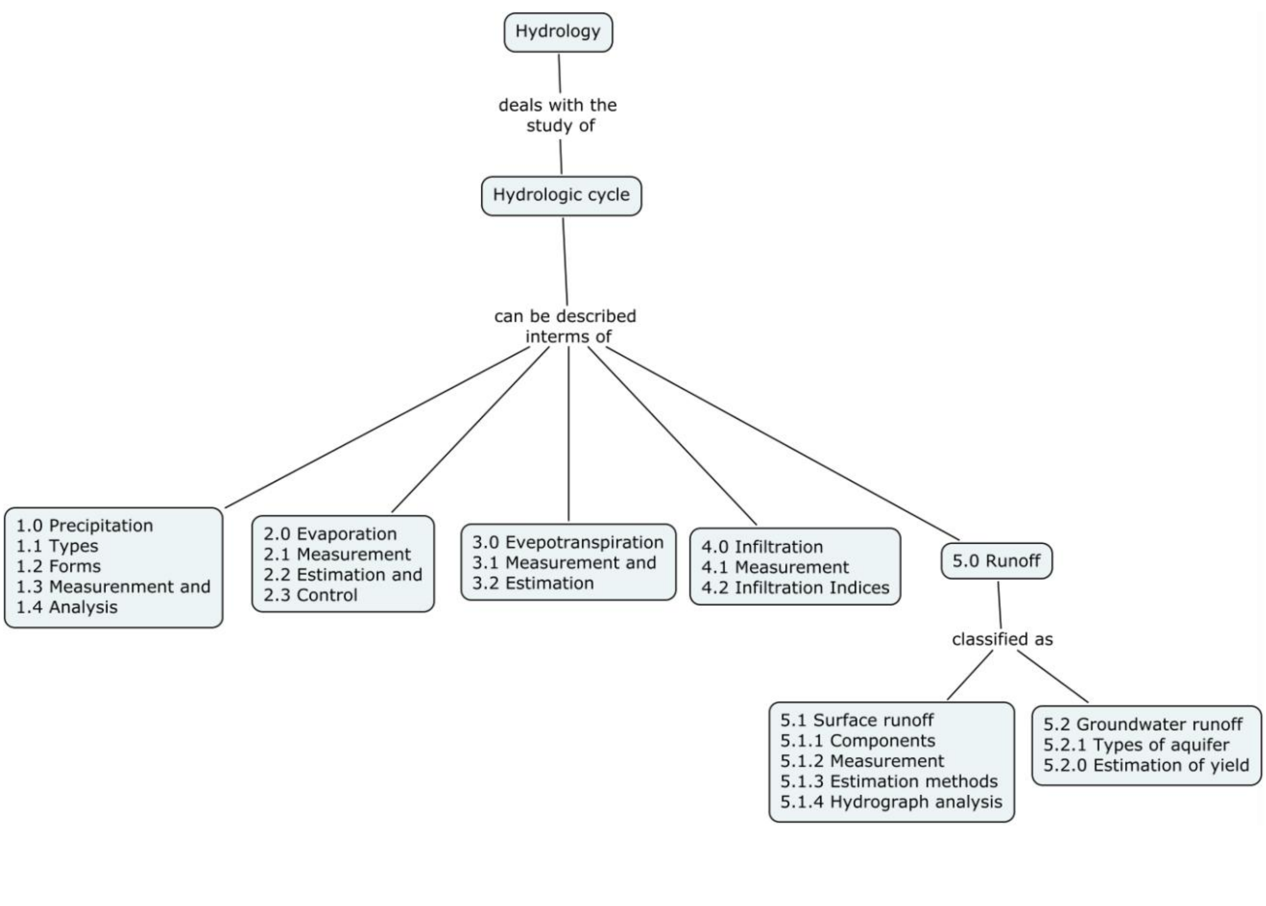
Time from start of rainfall(h)	-6	0	6	12	18	24	30	36	42	48	54	60	66
Observed flow (m^3/s)	3	2	8	20	18	14	10	7	5	3	3	3.5	3.5

6. Given below are the ordinates of a 6-h unit hydrograph for a catchment. Calculate the ordinates of the DRH due to a rainfall excess of 3.5cm occurring in 6hr.

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
UH Ordinates (m^3/s)	0	22	48	85	125	158	182	158	109	58	34	22	14	6	0

7. A 40cm diameter well completely penetrates a confined aquifer of permeability 48m/day. The length of the strainer is 20m. Under steady state of pumping the drawdown at the well wall was found to be 3m and the radius of influence was 300m. Calculate the discharge.

Concept Map



Course content and Lecture schedule

No	Topic	No. of Lectures
1.0	**Precipitation**	
1.1	Introduction, definition and scope, hydrologic cycle, and Types of precipitation	1
1.2	Forms of precipitation	1
1.3	Measurement of Precipitation - Recording and Non-recording rain gauges, Adequacy of rain gauges, Estimation of missing rainfall data, and Mean precipitation over an area.	3
1.4	Analysis of Precipitation - Frequency analysis- Rainfall hyetograph, and Rainfall mass curve	3
2.0	**Evaporation**	
2.1	Measurement of evaporation	3
2.2	Estimation of evaporation	3
2.3	Evaporation control	1
3.0	**Evapotranspiration**	
3.1	Measurement of evapotranspiration	2
3.2	Estimation of evapotranspiration	2
4.0	Infiltration	
4.1	Measurement of infiltration	2
4.2	Infiltration indices	1
5.0	**Runoff**	
5.1	Surface runoff	
5.1.1	Components of runoff	2
5.1.2	Measurement of runoff	2

5.1.3	Methods of estimation of runoff - SCS method	2
5.1.4	Hydrograph analysis - Methods of base flow separation, Unit hydrograph, Synthetic unit hydrograph, S-curve	5
5.1.5	Floods- Flood control measures, Flood routing by Muskingum method, Hydraulic Routing	2
5.2	Ground water runoff	
5.2.1	Types of aquifer- Definition, Properties and types of aquifer, Aquifer parameters, Rain water harvesting from roof top and open space and Methods of artificial reacharge	3
5.2.2	Estimation of yield - Steady flow to wells for confined and unconfined aquifer and Pumping test	2

Syllabus

Hydrologic processes: Introduction, definition and scope, hydrologic cycle, Types and form of precipitation, Adequacy of rain gauges, Recording and Non-recording rain gauges, Estimation of missing rainfall data, Mean precipitation over an area, Frequency analysis, Rainfall hyetograph, Rainfall mass curve, Evaporation and its control, Evapo transpiration, Infiltration and other abstractions.

Surface runoff: Definition of runoff, factors affecting ruoff and its components, SCS method, Hydrograph analysis, Components of hydrograph, Methods of base flow separation, Unit hydrograph, Synthetic unit hydrograph, S-curve and Stream flow measurements. **Floods**: Definition, Flood control measures, Flood routing by Muskingum method, Hydraulic Routing, Methods of artificial reacharge, Rain water harvesting from Roof top and open spaces. **Ground water:** Definition, Properties and types of aquifer, Aquifer parameters, Steady flow to wells for confined and unconfined aquifer and Pumping test.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6E	3	0	0	3

B6E Municipal Solid waste Management 3:0

Preamble

This course work aims at imparting the knowledge on types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste. The engineering and scientific details of solid waste management that meets public health and environmental concerns are well addressed.

Programme outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will identify, formulate, research literature and solve complex engineering problems, reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the end of the course, the student should be able to

1. Estimate the waste generated by a community
2. Understand the factors that affect generation of waste
3. Explain the frame work of resource management such as 4R concepts.
4. List the collection methods, collection vehicles & man power requirement.
5. Identify the optimum collection routes.
6. Identify the location of transfer station and disposal site.
7. Explain the engineering and scientific details of processing of solid wastes and resource recovery.
8. Plan the methods of disposing solid waste.
9. Understand the treatment, storage, and disposal facility for hazardous waste.

Assessment Pattern

S.No.	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	10
2	Understand	40	40	40
3	Apply	40	40	30
4	Analyze	0	0	10
5	Evaluate	0	0	10
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. What are the different functional elements in municipal solid waste management?
2. What is the composition of a typical municipal solid waste?
3. List the chemical characteristics of a municipal solid waste?
4. List the adverse health and environment impacts due to improper handling of solid waste.
5. What are the types of containers and collection vehicles used for solid waste management?
6. What are the attributes of hazardous wastes?

Understand

1. Based on the source and type, classify the waste generated in your locality.
2. Discuss the factors that contribute to the generation of solid waste in a community?
3. State the factors to be considered while finalizing a collection route.
4. Explain the role of a transfer station in solid waste management?
5. Explain the need for source reduction in waste management?
6. Differentiate recycling and reuse?

Apply

1. Find the current waste collection practice in your locality and state its role in waste management?
2. Discuss the various constraints faced by municipal authorities in identifying a disposal site?
3. Do you think a sanitary landfill is possible to manage wastes in your locality? List at least three reasons to support your answer.
4. How will you control leachate generation from a landfill?
5. Compare sanitary landfill and open dumping from the point of view of public health & environment?
6. Suggest the best disposal option for the municipal solid waste generated from your locality.

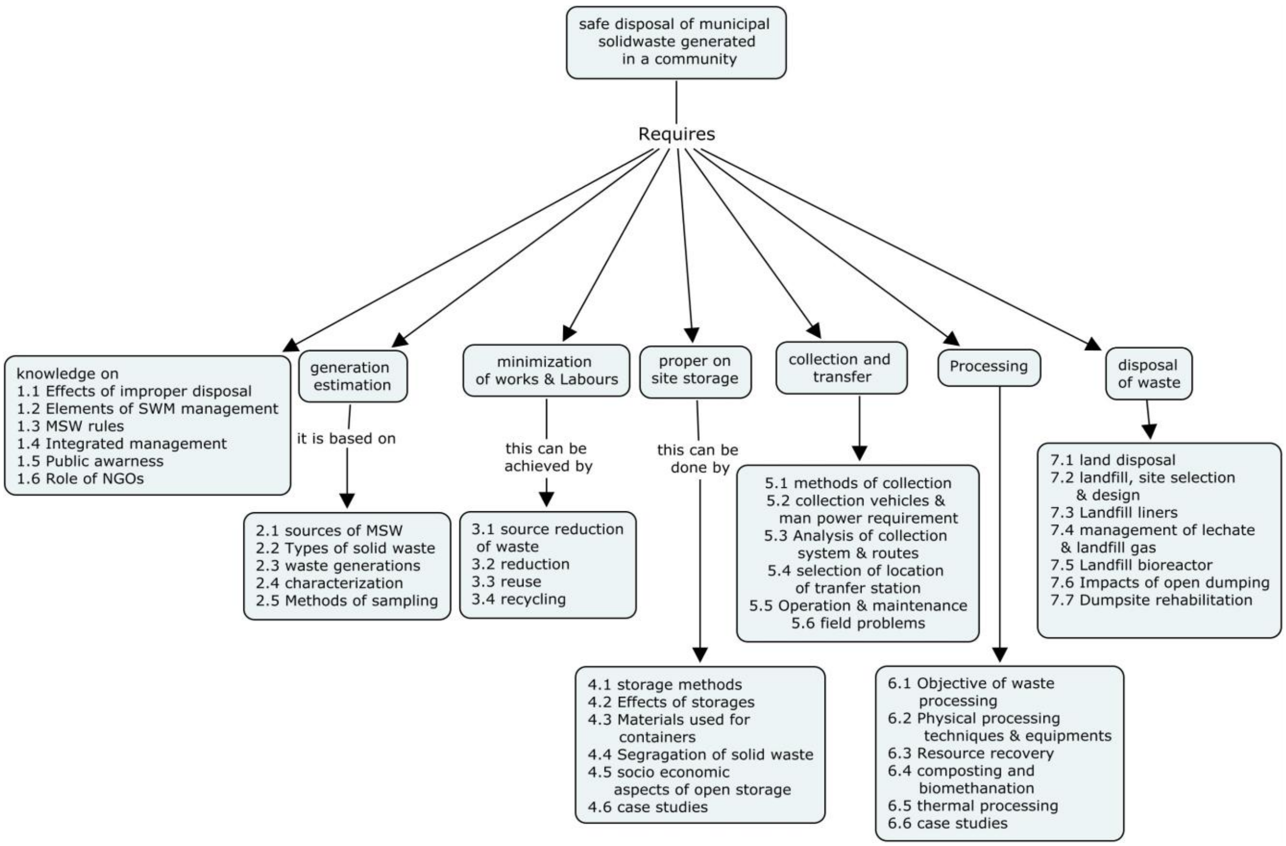
Analyze

1. Compare the various recovery options and processing technologies for the Municipal solid waste?
2. Analyze the environmental effects of composting and bio-gasification.
3. Discuss the various options for disposal of wastes and their selection criteria.
4. Assess the technical viability of various processing techniques.
5. Waste generation rate is normally high in bigger cities - why?
6. What are the factors contribute to the variations in composition of municipal solid waste.

Evaluate

1. Evaluate various options present before implementing a source reduction policy?
2. Assess the energy generation potential of a MSW.
3. How will you choose a solid waste collection system to a city?
4. Determine the most viable disposal options for join locality?
5. Evaluate the potential of solid waste to be used as a fuel for incineration process.
6. Comment on the current waste collection practice in your town.

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Solid Waste Management Overview	
1.1	Elements of solid waste management	1
1.2	Municipal solid waste (M & H) rules	1
1.3	Integrated solid waste management	1
1.4	Public awareness & Role of NGO's	1
1.5	Effects of improper disposal of solid wastes	1
	Sources & Generation	

2.1	Source and Types of solid waste	1
2.2	Waste generation rate & Characterization of waste	1
2.3	Methods of sampling	1
	Source Reduction	
3.1	Source reduction of waste	1
3.2	3R concepts - Reduction concept	1
3.3	Reuse concept	1
3.4	Recycling concept	1
	Storage & Segregation	
4.1	Storage methods & Effects of storage	1
4.2	Materials used for containers	1
4.3	Segregation of solid waste	1
4.4	Socio economic aspects of open storage	1
4.5	Case studies – regarding site storage	1
	Collection & Transfer of Solid waste	
5.1	Methods of collection	1
5.2	Collection vehicles and manpower requirement	1
5.3	Analysis of collection system and routes	3
5.4	Selection of location of transfer station	1
5.5	Operation and maintenance of transfer station	1
5.6	Field problems during transfer	1
	Processing	
6.1	Objectives of waste processing	1
6.2	Physical processing techniques and equipments	1
6.3	Resource recovery	1
6.4	Composting and biomethanation	1

6.5	Thermal processing of solid waste	1
6.6	Case studies - processing	2
	Disposal of solid waste	
7.1	Land disposal	1
7.2	Landfill site selection and design	1
7.3	Landfill liners	1
7.4	Management of leachate and landfill gases	1
7.5	Bioreactor Landfill	1
7.6	Impacts of open dumping – on surface, ground water, Green house effect	2
7.7	Dumpsite rehabilitation	1
		40

Syllabus

Solid Waste Management Overview Sources and types of municipal solid wastes-Waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes – Public health and environmental effects. Elements of solid waste management – Municipal solid waste (M & H) rules – integrated management – Social and Financial aspects; Public awareness; Role of NGO's.

Source Reduction Source reduction of waste -Reduction, Reuse and Recycling-On-site **Storage & Segregation** storage methods-Effect of storage, materials used for containers-segregation of solid wastes-Public health and economic aspects of open storage-waste segregation and storage-case studies under Indian conditions.

Collection & Transfer of Solid waste Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection system; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems.

Processing Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste - composting and biomethanation; Thermal processing options – case studies under Indian conditions.

Disposal of solid waste Land disposal of solid waste - Sanitary land fills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gases –bioreactor Landfill – Impacts of open dumping – on surface, ground water, Green house effect - Dumpsite Rehabilitation.

Text Book

1. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, " Integrated Solid waste management", McGraw Hill Publishers, New York, 1993.

Reference Books

1. "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
2. Bhide A.D and Sundaresan, B.B. "Solid Waste Management Collection, Processing and Disposal", 2001, ISBN 81-7525-282-0
3. Paul T Williams (200). "Waste Treatment and Disposal", John Willey and Sons.

Course Designers

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SIXTH SEMESTER – GENERAL ELECTIVE

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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Sub Code	Lectures	Tutorial	Practical	Credit
B6AG	3	0	0	3

B6AG SUSTAINABLE DEVELOPMENT 3:0

Preamble

This course work aims at imparting the knowledge on Sustainable development for a sustainable future. Starting from minimizing the causes for various Environmental issues (like resource degradation, green house gases, industrialization) implementing eco development programmes, promoting Environmental awareness among public/individuals for resource protection and technological innovations for sustainable development are well addressed. The student is expected to understand the Environmental issues and demonstrate knowledge of and need for sustainable development, apply knowledge of technological innovations, range of technology and an engineering specialization for achieving sustainable development, and understand the effects of various technologies on global health as they interact with society and culture.

Programme outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the End of the Course, the student should be able to

1. Understand the concept of Sustainable Development.
2. Understand the socio-economic policies for sustainable development.
3. Identify the strategies for implementing eco development programmes.
4. Review technological innovations for their impact on integrated in different settings.
5. Suggest action plans for implementing sustainable development.
6. Identify different approaches for resource protection and management.

Assessment Pattern

S.No	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	20
2	Understand	50	50	50
3	Apply	30	30	30
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. Define sustainable development.
2. What are the principles of Sustainable Development?
3. What are the Indicators for Sustainable Development?
4. Define Desertification.
5. What are the effects of green house gases?
6. What are the concepts of Sustainable Development?

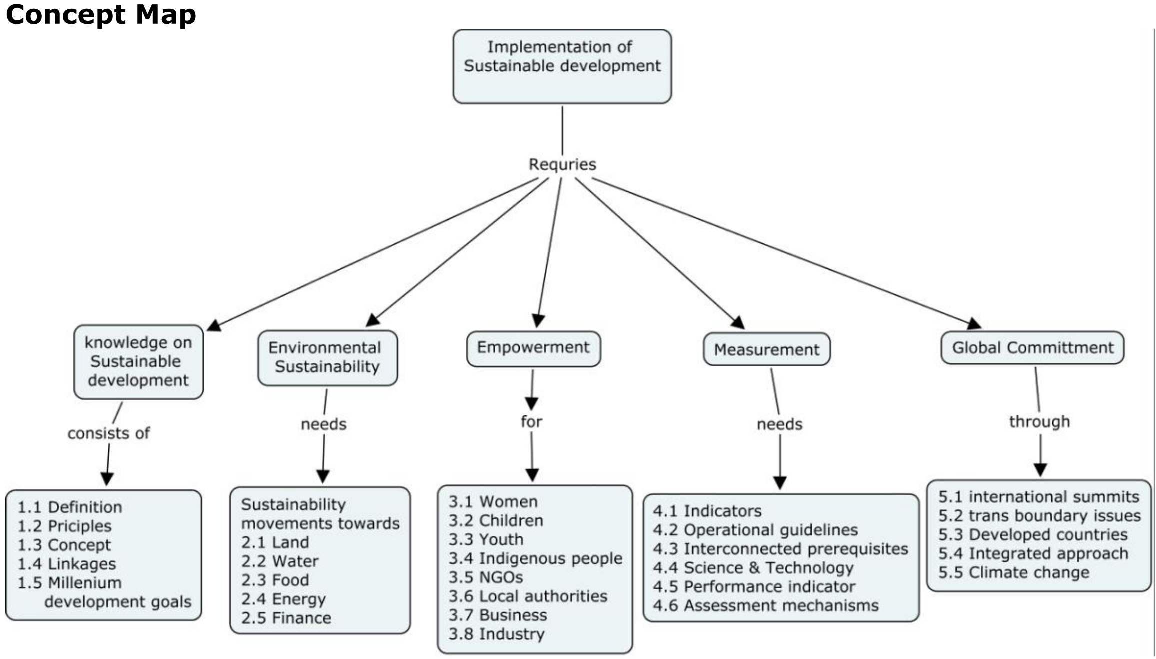
Understand

1. Explain the current Environmental issues.
2. Explain in detail about green house gases.
3. Explain the concept of sustainable development.
4. Describe in detail about global warming.
5. Discuss the role of fossil fuels in climate change.
6. Explain the strategies for implementing ecodevelopment programmes.

Apply

1. How will you minimize the environmental impact to achieve sustainable development?
2. How will you achieve sustainable development in global trading?
3. How will you promote Environmental awareness?
4. How will you minimize the effects on plants and animals due to green house gases?
5. How will you select the approach for resource protection?
6. How will you minimize the non renewable energy source in future?

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Introduction to Sustainable Development	
1.1	Definitions	1
1.2	principles of Sustainable Development	1
1.3	concept of Sustainable Development	1
1.4	Environment and Development linkages	1
1.5	Millennium Development Goals	1
	Environmental Sustainability	
2.1	Movement towards Sustainability	1
2.2	Role of Land, Water, food production in Sustainability	3
2.3	Energy and Sustainable development	1
2.4	Financing the environment	1

Empowerment		
3.1	Women	1
3.2	Children	1
3.3	Youth	1
3.4	Indigenous people	1
3.5	NGOs	1
3.6	Local authorities	1
3.7	Business	1
3.8	Industry	1
Measurements		
4.1	Sustainability Indicators	1
4.2	Operational guidelines	1
4.3	Interconnected prerequisites for sustainable development	1
4.4	Science and Technology for sustainable development	1
4.5	Performance indicators of sustainability	1
4.6	Assessment mechanism	1
4.6.1	Constraints and barriers for sustainable development	1
Global Commitment		
5.1	Developed countries	1
5.2	International summits	1
5.3	Transboundry issues	1
5.4	Integrated approach for resource protection and management	1
5.5	Climate change	1
5.5.1	Chemistry of atmosphere	1
5.5.2	Chemistry of green house gases	1
5.5.3	effects on plants and animals	1
5.5.4	Global warming, Sea level rise, Ozone problem	1

5.5.5	ecosystems and species interactions	1
5.5.6	changes in agricultural production, droughts, spread of epidemics	1
5.5.7	wildfires and other extreme weather events	1
5.5.8	Role of fossil fuels in climate change, future use of renewable energy	1
5.5.9	Role of governments, industries and individuals	1
5.5.10	International agreements and protocols	1
		40

Syllabus

Introduction to Sustainable Development Definitions and principles of Sustainable Development – History and emergence of the concept of Sustainable Development – Environment and Development linkages – Globalization and environment – Millennium Development Goals: Status (global and Indian) Impacts on approach to development policy and practice in India, future directions.

Environmental Sustainability Land, Water and Food production – Moving towards sustainability: Energy powering Sustainable Development – Financing the environment and Sustainable Development.

Empowerment - Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - **Measurements** - Sustainability indicators – Hurdles to sustainability – Operational guidelines – Interconnected prerequisites for sustainable development – Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Global Commitment - Role of developed countries in the development of developing countries – International summits, Transboundry issues – Integrated approach for resource protection and management.

Climate change - Chemistry of atmosphere, Chemistry of green house gases, effects on plants and animals. Global warming, Sea level rise, Ozone problem. The green house effect-ecosystems and species interactions, changes in agricultural production, droughts, spread of epidemics, wildfires and other extreme weather events. Role of fossil fuels in climate change, future use of renewable energy, role of governments, industries and individuals, International agreements and protocols.

Text Book

1. "Sustainable development" Kirkby. J, O'Keefe P. and Timberlake, Earth Scan Publication, London, 1996.

Reference Books

1. "Achieving Broad-Based Sustainable Development: Governance, Environment, and Growth with Equity" James H. Weaver, Michael T. Rock, Kenneth Kustere. Kumarian Press, West Hartford, CT. Publication Year: 1997.
2. Sustainable Environmental Management: Principles and Practice by R. Kerry Turner. 292 pgs. Publisher: Belhaven Press, ISBN:1852930039.
3. "Introduction to Sustainability", N. Munier ,Springer 2005
4. Rural Change and Sustainability - Agriculture, the Environment and Communities, Edited by S J Essex, A W Gilg and R Yarwood CABI September 2005.
5. Environmental Concerns and Sustainable development: Some perspectives from India,Editors: Ganesha Somayaji and Sakarama Somayaji, publisher TERI Press, ISBN 8179932249.

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6BG	3	0	0	3

B6BG PROJECT MANAGEMENT **3:0**

Preamble

An engineering student needs to have some exposure to the basic steps involved in the formulation of a project, project management concepts, importance of network techniques and its applications to a project.

Program Outcomes Addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models
- Graduate will develop confidence for self education and ability to engage in life – long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to:

1. Understand the concepts of project Formulation & Financing
2. Understand the conditions to be satisfied for the sanction of projects
3. Get an exposure to the concepts of Project Management and its functions
4. Understand the traditional method of analyzing projects with merits and limitations
5. Represent projects in the form of Network diagrams
6. Understand the scientific tools for analyzing projects namely PERT and CPM
7. Apply the principles of CPM for balancing of resources, updating and cost crashing in projects

Assessment Pattern

S. No.	**Blooms Category**	**Test-1**	**Test-2**	**Test-3/ End semester Examination**
1.	Remember	20	10	0
2.	Understand	20	10	10
3.	Apply	50	40	40
4.	Analyze	0	20	30
5.	Evaluate	10	20	20
6.	Create	0	0	0

Course Level Learning Objectives

Remember

1. What is meant by project management? Mention its need
2. List the conditions to be satisfied for the sanction of projects
3. What is meant by administrative approval? When is it accorded for projects?
4. Mention the goals of project management
5. Define the term planning of projects
6. Define the term updating of projects? Write its need and importance
7. What do you understand by the term work break down structure of projects?
8. Mention two advantages of network techniques of analyzing projects
9. Define the term total float. Mention its importance
10. Define the term direct cost in projects with examples
11. List the resources for a project
12. List the components of DPR
13. Write the essential contents of a TOR
14. Define BOOT, BOLT, BOT

Understand

1. Discuss the functions of project management
2. Write the objectives of project management
3. Discuss the different methods of project financial
4. Discuss the merits and limitations of bar-chart technique
5. Discuss the procedure of preliminary planning of schemes
6. Compare CPM and PERT
7. Compare GERT with CPM and PERT techniques
8. Why should resources be balanced in project? Write its significance
9. Compare the smoothing and leveling methods of resource balancing
10. Write the significance of optimum time minimum cost relationship of a project
11. Compare direct and indirect costs of a project with examples of each
12. Discuss the essential conditions to be satisfied for sanction of projects
13. Discuss the rules of Fulkerson for drawing of network diagram

Apply

1. A project consists of six activities with the following logical relationships. Draw a network for the project and determine the critical path using the traditional method

- A and B are the initial activities and can be performed concurrently
- C follows A but cannot start until B is over
- D and E succeed B
- C and D precede F
- E and F are terminal activities

Activity	A	B	C	D	E	F
Duration (Days)	2	4	7	1	6	3

2. A project consists of 5 activities with the following relationship, draw a bar chart assuming the project commences on 15 April wednesday with five working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion

3. A project consists of six activities with the following logical relationships. Draw a network for the project and determine the critical path using the traditional method

- A and B are the initial activities and can be performed concurrently
- C follows A but cannot start until B is over
- D and E succeed B
- C and D precede F
- E and F are terminal activities

Activity	A	B	C	D	E	F
Duration (Days)	7	8	3	2	7	4

Find the status of the project on 10th day of its commencement?

4. Conduct Activity oriented network analysis for the following project and determine:
- ES, EF, LS & LF times for the project
- Total , Free and interfering floats for the project
- Critical path and critical activities
- Draw the square network diagram for the project

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
Duration days	2	3	4	0	7	2	4

5. Conduct Event oriented network analysis for the following project and determine:
- Earliest and latest allowable occurrence times for the events
- Expected time and standard deviations for activities
- Project completion time and its degree of variability
- What is the probability of completing the project 2 days ahead of schedule?
- What is the probability of not completing the project 1 day behind schedule?
- Find the due date that has 75% chance of being met?

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
t_0 days	2	3	4	0	7	2	4
t_m days	3	3	10	0	12	7	6
t_p days	5	3	12	0	15	9	8

6. Write the DPR for converting your office with e- governance

Analyze

1. Which of the three methods of project financing (BOT, BOLT, BOOT) is the best from economy point of view? Substantiate with reasons
2. Why bar charts are suitable only for smaller magnitude project? Justify?

3. A project consists of 6 activities with the following relationship, draw a bar chart assuming the project commences on 8 July Thursday with six working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion
- C can start after E and F are completed

Find the completion date and day of the project. What would happen to the completion time of the project if B is delayed by 5 days?

4. A project consists of 6 activities with the following relationship, draw a bar chart assuming the project commences on 27 January Monday with five working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion
- C can start after E and F are completed

Find the completion date and day of the project. What would happen to the completion time of the project if D is delayed by 2 days?

Find the status of the project on 10th February?

5. A project consists of 5 activities with the following relationship, draw a bar chart. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 5 days and 4 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion

If on the 11th day of commencement the following status occurs, update the project and determine the revised completion time if any?

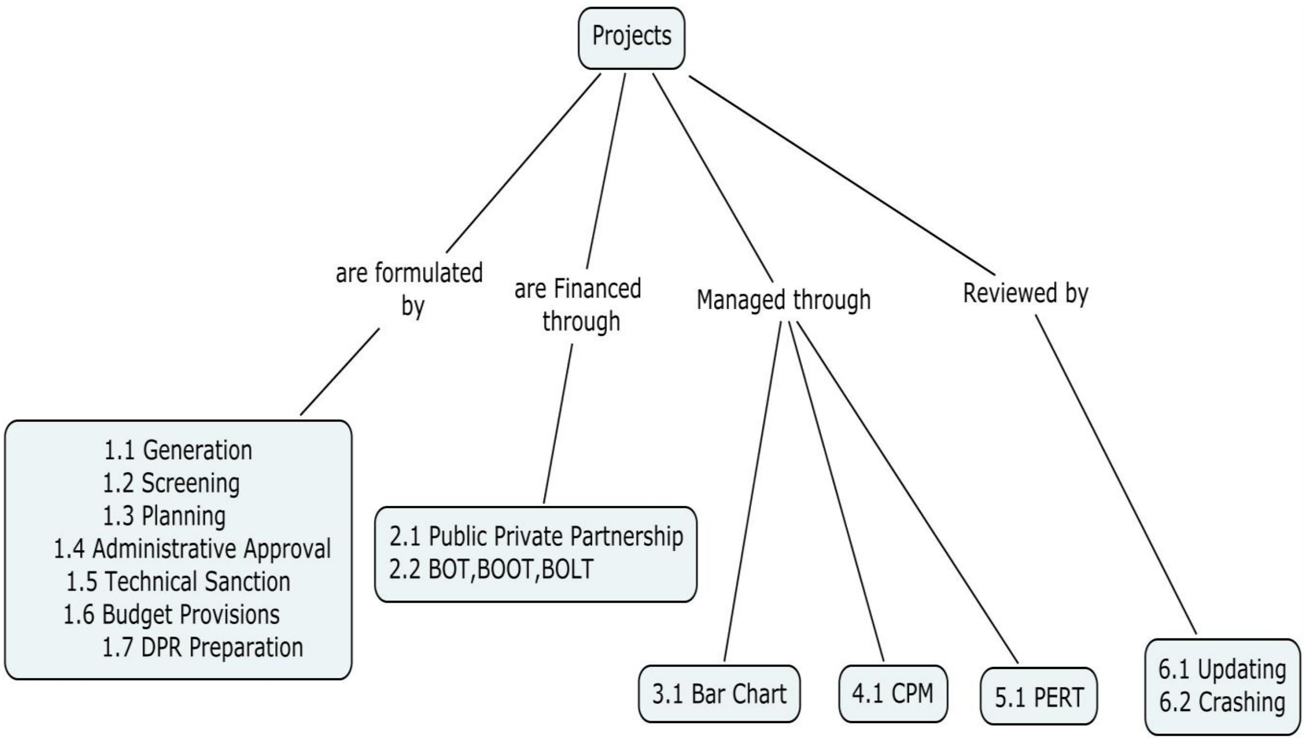
- A is completed as per schedule
- B is in progress and requires 2 more days for completion
- D is delayed by 7 days and it requires 8 more days for its completion
- E is in progress and the original time will hold good
- F is yet to start

Evaluate

1. A project consists of 7 activities with costs and times gives as shown in table. Crash the project and determine the optimum time and minimum cost relationship for the project. Assume the indirect cost to vary at Rs.500/- per day.

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
Normal time days	5	7	4	2	5	3	4
Crash time days	3	4	2	1	3	2	1
Normal cost Rs.	500	100	200	400	350	380	50
Crash cost Rs.	800	300	500	750	800	900	150

Concept Map



Course Content and Lecture Schedule

S. No.	Topics	Periods
Project Formulation		
1.1	Generation and screening of project ideas, project identification, preliminary analysis	1
1.2	Preliminary planning of schemes, investigation, preliminary estimate	2
1.3	Administrative approval, Technical sanction and Budget sanctions for projects, DPR preparation, TOR	2
Project Financing, Private Sector Participation		
2.1	Project Financing, means of finance, Private Sector participation	2

2.2	BOT, BOLT, BOOT, Technology transfer	2
Project Management		
3.1	Introduction to Project Management concepts, background of management, purpose, goal and objectives	1
3.2	Characteristics of projects and different functions of management	1
3.3	Traditional Management system, Gantt's Approach, Progress-chart – problems, merits and limitations of bar chart	2
3.4	Work study, work break down structure, time estimates, project programming, phasing of activities programmes	1
3.5	Scheduling project control, reviewing, updating and monitoring –concept	1
3.6	Problems in updating and monitoring of projects	1
Network techniques of Project Management		
4.1	Introduction to modern management concepts, uni-dimensional management techniques - introduction to network concepts, network elements and inter-relationships	2
4.2	Network techniques, network logic- inter-relationships activity information, data sheets and development of network- problems in drawing of network diagrams	2
4.3	PERT network, introduction to the theory of probability and statistics, probabilistic time estimate for the activities, analysis of PERT network	2
4.4	Problems in PERT analysis of projects	2
4.5	CPM for management, CPM network analysis, identification of critical path, floats, square network diagrams	2
4.6	Problems in CPM analysis of projects	2
4.7	GERT- Merits, comparison with PERT and CPM, Comparison of CPM and PERT	1
Network techniques of Project Management		
5.1	Resource balancing- Objective, resource smoothing and resource leveling techniques	1

5.2	Problems in resource smoothing	2
5.3	Problems in resource levelling	2
5.4	Introduction to two dimensional network analysis, activity cost information. Cost time relationship, crashed estimates for the activities, compression potential, cost slope utility data sheet, project direct and indirect costs	2
5.5	Crashed programme, network compression least cost solution, least time solution and optimum time solution	2
5.6	Problems in cost crashing	2

Syllabus

Project Formulation

Generation and screening of project ideas – project identification- preliminary analysis-planning of schemes, estimates – investigation –estimate -Administrative approval -Technical and budget sanctions, DPR, TOR.

Project Financing, Private Sector Participation

Project Financing- means of finance- Private Sector Participation – BOT, BOLT, BOOT-Technology transfer.

Project Management

Introduction to Project Management concepts- Background of management, purpose, goal and objectives, characteristics of projects and different functions of management.

Traditional Management system, Gantt's Approach, progress- Chart, Bar-Chart merits and limitations. Work study, work break down structure, time estimates.

Project programming, phasing of activities programmes, scheduling project control, reviewing, updating and monitoring.

Network techniques of Project Management

Introduction to modern management concepts, introduction to network concepts, network elements.

Network techniques, network logic- inter-relationships activity information, data sheets and development of network.

PERT network, introduction to the theory of probability and statistics, probabilistic time estimate for the activities, analysis of PERT network

CPM for management, CPM network analysis, identification of critical path, floats, square network diagrams. Generalized activity networks – GERT- Merits, comparison with PERT and CPM – updating a projects.

Balancing of resources and Crashing of cost in projects

Resource balancing- Objective, resource smoothing and resource leveling techniques.

Introduction to activity cost information. Cost time relationship, crashed estimates for the activities, compression potential, cost slope utility data sheet, project direct and indirect costs.

Crashed programme, network compression least cost solution, least time solution and optimum time solution.

Text Books:

1. Punmia B. C. and Khandelwal K.K., "Project Planning and Control with PERT/CPM", Laxmi publications, New Delhi, 1987.

Reference Books:

1. Jerome D. Wiest and Ferdinand K. Levy, (1982) "A Management Guide to PERT/CPM", Prentice Hall of India Publishers Ltd., New Delhi.
2. Srinath L.S., "PERT & CPM- Principles and Applications", Affiliated East West Press Pvt., Ltd., New Delhi
3. Sengupta. B and Guha. H, "Construction Management and Planning", Tata McGraw Hill, New Delhi, 1995
4. Sanga Reddi. S and Meiyappan. PL, "Construction Mangement", Kumaran Publications, Coimbatore, 1999

Course Designers

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SIXTH SEMESTER

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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Web: www.tce.edu

Department of Civil Engineering

Graduating Students of BE program of Civil Engineering will be able to

1. Survey, map and plan layouts for buildings, structures and alignments for canals and roads
2. Specify, design, supervise, test and evaluate foundations and superstructures for residences, public buildings, industries, irrigation structures, powerhouses, highways, railways, airways, docks and harbors.
3. Specify, design, supervise and evaluate water conveying systems.
4. Specify, select and formulate environmental engineering systems
5. Specify, design/select and operate hydraulic machines and surge systems
6. Analyze water resources hydrological systems to estimate safe and assured withdrawals.
7. Work in a team using common tools and environments to achieve project

   Objectives.

Thiagarajar College of Engineering, Madurai-625015

Department of Civil engineering

Scheduling of Courses

Semester	**Theory Courses**							**Practical / Project**	
8th (21)	Elective 6 3:0	Elective 7 3:0	Elective 8 3:0					B88 Project 0:12	
7th (22)	B71 Management Theory and Practice 3:0	B72 Construction Project Management 3:0	Elective 3 3:0	Elective 4 3:0	Elective 5 3:0		B77 GIS Laboratory 0:1	B78 Project 0:6	
6th (24)	B61 Accounting and Finance 3:0	B62 Transportation Engineering 1 4:0	B63 Geotechnical Engineering 2 4:0	B64 Structural Engineering 4.0	Elective 1 3:0	Elective 2 3:0	B67 Highways Lab 0:1	B68 Design and Drawing 0:1	B69 CAD 0:1
5th (24)	B51 Numerical Methods 4:0	B52 Wastewater Engineering 3:0	B53 Structural Analysis 2 4:0	B54 Design of Steel Structures 4:0	B55 Irrigation and Water Resources Engineering 3:0	B56 Geotechnical Engineering 1 4:0	B57 Geotechnical Engineering Lab 0:1	B58 Environmental Engineering Lab 0:1	
4th (24)	B41 Probability and Statistics 4.0	B42 Water Supply Engineering 3:0	B43 Structural Analysis 1 4:0	B44 Structural Design 1 4:0	B45 Hydraulics and Hydraulic Machinery 3:0	B46 Ecology 2:0	B47 Survey Lab II 0:1	B48 Fluid Mechanics Lab 0:1	B49 Professional Communication 1:1
3rd (22)	B31 Engineering Mathematics – 3 4:0	B32 Strength of Materials 2 3:0	B33 Surveying 4:0	B34 Fluid Mechanics 3:0	B35 Data Structures 3:0	B36 Concrete Technology 3:0	B37 Survey LabI 0:1	B38 Concrete Lab 0:1	
2nd (23)	B21 Engineering Mathematics -2 4:0	B22 Strength of Materials 1 3:0	B23 Engineering Geology 3:0	B24 Computers and Programming 3:0	B25 Materials Science 3:0	B26 Construction Materials & Technology 4:0	B27 Strength of Materials Lab 0:1	B28 Computer Programming Lab 0:1	B29 Workshop 0:1
1st (25)	H11 Engineering Mathematics – 1 4:0	H12 Physics 3:0	H13 Chemistry 3:0	H14 English 3:0	H15 Basics of ME and CE 4:0	H16 Basics of EEE 4:0	H17 Physics Lab 0:1	H18 Chemistry Lab 0:1	H19 Engineering Graphics 0:2

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SUBJECTS OF STUDY
(For the candidates admitted from 2008-2009 onwards)

FIFTH SEMESTER

Subject code	Name of the subject	Category	No. of Hours / Week L	T	P	credits
THEORY						
B 51	Numerical Methods	BS	4	-	-	4
B 52	Wastewater Engineering	DC	3	-	-	3
B 53	Structural Analysis - II	DC	4	-	-	4
B 54	Design of Steel Structures	DC	4	-	-	4
B 55	Irrigation and Water Resources Engineering	DC	3	-	-	3
B 56	Geotechnical Engineering - I	DC	4	-	-	4
PRACTICAL						
B 57	Geotechnical Engineering Lab	P	-	-	3	1
B 58	Environmental Engineering Laboratory	P	-	-	3	1
	Total		**22**	**-**	**6**	**24**

BS : Basic Science
HSS : Humanities and Social Science
ES : Engineering Science
DC : Department Core
L : Lecture
T : Tutorial
P : Practical

Note:

1 Hour Lecture/Tutorial is equivalent to 1 credit
2/3 Hours Practical is equivalent to 1 credit

THIAGARAJAR COLLEGE OF ENGINEERING: MADURAI – 625 015

B.E Degree (Civil Engineering) Program

SCHEME OF EXAMINATIONS
(For the candidates admitted from 2008-2009 onwards)

FIFTH SEMESTER

S.No.	Sub. code	Name of the subject	Duration of Terminal Exam. in Hrs.	Marks			Minimum Marks for Pass	
				Continuous Assessment *	Terminal Exam **	Max. Marks	Terminal Exam	Total
THEORY								
1	B 51	Numerical Methods	3	50	50	100	25	50
2	B 52	Wastewater Engineering	3	50	50	100	25	50
3	B 53	Structural Analysis II	3	50	50	100	25	50
4	B 54	Design of Steel Structures	3	50	50	100	25	50
5	B 55	Irrigation and Water Resources Engineering	3	50	50	100	25	50
6	B 56	Geotechnical Engineering - I	3	50	50	100	25	50
PRACTICAL								
7	B 57	Geotechnical Engineering Lab	3	50	50	100	25	50
8	B 58	Environmental Engineering Laboratory	3	50	50	100	25	50

* CA evaluation pattern will differ from subject to subject and for different tests. This will have to be declared in advance to students. The department will put a process in place to ensure that the actual test paper follow the declared pattern.

** Terminal Examination will be conducted for maximum marks of 100 and subsequently be reduced to 50 marks for the award of terminal examination marks.

Code	Lectures	Tutorial	Practical	Credit
B 51	4	0	-	4

B51 Numerical Methods **4:0**

(Common to D51, B51, G51)

Preamble: An engineering student needs to know some basic mathematical tools and techniques. This emphasizes the development of rigorous logical thinking and analytical skills of the student and appraises him the complete procedure for solving different kinds of problems that occur in engineering. Based on this, the course aims at giving adequate exposure in the numerical solutions in the field of polynomial and transcendental equations, simultaneous equations, interpolation, differentiation and integration, ordinary and partial differential equations.

Program Outcomes addressed

a. Graduate will demonstrate an ability to apply knowledge of Engineering and Information Technology in mathematics and Science.
b. Graduate will demonstrate an ability to identify, formulate and solve engineering problems.
c. Graduate will develop confidence for self education and ability to engage in life-long learning.

Competencies

At the end of the course the student should be able to

1. Differentiate between the analytical and numerical / approximate solutions for the problems in engineering and technology.
2. Apply the concept of solutions of algebraic and transcendental equations in engineering problems by formulating such equations.
3. Apply the different techniques for getting the solution of a system of simultaneous equations using direct and iterative methods.
4. Identify the importance of Eigen values for a matrix and calculate those using different techniques.
5. Interpolate and extrapolate the given data using different methods of interpolation with the help of various operators.
6. Apply the process of Numerical Integration to related problems of engineering and technology for getting approximate values of the given integral .
7. Formulate and Give Numerical solutions using various techniques for ODEs modeled in engineering and technology.

8. Formulate and Give Numerical solutions using various techniques for PDEs modeled in engineering and technology.

Assessment Pattern

	Bloom's category	Test 1	Test 2	Test 3 / End Semester Examination
1	Remember	10	10	0
2	Understand	30	30	30
3	Apply	60	60	70
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course level learning objectives

Understand

1. Compare the exact solution and approximate solution of equations
2. Discuss the various techniques for the approximate solution of Algebraic and transcendental equations.
3. List the various methods for obtaining the approximate solution of system of simultaneous equations stating the basic principles used.
4. Discuss the various methods to interpolate and extrapolate the given data using various methods of interpolation.
5. Interpret the importance and significance of the process of numerical integration.

Apply

1. Solve the following system of equations by Gauss Jacobi method
   $8x + y + z = 8$; $2x + 4y + z = 4$; $x + 3y + 3z = 5.$
2. Using Newton's method find the root of $x^3 - 4x^2 + x + 6 = 0$; $x_0 = 5$ correct to 4 decimal places
3. Using Lagrange's formula for interpolation find $y(9.5)$ given:

x	:	7	8	9	10
y	:	3	1	1	9

4. The following data gives the velocity of the particle for 2 seconds at an interval of 5 seconds. Find the acceleration at 5 seconds

Time	:	0	5	10	15	20
Velocity	:	0	3	14	69	228

5. Compute $\int_0^6 \frac{dx}{1+x}$, using Simpson's $\frac{1}{3} rd\ and\ \frac{3}{8} th$ rule.

6. Find the value of $y(0.2)\ and\ y(0.4)$ using Runge-Kutta method of fourth order with h=0.2 given that $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$; $y(0) = 1.$

7. Solve : $u_t = u_{xx}$ given $u(0,t) = 0$; $u(x,0) = x(1-x)$; $u(1,t) = 0$; assume h=0.1 and choose suitable k so that u(i,j) is found out for i=0,0.1…1 and j=k,2k,3k.

Course contents and lecture schedule

No	Topic	No. of Lectures
1	**Solution of transcendental and polynomial equations**	
1.1	Bisection , Regulafalsi , Newton- Raphson method	3
1.2	Iterative method	2
1.3	Horner's method	3
1.4	Graffe's root squaring method	2
2	**Solution to system of equations**	
2.1	Gauss elimination and Gauss Jordan methods	2
2.2	Crout's method	2
2.3	Gauss Jacobi and Gauss siedal methods.	2
2.4	Inversion by Gauss Jordan and Crout's methods.	2
2.5	Power method and Jacobi method for finding eigen values	2
3	**Interpolation, Differentiation and integration**	
3.1	Newton Gregory's forward and backward difference interpolation formulae	2
3.2	Gauss's and Lagrange's interpolation formulae	2
3.3	Newton's forward formulae for derivatives	2
3.4	Trapezoidal, Simpson's 1/3rd & 3/8th Rules	2
3.5	Gauss quadrature ,1 point , 2 point and 3 point formulae	2
4	**Ordinary Differential equations**	
4.1	Introduction – Initial value problems	2
4.2	Runge- Kutta Methods-second and fourth order	2
4.3	Predictor corrector methods-Milne and Adams	2
4.4	Boundary value problems Finite difference method.	2

4.5	Numerov's method	2
5	**Partial Differential equations**	
5.1	Introduction, Classification of PDEs.	2
5.2	Solution of parabolic equations-Implicit and explicitmethods, Bender Schmidt method, Crank Nicholson Method	3
5.3	Solution of hyperbolic equations by explicit scheme.	3
5.4	Solution of elliptic equations - Leibmann's process	2
	Total	**50**

Note: Students are required to submit one assignment in application oriented problems using MATLAB

Syllabus

Solution of Transcendental and Polynomial Equations: Bisection, Regula falsi, Newton-Raphson, Iterative Methods, Horner's Method, Giraeffes Root Squaring Method.

Solution to System of Equations: Gauss Elimination, Gauss Jordan, Crouts, Gauss Seidel, Gauss Jacobi, Inversion by Gauss Jordan and Crout's Method.

Eigen Values: Power method, Jacobi Method.

Interpolation and Differentiation: Newton's forward difference interpolation and differentiation formula and backward difference interpolation and differentiation formula, Gauss's Forward difference interpolation and differentiation formula and backward difference interpolation formula, Lagrange's Interpolation formula. Newton's formulae for derivatives.

Integration:

Trapezoidal, Simpson's $\frac{1}{3}$rd , $\frac{3}{8}$th rules, Gauss quadrature 1point, 2point, 3point formula

Ordinary Differential Equations:
Initial value Problem - Runge-Kutta Method, Predictor-Corrector Methods -Milne's, Adams - Boundary Value Problem - Finite difference Method- Numerov's method

Partial Differential Equations:
Classification: Parabolic (Schmidt)-Hyperbolic- Elliptic- Implicit and Explicit methods, Crank Nicholson method.

Text Book: Jain.M.K.,Iyengar.S.R.K.,JainR.K., "Numerical Methods for Scientific and Engineering Computation"-Fifth edition, New Age International Publishers, New Delhi-2009.

Reference Books:

1. Robert.J Schilling, Sandra L.Harris "Applied Numerical Methods for Engineers using Matlab and C" Thomson Books/cole,1999

2. Sastry S.S "Introductory Methods of Numerical Analysis" Prentice Hall of India -2006

Course Designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 52	3	0	0	3

B52-Wastewater Engineering 3:0

Preamble

This course offers the basic principles of operation of the processes that are normally used for wastewater treatment. It provides information on methods of collection of sewage, design of sewers, possible methods of treatment and its safe disposal without endangering the environment.

Program outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will identify, formulate, research literature and solve complex engineering problems, reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the end of the course, the student should be able to

1. Understand the characteristics of sewage.
2. Understand the different methods of safe disposal of sewage
3. Understand the design criteria for various treatment units.
4. Estimate the quantity of sewage generated from a community.
5. Estimate the storm runoff from a specified area.
6. Design the sewers for transportation of sewage and storm water.
7. Select an appropriate sewage treatment system for given situations
8. Design a sewage treatment system as per requirements.
9. Plan the drainage system and sanitary fittings used for a building.

Assessment Pattern

S.No	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	0
2	Understand	50	20	30
3	Apply	30	30	30
4	Analyze	0	10	10
5	Evaluate	0	0	10
6	Create	0	20	20

Course Level Learning Objectives

Remember

1. Define Dry weather flow
2. Define self cleaning velocity
3. What is Co-efficient of runoff?
4. Define BOD and COD
5. What is Population equivalent?
6. What are the objectives of sewage treatment?
7. What is an "Activated sludge"?
8. Define (F/M) ratio.
9. Define organic loading rate on a trickling filter.
10. Define Bacteria – Algae symbiosis.
11. What is self purification of streams?
12. Define sewage sickness.

Understand

1. What are the demerits of combined sewerage?
2. Why sewers are designed for partially flowing full conditions?
3. How could a newly laid sewer line be tested?
4. Why and when do sewage need pumping?
5. Why anaerobic decomposition of sewage is to be discouraged?
6. What are the uses of oxygen sag curve?
7. Explain, how eutrophication of lakes are caused?
8. What are the precautions to be taken while practicing sewage farming?
9. What is the need for recirculation of sludge in activated sludge process?
10. Explain the working principle of a high rate trickling filter with a help of a neat sketch.
11. Explain the process of self purification of streams indicating the different stages in it.
12. How do anti-siphonage pipes usage in plumbing system become so important?

Apply

1. A district consists of 20% of area with runoff coefficient 0.9,20% of area with runoff coefficient 0.85,5% of area with 0.80,15% of area with 0.40 runoff coefficient, 35% of area with runoff coefficient 0.10 and remaining area with runoff efficient 0.05; determine the co-efficient of runoff for the area. If the total area of the district is 36 hectares and the maximum rain intensity is taken as 5cm/hr; what is the total runoff for the district? If the density of population is 250 per hectare and the rate of water supply is 200lit/day/capita. Calculate the quantity of sewage for which the sewer of a separate system is to be designed.
2. A 30cm dia sewer having an invert slope of 1 in 150 was flowing full. What would be the velocity of flow and discharge. N=0.013. Is the velocity self cleansing? What would be the velocity and discharge when the same is flowing at 0.20 and 0.80 of the full depth.
3. The 7 days 20°C BOD of a sample of sewage is 300mg/L and its 3days 20°C BOD is 210mg/L. find out the value of de-oxygenation constant k and then estimate its 5 days 30°C BOD.
4. The sewage discharge of a city is 85m3/s in the river having a minimum discharge of 930 l/s with a velocity of 0.12m/s. the BOD at 20°C of the sewage is 325mg/L. the BOD of the river is zero. Determine the quantity and point of critical DO deficit.
5. Design a standard rate trickling filter for the following:
   Average incoming flow=350m3/hr
   BOD of primary effluent=210mg/L
   No of units=4
   Make suitable assumptions for any missing data.
6. Design a septic tank for the following data:
   No of people=100
   Sewage/capita/day=120L
   Desludging period=1yr
   L:B=4:1
7. A sedimentation tank treating 4.5 million liters of sewage per day containing 275mg/L of suspended solids. The tank removes 50% suspended solids. Calculate the quantity of sludge produced per day in volume basis & weight basis, if (i) moisture content is 98% (ii) moisture content is 96%

Analyze:

1. Why do sewers are designed for partially flowing conditions even at peak rate of flow?
2. How do "population equivalent" become an important tool in expressing the strength of the sewage?
3. Why do usage of septic tanks to be discouraged to the possible extend? When do its usage becomes mandatory?
4. Why do we go for anaerobic treatment of sewage? Analyze the performance of different anaerobic treatment system?
5. How do velocity of flow of sewage controls the hydraulic design of sewers?
6. How do various sewer appurtenances bring up efficient performances of sewer system?

Evaluate:

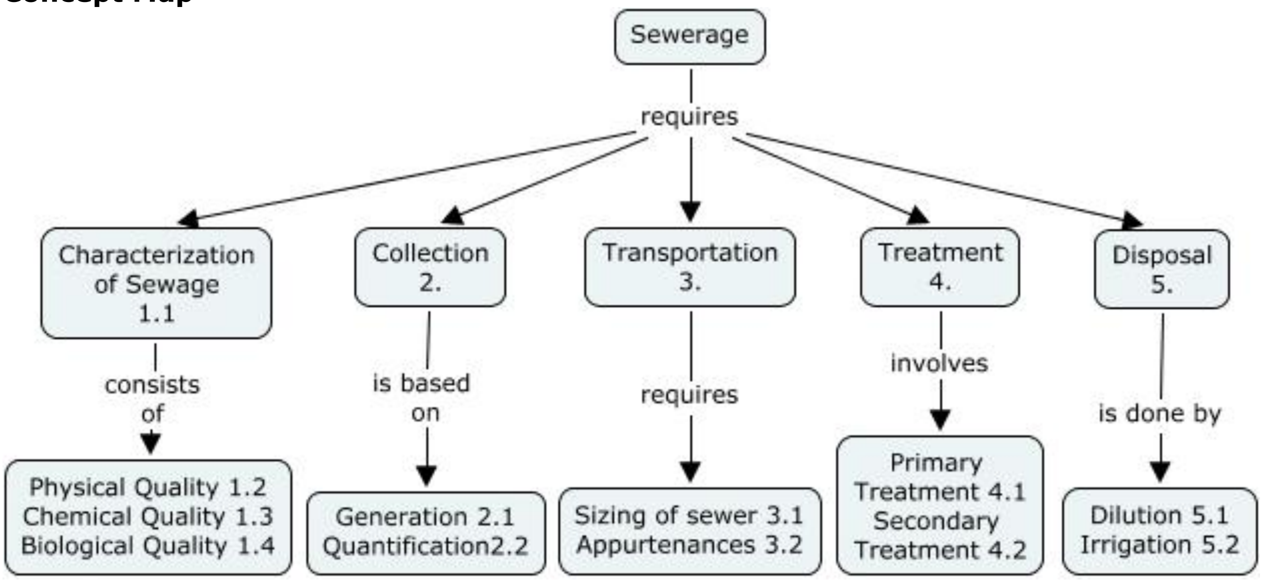
1. Compare separate system with combined system, bring out the merits and demerits of each system. How would you choose the system for a city?
2. What are the advantages of Trickling filter over activated sludge process?
3. Under What circumstances land treatment of sewage disposal is preferred over dilution method.
4. Compare the three types of plumbing system are in use in the field and come out with a logical conclusion.
5. Conservancy system of sanitation is to be eradicated – Justify the statement with your own evaluation.
6. Why do circular shaped sewers are used most commonly then other sections?

Create:

1. Design a grit chamber system for a town with a population of 1.0 Lakh. Assume necessary design parameters appropriately.
2. Design a septic tank unit for a housing colony with 100 persons. Also design the suitable effluent percolation unit.
3. A city with a population of 2.0 Lakhs is to be provided with a secondary treatment facility. Suggest a treatment system and make a complete design.
4. Suggest a suitable sewage collection system for a town with a population of 5.0 Lakhs. This town is very old with narrow lay- out of roads and streets.
5. Suggest a disposal system for a town where the water scarcity is very high.

6. With a help of a neat sketch, propose a wastewater collection system for a house with 2 bed rooms, 1 Hall, 1 sit-out, 1 kitchen etc.

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Characterization of sewage	
1.1	Characteristics and aerobic & Anaerobic decomposition of sewage	1
1.2	Physical quality of sewage & chemical quality of sewage	1
1.3	BOD and their testing & BOD equation	1
1.4	Problems in BOD and Population equivalent	2
	Sewage Collection	
2.1	Generation of sewage	1
2.1.1	Systems of sanitation	1
2.2	Quantification of sewage	1

2.2.1	Systems of sewerage	1
Transportation of sewage		
3.0	Sizing of sewer	1
3.1	Hydraulic design of sewers	1
3.1.1	Use of Nomo grams and Charts & Uses of soft wares	2
3.2	Sewer materials & Sewer appurtenances	1
3.2.1	Laying and testing of sewers	1
3.2.2	Maintenance of sewer	1
3.2.3	Pumping of sewage	1
Treatment of sewage		
4.1	Primary treatment- Screening & Grit chamber, Design of grit chamber	2
4.1.1	Skimming tanks & Primary sedimentation tanks	1
4.2	Secondary treatment of sewage - Introduction	1
4.2.1	Activated sludge process – Mechanism & Methods of aeration	1
4.2.1.1	Design considerations in ASP & Design	2
4.2.1.2	Modifications in ASP	1
4.2.2	Trickling filters- process Mechanism & types - Design considerations in trickling filter & Design	2
4.2.3	Oxidation Ponds and lagoons	1
4.2.4	Sludge digestion	1
4.2.4.1	Design of Digestion tanks	1
Disposal of Sewage		
5.1	Disposal by dilution – introduction	1
5.1.1	Self purification & oxygen sag curve	1
5.1.2	Streeter phelps equation – Problems	2
5.1.3	Disposal on lakes – eutrophication & sea disposal	1
5.2	Land Irrigation – sewage farming and sickness	1
5.3	Disposal of sewage in isolated buildings- Septic tanks	2

5.4	Plumbing systems	1
5.5	Sanitary practices in rural areas	1
		40

Syllabus

Characteristics of sewage, decomposition – aerobic and anaerobic decomposition- physical and chemical quality of sewage – BOD and their testing– BOD equation – problems – population equivalent.Systems of sanitation– Estimating quantity of sewage – dry weather flow – estimating storm run off by rational formula – Sewerage – separate, combined and partially separate system – hydraulic design of sewer, use of nomograms, charts and softwares.

Sewer materials - laying and testing of sewer sewer appurtenances, cleaning and ventilation of sewers- pumping of sewage. Primary & secondary treatment of sewage – activated sludge process – process mechanism, design parameters, design – modifications in ASP.

Trickling filters – process mechanism, types, design parameters and design.

Anaerobic systems – UASB and anaerobic filters. Other treatment systems – Ponds and Lagoons. Sludge digestion – characteristics- digestion tanks, design - disposal of digested sludge.

Disposal – disposal of treated sewage – disposal by dilution – disposal on river – self purification – oxygen sag curve – streeter phelps equation – disposal on lakes – Eutrophication – sea disposal, land irrigation – sewage farming, sewage sickness.

Disposal of sewage in isolated buildings, plumbing system – types; Sanitary practices in rural areas.

Text Book

1. Garg S.K.: "Sewage Disposal and Air Pollution Engineering", Khanna Publishers New Delhi 2001.

Reference Books

1. Bridie G.S Birdie J.S, "Water Supply and Sanitary Engineering", Dhanpatrai Publications, New Delhi, 1998.
2. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", McGraw Hill Publishers, New Delhi, 1998.
3. Hussian S.K Water Supply and sanitary Engineering", oxford and IBH publishers publishing co. Pvt Ltd.,New Delhi, 1985.

4. Punmia B.C, Ashok Jain, "Wastewater Engineering", Laxmi publications, New Delhi, 1998.
5. Mark J.Hammer, Mark J.Hammer,Jr, "Water and Wastewater Technology",Prentice Hall of India Pvt.Ltd.,New Delhi,2002.
6. Duggal K.N, "Elements of environmental Engineering", S.Chand & Company Ltd, New Delhi, 2000.
7. Manual on sewerage and sewage treatment, CPHEEO, ministry of urban affairs & employment, Govt.of India, New Delhi,2001

Course designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 53	4	0	0	4

B53 Structural Analysis - II 4:0

Preamble

This course offers the analysis for indeterminate beams and portal frames upto three degrees of freedom. it aims at determination of end moment and Bending moment diagrams for the beam and frames.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Determine the moment in indeterminate beams and frames having EI variations and initial yield using slope deflection method
2. Determine the induced forces in indeterminate beams and frames having EI variations and sway using moment distribution method
3. Construct bending moment diagram for continuous beams using Clapeyron's theorem
4. Draw Influence Line Diagram (ILD) for indeterminate beams by Muller breslau's principle
5. Calculate internal forces in indeterminate beams, frames and trusses by energy approach.
6. Verify the adequacy of given designs of indeterminate beams

Assessment Pattern

Bloom's Category	Test 1	Test 2	Test 3 / End Semester Examination
Remember	10	10	10
Understand	10	10	10
Apply	80	80	80
Analyze	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course level learning objectives

Remember

1. State Muller Breslau's principle
2. When a structure is considered internally indeterminate?
3. State Castigliano's II theorem
4. Define degree of redundancy
5. What is meant by distribution factor?
6. Define Stiffness

Understand

1. Draw a ILD for a reaction of a propped cantilever
2. Compare Castigliano's I and II theorem
3. Explain internally and externally indeterminate structures
4. How the concept of strain energy is used to analyze a frame?
5. Compare the behavior of rigid and yielding support with example for each
6. Draw the elastic curve for a two span continuous beam of equal length subjected to UDL throughout
7. Draw the elastic curve for a portal frame when subjected to horizontal point load at the beam level.

Apply

1. Determine the influence line for the bending moment at D, the midpoint of span AB of a continuous beam shown in Fig-1. Compute the ordinates at 1m intervals.

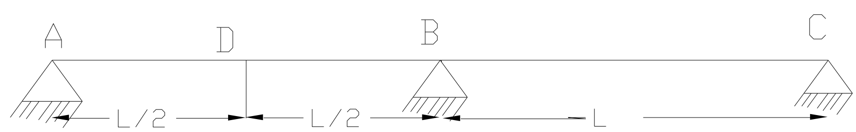


Figure-1

2. For a continuous beam shown in Fig-2., draw the influence lines for the reaction at A, B and C. Indicate the values at every quarter of each span.

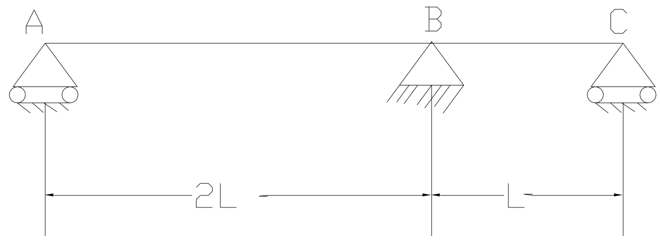


Figure-2

3. Using Castigliano's Theorem of minimum energy, analyze the frame shown in Fig-3. EI is constant for the whole frame.

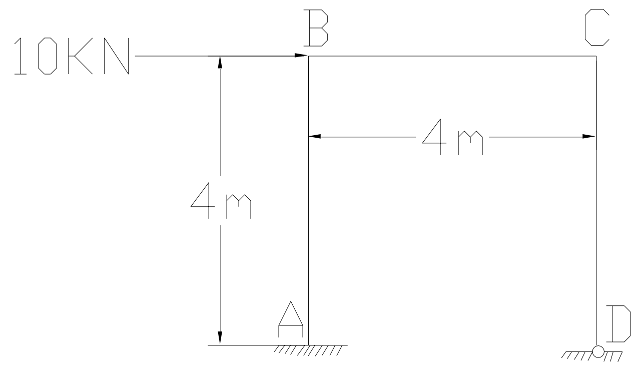


Figure-3

4. Fig-4. shows a two span portal frame with the columns fixed at the ends A, E & F and carries UDL of w kN/m along BD. The stiffness ratios of the members are shown in the diagram and all the members are of equal length. Determine the bending moment throughout the frame and sketch the bending moment diagram using Moment Distribution Method.

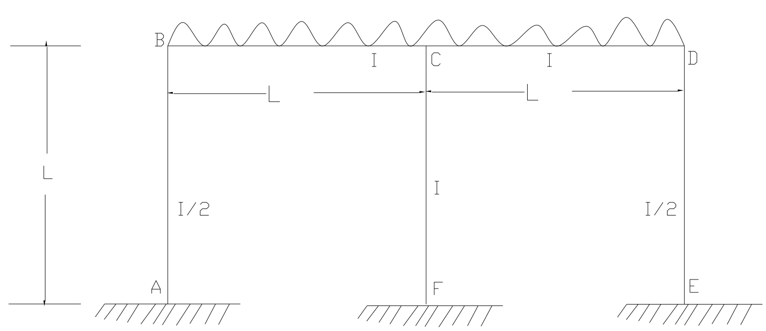


Figure-4

5. A continuous beam ABCD is fixed at ends A and D, and is loaded as shown in Fig-5. Span AB, BC and CD is having moment of inertia of I, 1.5I and I respectively and are of the same material. Determine the moments at the supports and plot the bending moment diagram using Moment Distribution Method.

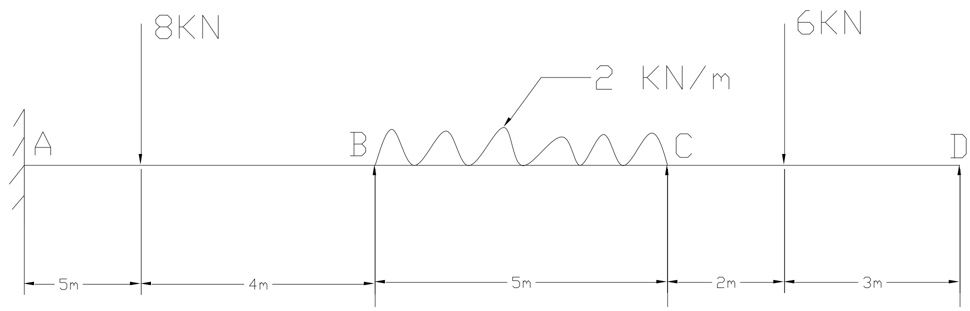


Figure-5

6. Draw the bending moment diagram and sketch the deflected shape of the frame shown in Fig-6. All the members are of the same material.

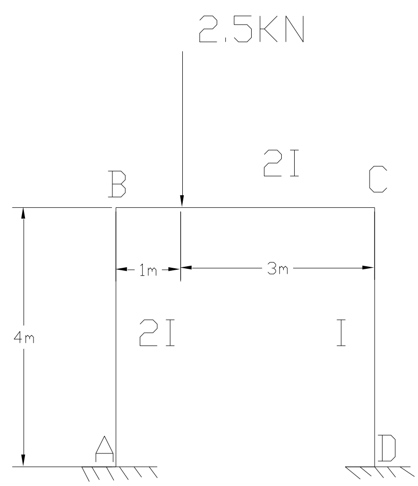


Figure-6

7. A fixed beam AB of span L carries a UDL of w / unit length and is propped at a distance L/3 from A. If the deflection of the beam at this point is kR where R is the load on the prop, determine the magnitude of R.
8. A beam ABCD, 16 m long is continuous over three spans; AB = 6m, BC = 5m & CD= 5m. The support B sinks by 0.5 cm. There is a UDL of 20kN/m over BC. On AB there is a point load of 80 kN at 2m from A and CD there is a point load of 60kN at 3m from D. Take I = 9300 cm^4 and E = 2.1 x 10^5 N/mm^2. Calculate the moments and reactions at the support.

9. Fig-7. shows a two span portal frame with the columns fixed at the ends A, E & F and carries UDL of 5kN/m along BD. The stiffness ratios of the members are shown in the diagram and all the members are of equal length of 6m. Determine the bending moment throughout the frame and sketch the bending moment diagram using Kani's Method

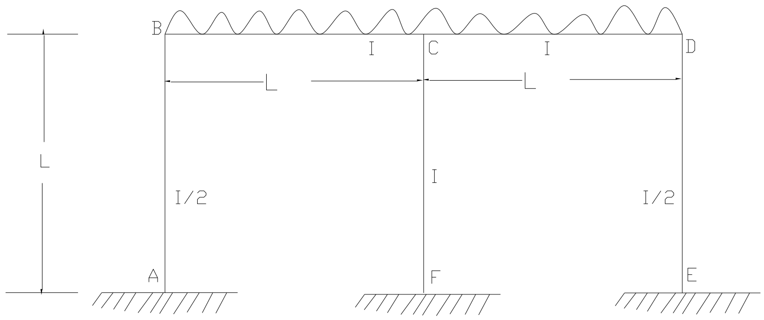
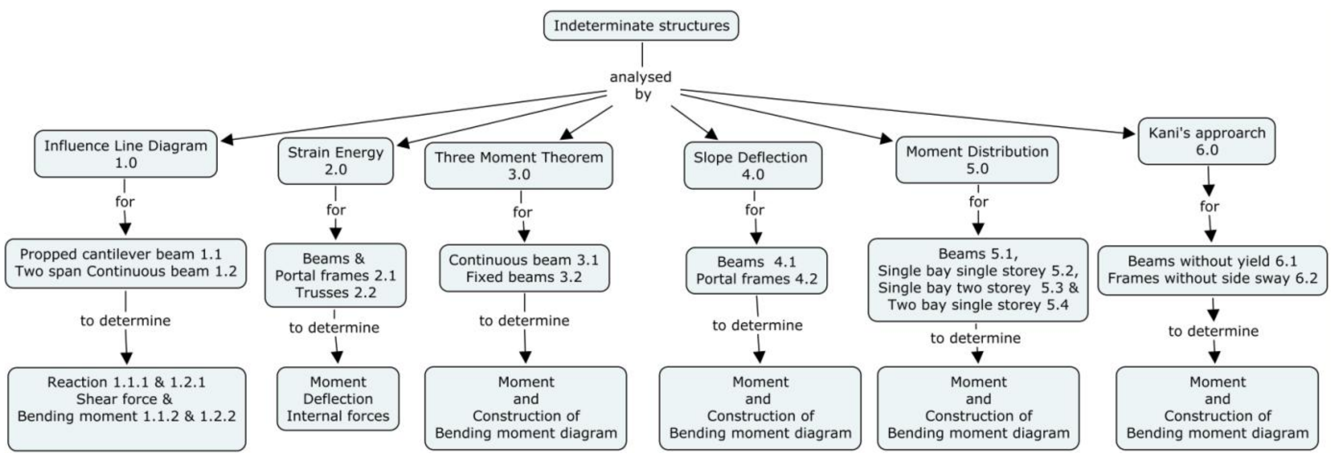


Figure-7

Concept Map



Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	ILD for forces in indeterminate beams	
1.0	Introduction to ILD for forces in indeterminate beams	1
1.1	Muller Breslau's principle - Types of indeterminate beams – propped cantilever,	1

1.2	Muller Breslau's principle - Types of indeterminate beams – Two span continuous beams	1
1.1.1	ILD for reaction for propped cantilever beams	1
1.1.2	ILD for shear force& bending moment for propped cantilever beams	1
1.2.1	ILD for reactions of two span continuous beams	1
1.2.2	ILD for shear force& bending moment for two span continuous beams	2
	Energy methods for beams and trusses	
2.0	Introduction to strain energy methods	1
2.1	Analysis of indeterminate beams and frames by Strain Energy methods	3
2.2	Analysis of indeterminate trusses by Strain Energy methods	3
2.2.1	Degree of redundancy(internal &external redundancy)	1
2.2.2	Analysis of externally indeterminate trusses by Strain Energy methods	2
2.2.3	Analysis of trusses due to Lack of fit	1
2.2.4	Analysis of trusses due to change in temperature	1
	Three Moment Equation Method	
3.0	Introduction to Clapeyron's theorem of three moment	1
3.1	analysis of continuous beam with or without support yield	3
3.1.1	analysis of continuous beam with or without EI variation	2
3.2	analysis of fixed beams	2
	Slope Deflection Method	
4.0	Derivation of slope deflection method	1
4.1	Analysis of continuous beams without support yielding	2

4.1.1	Analysis of continuous beams with support yielding	2
4.2	Analysis of portal frames(single storey and single bay only)	2
	Moment Distribution Method	
5.0	Definition of stiffness, carryover factor, distribution factor	1
5.1	Analysis of continuos beams without support yielding	2
5.1.1	Analysis of continuos beams with support yielding	1
5.2	Analysis of portal frames(single storey and single bay only)	2
5.3	Analysis of portal frames(single storey and two bay only)	3
5.4	Analysis of portal frames(two storey and single bay only)	3
	Kani' s Method	
6.0	Concept of Kani's method, Stiffness, and distribution factor	1
6.1	Relationship between bending moment, deformation and displacement	1
6.2	Analysis of continuous beams without support yield	1
6.3	Analysis of portal frames without side sway	1
	Total	50

Syllabus

ILD for forces in indeterminate beams - Muller Breslau's principle - ILD for reaction - ILD for shear force& bending moment for propped cantilever beams - ILD for reactions of two span continuous beams - ILD for shear force& bending moment for two span continuous beams

Energy methods for beams and trusses - Introduction to strain energy methods - Analysis of indeterminate beams by Strain Energy methods - Degree of redundancy(internal &external redundancy) - Analysis of externally indeterminate trusses by Strain Energy methods - Analysis of trusses due to change in temperature - Analysis of trusses due to Lack of fit - Analysis of indeterminate trusses by Strain Energy methods

Three Moment Equation Method - analysis of continuous beam with or without support yield - analysis of continuous beam with or without EI variation - analysis of fixed beams - Introduction to Clapeyron's theorem of three moment

Slope Deflection Method - Derivation of slope deflection method - Analysis of continuous beams with or without support yielding - Analysis of portal frames(single storey and single bay only)

Moment Distribution Method - Definition of stiffness, carryover factor, distribution factor - Analysis of continuos beams without support yielding - Analysis of continuos beams with support yielding - Analysis of portal frames(single storey and single bay only) - Analysis of portal frames(two storey and single bay only) - Analysis of portal frames(single storey and two bay only)

Kani's Method – Concept – Relationship between bending moment, deformation and displacement – analysis of beams without yield and frames without side sway.

Text Books:

1. Punmia B.C.,Ashok Kumar Jain Arun Kumar Jain,"Strength of materials and theory of structures, vol I &II",Laxmi Publications, New Delhi, 2005
2. Junarkar.S.B. Shah.H.J. " Mechanics of structures" ,vol II, Charotar publishing house,Anand, 2000

Reference Books:

1. Wang., C.K.,"Indeterminate Structures" McGraw Hill Book Co., Newyork,1994
2. Reddy,C.S.,"Basic Structural Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi.2001
3. Sterling Kinney.J., "Indeterminate Structural Analysis", Addition-Wesley Publishing Company, Sydney. 1992
4. Thandavamoorthy, "Analysis of Structures", Oxford &IBH Publishers, New Delhi.2008
5. Jindal, R.L, 'Indeterminate Structures, S.Chand and Company Ltd., New Delhi - 2000

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Sub Code	Lectures	Tutorial	Practical	Credit
B 54	4	0	0	4

B54 Design of Steel Structures **4:0**

Preamble

This course offers the design of steel structures as per limit state method. This course follows the recommendation of IS: 800 – 2007. It aims at determination of safe as well as economical steel section for various industrial and framed structures

Program outcomes addressed

- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Determine the maximum load effects and fatigue effects on a gantry girder and also section properties
2. Design a Plate girder using the IS800-2007 Provisions
3. Determine the nominal strength of the beam column
4. Design a roof truss using rolled steel sections
5. Design a light loaded roof truss using tubular sections.
6. Design simple beam-to-column, and beam-to-beam connections
7. Design column splices

Assessment Pattern

	Bloom's Category	**Test 1**	**Test 2**	**Test 3 / End Semester Examination**
1	Remember	10	10	10
2	Understand	20	10	10
3	Apply	50	40	30
4	Analyse	-	-	-
5	Evaluate	-	-	-
6	Create	20	40	50

Course level learning objectives

Remember

1. What is the difference between plate girder and beam?
2. Where are plate girders used?
3. State the minimum web thickness provisions of a IS 800-2007.
4. State some advantages and disadvantages of plate girders over trusses.
5. What are the main functions of a longitudinal stiffener?
6. What is the range of the minimum thickness of the web that is usually adopted in practice?
7. List few types of cranes.
8. List the loads that should be consider while designing a gantry girder.
9. List the various steps involved in the design of gantry girder.
10. What is the advantage of using a second order analysis method over first order elastic method in the interaction equations?
11. Define efficiency of joint?

Understand

1. How are bending moments introduced in columns?
2. How can load deflection effects be considered in the design of beam columns?
3. write short notes on
    a. Bolted moment end plate connection
    b. Flange angle connection
    c. Split beam T connection
    d. Beam to beam connection
    e. Beam splices
    f. Column splices.
4. Why are simply supported girders preferred to two span gantry girders?
5. Write short notes on rigid, simple and semi-rigid joints.
6. What are the advantages of butt joints over lap joints?

Apply

1. Determine the buckling resistance moment for a welded plate girder consisting of 500 x 25 mm flange plates and a 1250 x 12 mm web plate in grade 410 steel. Assume a laterally unbraced span of 5.5 m.
2. Determine the moments and forces due to the vertical and horizontal loads acting on a simply supported gantry girder given the following data:

i. Simply supported span = 6 m
ii. Crane's wheel centres = 3.6 m
iii. Self weight of the girder (say) = 1.5 KN/m
iv. Maximum crane wheel load (static) = 220 KN
v. Weight of crab/ trolley = 60 KN
vi. Maximum hook load = 200 KN
vii. Calculate also the serviceability deflection (working load)

3. A 20 m long plate girder has to support a u.d.l and concentrated loads at one third points. The uniform load consists of 18KN/m dead load and 30KN/m live load. Each concentrated load consists of a 125 KN dead load and 225KN live load. There is lateral support at the ends and at the points of concentrated load. Using grade 410 steel determine the following:

i. mid section.
ii. the location and size of intermediate stiffeners.
iii. suitable bearing stiffeners at the supports and beneath loading points.
iv. welds for all the elements.

Create

1. Design a welded plate girder for a simply supported bridge deck beam with clear span of 20 m subjected to the following:

i. Dead load including self weight = 20 KN/m
ii. Imposed load = 10 KN/m
iii. Two moving loads = 150 KN each spaced 2 m apart

Assume that the top compression flange of the plate girder is restrained laterally and prevented from rotating. Use mild steel with fy=250 MPa. Design as an unstiffened plate girder with thick webs and also redesign same with intermediate stiffeners
utilizing tension field action.

2. Design a gantry girder without lateral restraint along its span, to be used in an Industrial building carrying over head traveling crane for the following data:

i. Centre to centre distance between columns = 6 m (span of the gantry girder)
ii. Crane capacity = 50 KN
iii. Self weight of the crane girder excluding trolley = 40 KN

iv. Self weight of the trolley, electric motor, hook etc., = 10 KN
v. Minimum hook approach = 1 m
vi. Wheel centres = 3 m
vii. Centre to centre distance between gantry rails = 12 m (span of crane)
viii. Self weight of rail section = 100N/m
ix. Yield stress of steel = 250 MPa.

3. Design a roof truss, rafter bracing, purlin, tie runner, side-runner and eave girder for an industrial building located at Guwahati with a span of 20m and a length of 50m. The roofing is galvanized iron sheeting. Basic wind speed is 50m/s and the terrain is an open industrial area. Building is class B building with a clear height of 8m at the eaves.
4. A beam column of length 5 m is subjected to a compression of 800 KN and a major axis moment of 4.5 KNM. The weaker plane of the column is strengthened by bracing. If the effective length factor is 0.8, design the beam column, assuming Fe 410 grade steel.
5. An industrial building is shown in fig. the frames are at 5m centres and the length of the building is 40m. The purlin spacing of the roof is as shown in figure-1. The Building is situated in Delhi. Assume live and wind loads as per IS875 (part 2 and Part 3) and the roof is covered with GI sheeting. Design the roof truss using angle members and gusseted joints. The truss is to be fabricated using welded joints in two parts for transport and assembled at site using bolted joints at A,B and C as shown in figure-1(b).

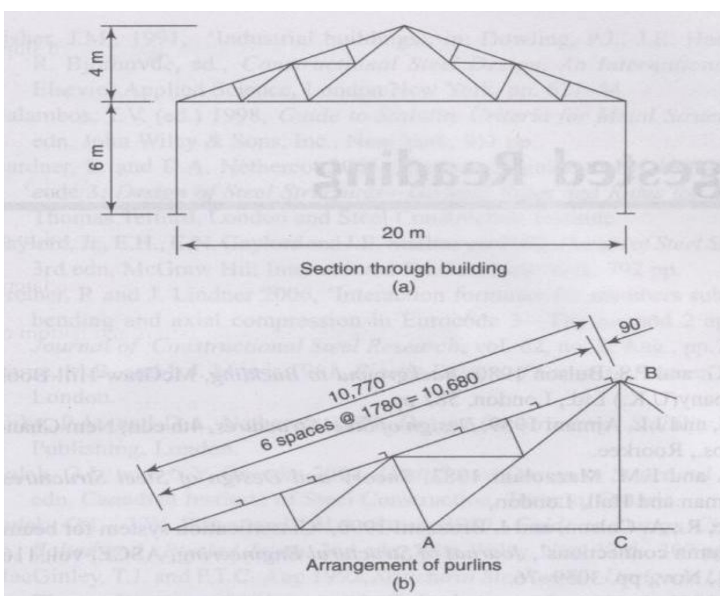


Figure-1

6. Design the members of the truss of the previous problem using tubular members.
7. Design a seat-angle connection between a beam MB300 and column SE200 for a reaction of beam 100kN using M20 bolts of property class 4.6. Take Fe410 grade steel (fy =250MPa). Refer fig.

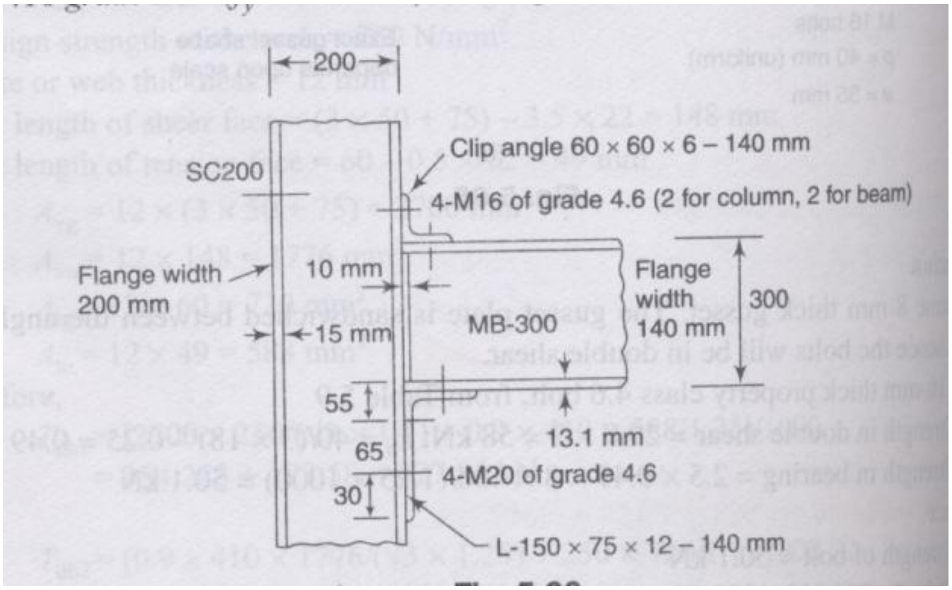
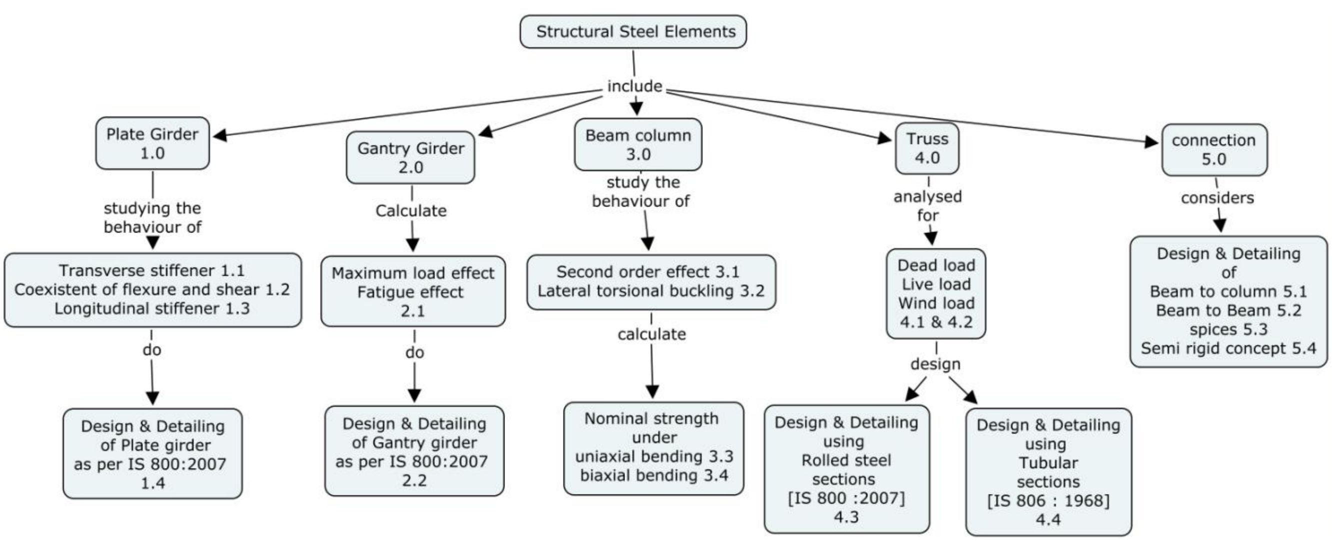


Figure-2

Concept Map



Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	Plate girder (according to IS 800 :2007 provision)	
1.0	Introduction and distribution of stress in plate girder	1
1.1	Shear resistance of transversely stiffened plate girder	1
1.2	Shear resistance of web, web subjected to co-existent bending and shear	1
1.2.1	Ultimate behavior of transverse web stiffener	2
1.3	Behavior of longitudinally stiffened girders	1
1.4	Design of mid section of plate girder	2
1.4.1	Design of transverse web stiffener of plate girder	2
1.4.2	Design of longitudinal web stiffener of plate girder	1
1.4.3	Connection of stiffeners to web of plate girder	1
	Gantry girder(according to IS 800 :2007 provision)	
2.0	Introduction and load considerations	1
2.1	Maximum load effects and Fatigue effects	1
2.1.1	Determination of maximum bending moment and shear force due vertical component of crane wheel load	2
2.1.2	Determination of maximum bending moment and shear force due horizontal component of crane wheel load and longitudinal effect of wheel load	1
2.2	Design of gantry girder	2
2.2.1	Connection in gantry girder	1
	Beam – Column(according to IS 800 :2007 provision)	
3.0	Introduction to the behaviour of Beam-column	1
3.1	second order moment in beam-column	1
3.2	Elastic torsional buckling of beam columns	2
3.3	Nominal strength in beam column in uniaxial bending	2
3.4	Nominal strength in beam column in biaxial bending	2
	Design of Truss	
4	Introduciton and evaluation of design dead load, live load	1

4.1	Evaluation of wind load	1
4.2	Analysis of trusses	2
	Design of Truss using Rolled steel sections	
4.3	Design of Truss using Rolled steel sections	2
4.3.1	Design of purlins and Design of members	2
4.3.2	Design of supports	1
	Design of Truss using tubular sections	
4.4	Design of Truss using tubular sections	2
4.4.1	Design of purlins and Design of members	2
4.4.2	Design of supports	1
	Design of Connection	
5.0	Introduction to connection behaviour	1
5.1	web angle connection	1
5.1.1	clip and seat Connection	1
5.1.2	End plate Connection	1
5.2	Beam to Beam Connection	1
5.3	Beam Splices	1
5.3.1	Column Splices	1
5.4	Concept of semi rigid Connection	1
	Total	50

Syllabus

Plate girder- Introduction - Distribution of stress in plate girder - Shear resistance of transversely stiffened plate girder; Shear resistance of web, web subjected to co-existant bending and shear - ultimate behavior of transverse web stiffener - behavior of longitudinally stiffened girders - Design of plate girder using IS800-2007 provisions – problems.

Gantry girder - Introduction - load considerations - max load effects - Fatigue effects - Design of gantry girder using IS800-2007 provision - problems.

Beam – Column - Introduction - behavior of beam-column - second order moment in beam-column – Elastic torsional buckling of beam columns - Nominal strength in beam column in uniaxial bending - Biaxial bending.

Design of Truss - Evaluation of design dead load, live load and wind load. Analysis of trusses. Design of Truss using Rolled steel sections – Purlins – truss members – Supports. Design of Truss using tubular sections – Purlins – truss members – supports.

Design of Connection - Introduction – web angle connection – clip and seat Connection – End plate Connection – Beam to Beam Connection – Beam Splices – Column Splices – Concept of semi rigid Connection.

Text Book:

1. Teaching Resource for Structural Steel Design Volume – I to III – INSDAG, Kolkata (2000)
2. Design of Steel Structures, N.Subramanian, Oxford University press,(2008)

Codes:

1. IS 800-2007 – Code of practice for general Construction in steel
2. SP6 (1) – Hand book for Structural Engineers – Part I :Structural Steel Sections, BIS
3. IS 875 (1-5) - 1987 Code of practice for Design Loads (Other than Earthquake) for Buildings and Structures, BIS
4. IS 816 :1969 - Code of practice for Metal Arc Welding for general Construction in Mild Steel, BIS
5. IS 1161 :1998 – Steel tubes for structural purposes – specifications, BIS.
6. IS 806 : 1968 – Code of practice for use of steel tubes in general building construction, BIS

Web site

www.steel-insdag.org

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Sub Code	Lectures	Tutorial	Practical	Credit
B 55	3	0	0	3

B55 Irrigation and Water Resources Engineering 3:0

Preamble

This subject helps in knowing about irrigation practices, and methods adopted in our country. Also to know the irrigation water requirements in order to design the structures like dams, weirs and canals. This subjects also deals with the study of planning of water resources projects.

Program outcomes addressed

- An ability to apply knowledge of engineering, information technology, mathematics and science.
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
- Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
- Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
- Graduate who can participate and succeed in competitive examinations

Competencies

At the end of the course the student should be able to

1. Explain quantitatively the hydrological cycle
2. Explain how water resources are distributed in India and particularly in Tamilnadu
3. Explain how water resources can be managed.
4. Understand the irrigation practices and methods in India.
5. Explain the components of irrigation systems.
6. Determine the storage capacity of reservoirs
7. Determine the forces acting on dams
8. Explain the failures of dams and remedies
9. Determine the dimensions of the weirs based on Bligh's, Lanes and Khosla's theory
10. Estimate the dimensions of canals using Lacey's and Kennedy's theory

Assessment Pattern:

	Bloom's Category	Test 1	Test 2	Test 3/End-semester examination
1	Remember	30	30	10
2	Understand	50	50	50
3	Apply	20	20	40
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course level learning objectives:

Remember

1. Why irrigation is essential in our country?
2. Distinguish temporary and permanent wilting point.
3. List out the equipments used for lift irrigation.
4. What are the objectives of river training works?
5. What is meant by cross drainage works?
6. What is the objective of studying the irrigation efficiency?
7. What are the assumptions made in Bligh's theory?
8. Differentiate silt excluder and silt ejector.
9. What are the advantages of canal lining?

Understand

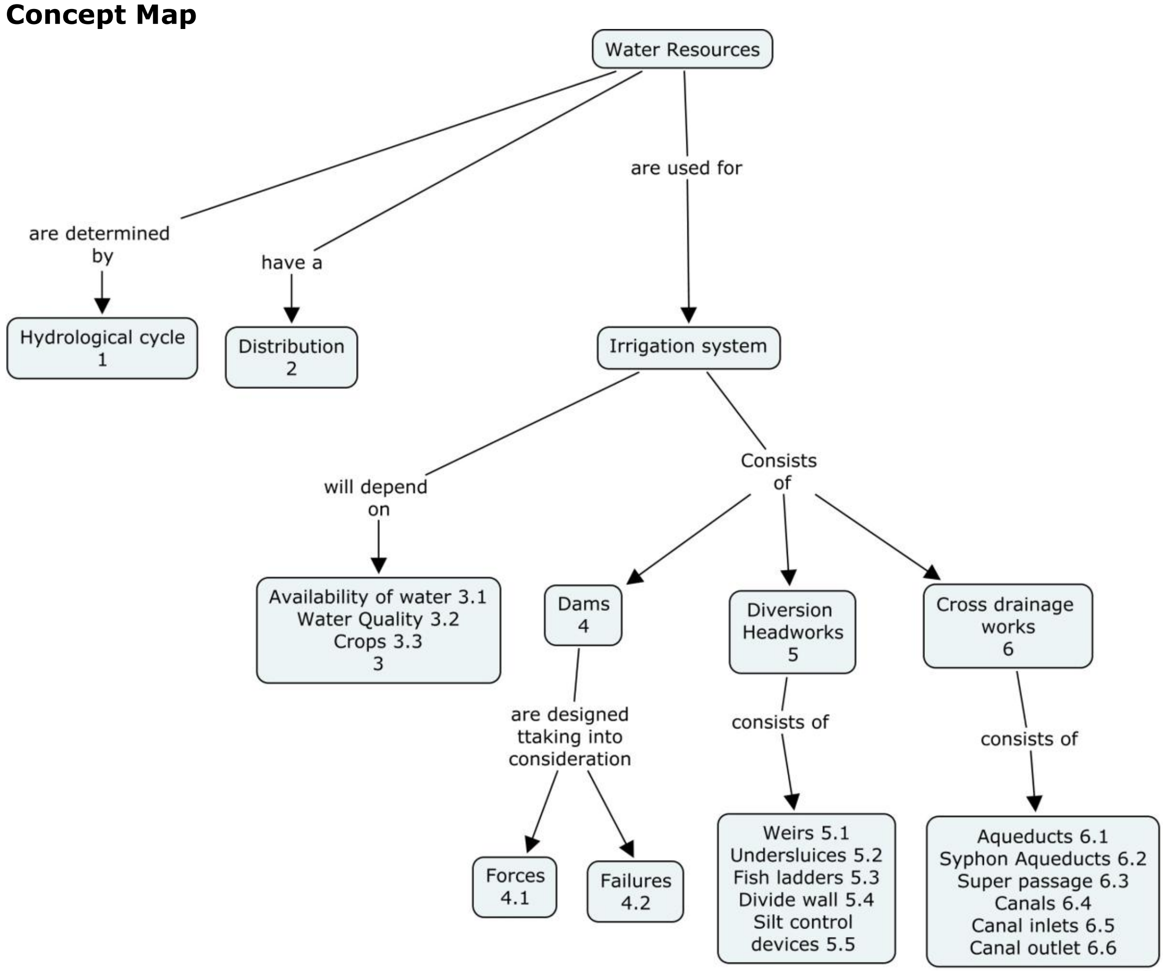
1. How the irrigation water is classified based on salt concentration?
2. What are the benefits and ill effects of irrigation?
3. How will you select a site for reservoirs?
4. Explain the storage zones of reservoir with neat sketch.
5. How will you control the sedimentation in reservoirs?
6. Compare Blligh's theory and Lanes weighted creep theory.
7. How the canals are classified?
8. Differentiate aqueduct and siphon aqueduct
9. Discuss briefly the causes of failures of weirs and their remedies

Application

1. Discuss the benefits of water resources developments projects in our country.
2. What are the objectives of irrigation water management? Discuss the components of water management in detail.

3. Interlinking of Indian rivers – Discuss critically the merits and demerits of such project.
4. How will you fix the storage capacity of a reservoir for fulfilling the given demand?
5. How a canal is designed based on Kennedy's theory?
6. What are the forces acting on gravity dam? Explain in detail how these forces are calculated in gravity dam.
7. Design an irrigation channel for a discharge of 40 cumecs, Lacey's silt factor = 1.0, side slope = ½:1. Determine also the bed slope.
8. What do you understand by elementary profile of a gravity dam? Derive safe base width for such dams.
9. What is the role of formers and government agencies in developing the water resources projects in our country?

Concept Map



Course contents and Lecture schedule:

S. No	Topics	No. of Periods
1. Importance of Water resources		
1.1	Hydrological cycle and its importance	1
1.2	Status of water resources in India and Tamilnadu	1
1.3	National water policy, Requirements of water for various use	2
1.4	Need for water conservation, water harvesting technique	2
1.5	Economy in water resources project – cost-benefit ratio	1
1.6	Planning of water resources projects	1
2. Water Resources Planning		
2.1	Surface and Groundwater Resources- Rivers, lakes and tanks- Estimation of Groundwater.	1
2.2	Site selection for reservoir, classification of reservoirs	1
2.3	Determination of Storage capacity	1
2.4	Reservoir sedimentation, methods of controlling the sedimentation	2
2.5	Reservoir losses	1
3. Irrigation		
3.1	Need for irrigation	1
3.2	Crop water Requirement	1
3.3	Types of irrigation and methods of irrigation	2
3.4	Irrigation efficiencies, Concept of Adequacy, Irrigation water quality	2
4. Dams		
4.1	Dam and their classifications	2
4.2	Forces acting – failures and remedies	2
4.3	Design of gravity dam	2
4.4	Elementary profile of gravity dam	2
4.5	Drainage galleries in dams	1
5. Diversion Head works		
5.1	Types of weirs, failures and Remedies	1
5.2	Bligh's theory, Lanes weighted creep theory, Khosla's theory	2
5.3	Divide wall, Fish ladder, Under sluices, Head regulator	2

5.4	Silt control at head works	2
5.5	Silt excluder and silt ejector	1
5.6	River training works - types of works	1
6. Cross drainage works		
6.1	Functions of Aqueduct, Syphon aqueduct, Level crossing, inlet and outlet, Canal outlets	2
6.2	Design of canal by Lacey's theory, Kennedy's theory	2
6.3	Canal regulators - Water logging,	2
6.4	Canal lining and Canal maintenance	1

Syllabus

Water resources: Importance and necessity of water resources – Status of water resources in India and Tamilnadu – National water policy – requirement of water for various use – need for water conservation – water harvesting technique – economy in water resources project – cost-benefit ratio – planning water resources projects.

Water Resources Planning: Surface and Groundwater Resources- Rivers, lakes and tanks- Estimation of Groundwater -Reservoir types – fixing storage capacity of reservoirs – reservoir sedimentation – reservoir losses.

Irrigation: Need for irrigation – Crop water Requirement - methods of irrigation – irrigation efficiencies – concept of Adequacy - irrigation water quality.

Dams: Types of dams – forces on gravity dam – modes of failure – elementary profile of gravity dam – design of gravity dam – galleries in dams.

Diversion headwork: Weirs – types – failures – design of weirs by creep theory and potential theory – undersluices – fish ladder – divide wall – silt control measures and devices at diversion headworks – river training works.

Cross drainage works: types and objectives – design of canals - Kennedy's theory – Lacey's theory – canal lining – water logging – causes and ill effects.

Text books:

1. Santhosh Kumar Garg, **"Irrigation Engineering and Hydraulic Structures",** Khanna Publishers – New Delhi. 2008.
2. Punmia, B.C and Pande B.B. Lal, **"Irrigation and Water Power Engineering",** Lakshmi Publications (P) Ltd, New Delhi. 2007

Reference Books:

1. Sharma, R.K and Sharma, T.K, **"Irrigation Engineering (Including Hydrology)",** S.Chand & Co Ltd, New Delhi. 2009
2. Dilip Kumar Mujumdar, **"Irrigation Water management – principles & practice"**, Prantice Hall of India (P) Ltd, New Delhi. 2005
3. Linsey R.K and Franzini J. B, **"Water Resources Engineering"**, McGraw Hill. 2000
4. Douglas J.L and Lee R.R, **"Economics of Water Resources Planning"**, Tata McGraw Hill. 2000.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 56	4	0	--	4

B56 Geotechnical Engineering - I 4:0

Preamble

This course is a branch of Civil Engineering which deals with the application of laws of Mechanics and Hydraulics to Engineering problems related with soils like Permeability, stresses within soils, Shear strength and compressibility of soils and stability of sloping ground. These form the basis for the computation of discharge through earthen dams, shear strength parameters required for determining the bearing capacity of soils, settlement of buildings and slope stability analysis.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science, and engineering.
- Graduates will demonstrate an ability to identify, formulate and solve complicated Engineering problems.
- Graduates will demonstrate skills to use modern engineering tools, equipments to analyze engineering problems related to soil.

Competencies

At the end of the course the student will be able to

1. Understand the basic properties of soils and classify the Soil according to IS.
2. Determine the Permeability of Cohesive and Cohesionless soils.
3. Understand the concept of Effective stress and its significance.
4. Compute the Shear Strength of soils based on the parameters obtained from shear tests.
5. Compute the consolidation settlement of foundations.
6. Compute the stresses within soils due to applied loads.
7. Understand the concept and significance of compaction and slope stability analysis.

Assessment Pattern

S.No.	Bloom's Category	Test 1	Test 2	Test 3/End semester Examination
1	Remember	20	10	10
2	Understand	40	40	40
3	Apply	40	50	50
4	Analyse	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives:

Remember

1. What is a three phase diagram?
2. What are loess deposits?
3. Define Liquid Limit.
4. What is effective stress?
5. List out the factors affecting permeability of soil.
6. Write the Mohr's equation for shear strength of soils?
7. What are the draw backs of Direct Shear test?
8. Mention the assumptions in the Terzaghi's one dimensional Consolidation Theory.
9. Define theoretical maximum dry density.
10. What are the different types of slope failures?

Understand

1. Distinguish between Index and Engineering properties.
2. Obtain a relationship between Dry density, Void ratio and Specific gravity of soil solids using a three phase diagram.
3. Explain Quick sand condition in soil.
4. Describe the different stages of a shear test.
5. Explain Mohr-Coulomb failure criterion.
6. Explain the concept of consolidation with the help of a spring and dashpot system.
7. Explain the step by step procedure of constructing the Newmark's influence chart.
8. Explain the procedure of constructing an isobar of intensity 0.1Q. Where 'Q' is the intensity of point load acting at the ground surface.
9. Differentiate compaction and consolidation.
10. Explain the method of checking the compaction in the field using proctor needle.
11. Describe method of slices of slope stability analysis.
12. Explain the reasons for failure of slopes

Apply

1. An imaginary soil mass is contained in a container measuring 10cm x 10cm x 10cm. The soil consists of spherical grains of size 1cm in diameter. Determine the maximum possible void ratio and percentage solids.

2. The wet unit weight of a soil sample is 19.2kN/m^3. Its water content is 12%. Determine the void ratio, porosity, Percentage air voids, degree of saturation, saturated unit weight, dry unit weight and submerged unit weight of the sample. Take G= 2.67.
3. Following are the results of a field density test by sand replacement method for a compacted embankment.
   i) Mass of empty calibrating can = 944 gm
   ii) Mass of calibrating can + sand = 2483 gm
   iii) Volume of calibrating can = 1000 c.c
   iv) Mass of soil excavated from the hole dug in the embankment= 925 gm
   v) Mass of sand pouring cylinder + sand before test = 5332 gm
   vi) Mass of sand pouring cylinder + sand after filling the hole = 4152 gm
   vii) Mass of sand filling the pouring cone = 432 gm
   Determine the bulk density of the soil.
4. A constant head permeability test was conducted on a sample of sand 10cm in diameter and 20cm in height. The head of water was maintained at 40cm. If 110cm^3 of water is collected in 1minute and 20 seconds, compute the coefficient of permeability of the sand in mm/hour.
5. In a falling head permeability test if equal time intervals are noted for the drops in head from h_1 to h_2 and again from h_2 to h_3, obtain a relationship between h1, h_2 and h_3.
6. Water table is lowered from a depth of 3m to a depth of 6m in a deposit of silt. The silt deposit has a water content of 20%. Its degree of saturation above water table is 65%.Estimate the increase in effective stress at a depth of 10m due to lowering of the water table. Assume G=2.7.
7. Consolidated Undrained triaxial tests are performed on two identical specimens of saturated, remoulded clay with pore pressure measurements. The observations are recorded in the table below

Test No.	Cell pressure at failure (kN/m^2)	Deviator stress at failure (kN/m^2)	Pore pressure at failure (kN/m^2)
1.	250	179	101
2.	350	242	145

Determine the values of the shear strength parameters in terms of total and effective stresses. If in the consolidated undrained test, an identical specimen is first consolidated under a cell pressure of 400 kN/m^2, what would be the deviator stress at failure?

8. Borings at a site show the following subsurface condition:

Depths	Material	Properties
0 to 2m	Silt	ρ = 1.44 gm/cc
2m to 12m	Sand	ρ_{sat} = 1.9 gm/cc
12m to 18m	clay	ρ_{sat} = 1.78 gm/cc, c = 20kN/m^2, Φ= 18^0

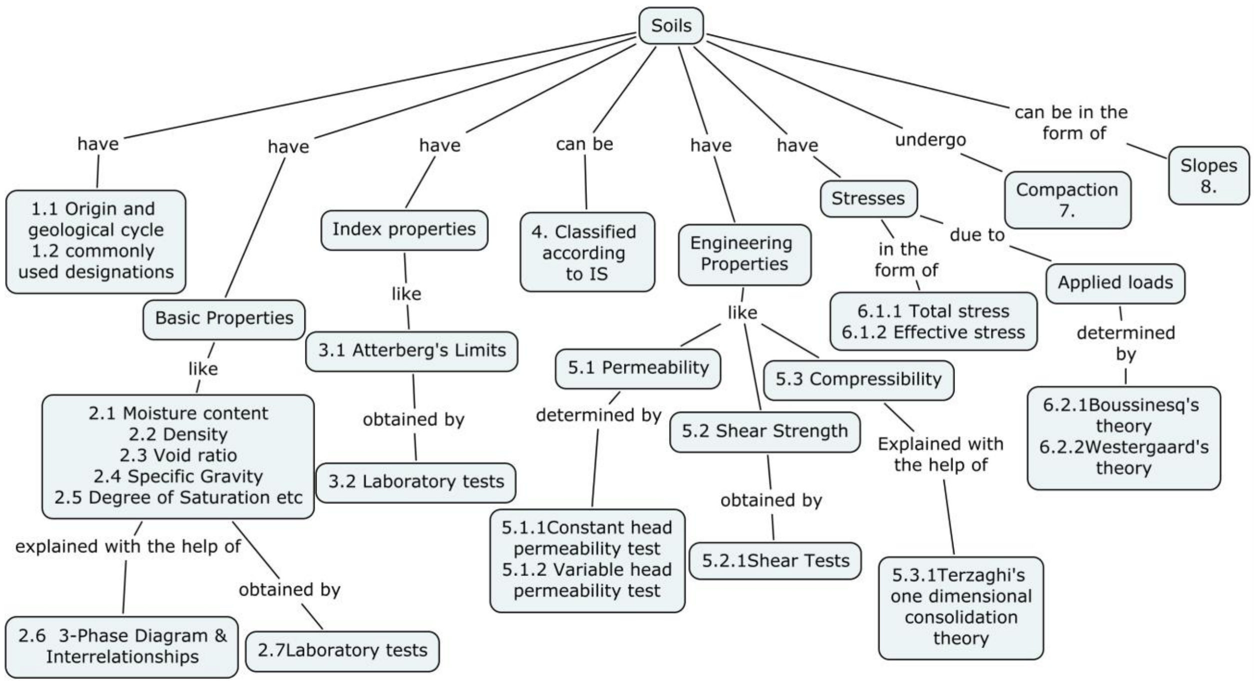
Ground water table is at a depth of 2m below the ground surface. Estimate the shear strength along a plane at a depth of 16m below the ground surface.

9. In an oedometer test 2 cm thick sample of clay reached 40% consolidation in 5minutes.What will be the time required for a clay layer 4m thick in field to reach the same degree of consolidation? Sample and the clay layer in field have same drainage conditions (double drainage).
10. A square footing 2m x 2m resting on the surface of a soil exerts a pressure of 150kN/m^2. Determine the stress at a point which is at a depth of 5m below the center of the footing using Boussinesq's theory.
11. Following are the results of Standard Proctor Compaction test performed on a soil sample

Water Content (%)	5	10	14	20	25
Bulk density (g/c.c)	1.77	1.98	2.1	2.18	2.16

Plot the water content – dry density curve and obtain the optimum moisture content and maximum dry density. Calculate the water content necessary to completely saturate the sample at its maximum dry density, assuming no change in the volume. Take G = 2.7.

Concept Map



Course content and Lecture schedule:

S.No	Topic	No. of Lectures
1.	**Origin and types of soils**	
1.1	Geological cycle	1
1.2	Commonly used soil designations	
2.	**Physical Properties of soils**	
2.1	Basic soil properties	2
2.2	3 Phase Diagram and interrelationships	1
2.3	Laboratory tests for determining basic soil properties	2
2.4	Sieve Analysis including hydrometer Analysis	2
2.5	Field identification of soils	1
3.	**Consistency Limits**	
3.1	Determination of consistency limits and their significance to the field behavior of soil	2
4.	**Soil Classification**	
4.1	IS Soil Classification system	1

5.	**Engineering Properties**	
5.1	Permeability	
5.1.1	Darcy's law and its validity	3
5.1.2	Determination of permeability in laboratory for cohesive and cohesionless soils	
5.1.3	Factors affecting permeability	1
5.1.4	Permeability of layered soil deposits	1
5.2	Shear Strength	
5.2.1	Shear and normal stress at a point	1
5.2.2	Mohr's circle of stresses	
5.2.3	Mohr's Strength Theory	1
5.2.4	Mohr-Coulomb failure criterion	
5.2.5	Classification of shear test based on drainage conditions	2
5.2.6	Direct shear test, Unconfined compression test	
5.2.7	Triaxial test and Vane Shear test	3
5.3	Compressibility	
5.3.1	Terzaghi's theory of one dimensional consolidation	1
5.3.2	concept of consolidation	1
5.3.3	Determination of coefficient of consolidation from consolidometer test data by square root of time method and log time method	2
5.3.4	Calculation of consolidation settlement	2
6.	**Stresses in soils**	
6.1	Total stress and Effective stress in soils	
6.1.1	Concept of Effective Stress in saturated soils deposits	1
6.1.2	Seepage flow, seepage pressure, Quick sand condition and critical hydraulic gradient	2
6.2	Stress due to applied loads	
6.2.1	Boussinesq's theory for point load, circular load area and square loaded area	2
6.2.2	Concept of pressure bulb, Westergaard's theory for point load	1
6.2.3	Approximate methods	1
6.2.4	Newmark's influence chart	1
7.	**Soil Compaction**	
7.1	Concept of Compaction	1

7.2	Standard Proctor Compaction Test	1
7.3	Modified Proctor Compaction Test	1
7.4	Factors affecting Compaction	1
7.5	Zero air voids curve	1
7.6	Field Compaction control	
8.	**Stability of Slopes**	
8.1	Types of slope failures	1
8.2	Different Factors of safety	1
8.3	Stability Analysis of Finite slopes	2
8.4	Taylor's stability number	1
8.5	Stability Analysis by method of slices	1
8.6	$Ø_u$=0 Analysis	1

Syllabus

Origin and types of soils: Geological cycle - commonly used soil designations. **Physical Properties of soils:** Basic soil properties - 3 Phase Diagram – interrelationships - Laboratory tests for determining basic soil properties - Sieve Analysis including hydrometer Analysis - Field identification of soils. **Consistency limits:** Determination of consistency limits and their significance to the field behavior of soil – **Soil Classification:** IS Soil classification system - **Permeability:** Darcy's law and its validity - Determination of permeability in laboratory - Factors affecting permeability - Permeability of layered soil deposits. **Shear Strength:** Shear and normal stress at a point - Mohr's circle of stresses - Mohr's Strength Theory - Mohr-Coulomb failure criterion - Classification of shear test based on drainage conditions - Direct shear test - Unconfined compression test - Triaxial test and Vane Shear test. **Compressibility:** Terzaghi's theory of one dimensional consolidation - concept of consolidation - Determination of coefficient of consolidation from consolidometer test data by square root of time method and log time method - Calculation of consolidation settlement **Effective Stress:** Concept of Effective Stress in saturated soils deposits - Seepage flow and seepage pressure - Quick sand condition and critical hydraulic gradient. **Stress due to applied loads:** Boussinesq's theory for point load - circular load area and square loaded area - Westergaard's theory for point load - Concept of pressure bulb - Approximate methods - Newmark's influence chart. **Soil Compaction:** Concept of Compaction - Standard Proctor and Modified Proctor Compaction Tests - Factors affecting Compaction - Zero air voids curve - Field Compaction control. **Stability of Slopes:** Types of slope failures - Different Factors of safety - Stability Analysis of Finite slopes - Taylor's stability number - Stability Analysis by method of slices and $\varnothing_u$=0 Analysis.

References:

1. Dr. Arora. K.R, "Soil Mechanics and Foundation Engineering (Geotechnical Engineering)", Standard Publishers Distributors, Nai Sarak, Delhi, 2009.
2. Venkatramaiah. C, "Geotechnical Engineering", New Age International (P) Ltd., Publishers, Daryaganj, New Delhi, 2009.
3. Murthy. V.N.S, "A Text book of Soil Mechanics and Foundation Engineering", Kripa Technical Consultants, Bangalore, 1992.
4. Dr. Punmia. B.C, Ashok Kumar Jain, Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publications (P) Ltd., Daryaganj, New Delhi, 2007.
5. Gopalranjan and Rao. A.S.R, "Basic and Applied Soil Mechanics", Wiley Eastern Ltd., New Delhi, 1997.
6. Donald P. Coduto, "Geotechnical Engineering – Principles and Practices", Prentice Hall of India (P) Ltd., New Delhi, 2002.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 57	0	0	1	1

B57 Geotechnical Engineering Lab 0:1

Objective:

To impart hands on training in Soil testing for the determination of Index and Engineering Properties of soils.

List of Experiments:

1. a. Determination of specific Gravity of soil using Pycnometer and Density bottle.
   b. Determination of Relative Density of sand.

2. a. Determination of Soil Moisture content by oven drying method and by using volumetric flask.
   b. Determination of Shrinkage factors of soil.

3. a. Determination of Liquid limit of the soil by Casagrande's Apparatus.
   b. Determination of Plastic limit of the soil.

4. Particle size distribution analysis – By sieve analysis and Sedimentation analysis.

5. Determination of field density of soil by sand replacement method.

6. Constant Head Permeability test on coarse grained soil.

7. Variable Head permeability test on fine grained soil.

8. One Dimensional consolidation Test for the determination of Coefficient of consolidation (C_v).

9. Standard Proctor Compaction test on soil (Light compaction).

10. Direct Shear test on cohesionless soil.

11. Unconfined compression test on clay.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 58	0	0	1	1

B58-Environmental Engineering Laboratory **0:1**

Objective:

This laboratory course work is intend to impart hands on training in evaluating the water quality parameters, wastewater characteristics and ambient air quality status measurement. This will form the basic input data for arriving at a solution/treatment system for upkeep of the environment and promoting public health.

List of Experiments:

1. Determination of Hardness, Alkalinity and Chlorides in water samples.
2. Determination of Sulphate in water sample – Turbiditymetric analysis.
3. Determination of Nitrates in water & wastewater – Spectro photometric analysis.
4. Optimum coagulant dosage for turbidity removal.
5. Estimation of chlorine dosage for disinfection of water.
6. Determination of COD of wastewater samples.
7. Determination of Oil & greasy matters in wastewater samples.
8. Determination of Fluorides in drinking water – spectro photometric analysis.
9. Determination of Dissolved oxygen in drinking water.
10. Determination of Iron in water samples – Spectro photometric analysis.
11. Determination of Total solids, suspended solids, Dissolved solids, Organic solids & Inorganic solids in water & wastewater samples.
12. Measurement of Ambient air quality parameters – SPM, SO_2 & NOx

Demonstration Experiments:

1. Determination of BOD of wastewater.
2. Heavy metals measurement using AAS (Lead, Chromium & Zinc).
3. Sodium & potassium measurement using flame photometer & % Sodium, SAR Calculation.
4. Characterization of municipal solid waste & volatile component Estimation.

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SIXTH SEMESTER – ELECTIVE

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

MADURAI – 625 015, TAMILNADU

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6A	3	0	0	3

B6A FINITE ELEMENT ANALYSIS 3.0

PREAMBLE

This course provides an introduction to the finite element analysis, from engineering rather than a purely mathematical point of view.

PROGRAMME OUTCOMES ADDRESSED

- Graduates will develop confidence in finite element method solutions of different field problems in engineering
- Graduates will understand the significance of the versatile tool finite element method
- Graduates will commit to develop computer aided programs using finite element analysis

COMPETENCIES

At the end of the course, the students will be able to

1. formulate basic energy, weak formulation and weighted residual techniques
2. differentiate global, local and natural coordinates
3. handle one dimensional line elements having linear and quadratic shape functions
4. originate truss elements capable of solving two dimensional truss problems
5. formulate two dimensional elements (triangular and isoparametric)
6. understand Gaussian numerical integration technique

ASSESSMENT PATTERN

Sl.No.	Bloom's Category	Test 1	Test 2	Test 3 / End semester examination
1.	Remember	10	10	10
2.	Understand	20	20	20
3.	Apply	70	70	70
4.	Analyze	-	-	-
5.	Evaluate	-	-	-
6.	Create	-	-	-

COURSE LEVEL LEARNING OBJECTIVES:

Remember

1. Explain boundary value and initial value problems with examples.
2. What do you mean by shape function? What are the shape functions of a line element?
3. Write the properties of Global Stiffness Matrix K in case of a one dimensional line element.
4. Write the element body force and element traction force matrices.
5. Give the constitutive matrix in case of a plane strain problem
6. Give the weights and Gauss points in case of one point formula and two point formula

Understand

1. What is the significance of integration by parts?
2. The coordinates of two nodes of a truss element are (0,0) and (7,4). Determine the length and direction cosines.
3. The coordinates of points of a triangular element are (1,2), (3,7) and (5,4). Obtain the Jacobian matrix.
4. Derive the element stiffness matrix and element body force matrices of a line element.
5. Derive the Jacobian of transformation of a triangular element.
6. Derive from basic principles the shape functions and the element stiffness of a four node quadrilateral element.

Apply

1. Consider the bar shown in Fig.1. Axial force P=20N is applied as shown. Determine the nodal displacement, stresses in each element and reaction forces.($E=2x10^5$ N/mm^2)

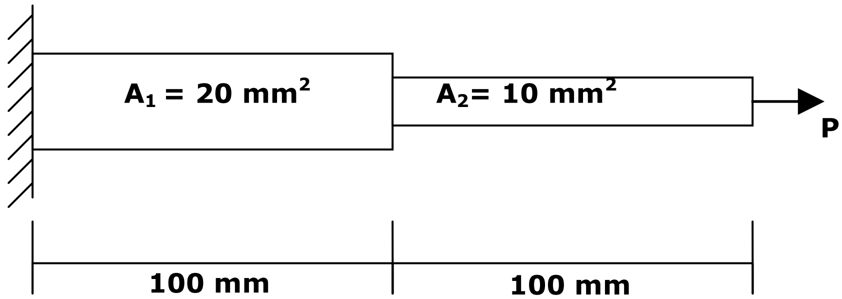


Fig.1

2. Evaluate the integral $\int 3e^{x} + x^{2} + \frac{1}{x+2} dx$ using one point and two point Gauss quadrature formula.
3. Determine the forces in the members of the truss shown in Fig.2 by finite element method. Take E = 200 GPa.

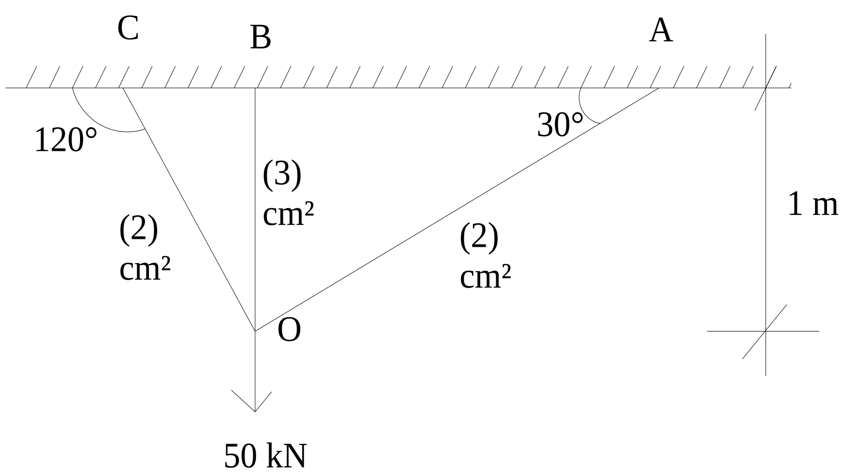


Fig.2

4. For the two-dimensional loaded plate shown in Fig. 3, determine the displacements of nodes 1 and 2 and the element stresses using plane stress conditions. Body force may be neglected in comparison with the external forces.

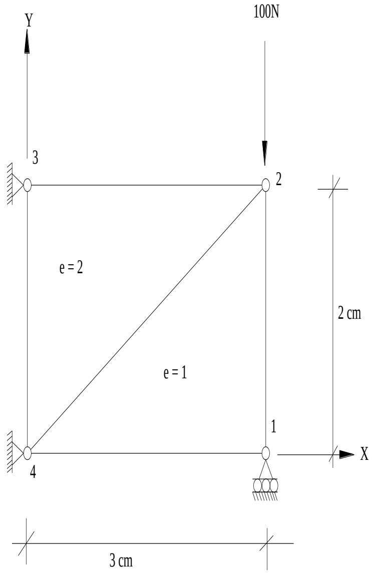


Fig.3

5. If a displacement field is described by

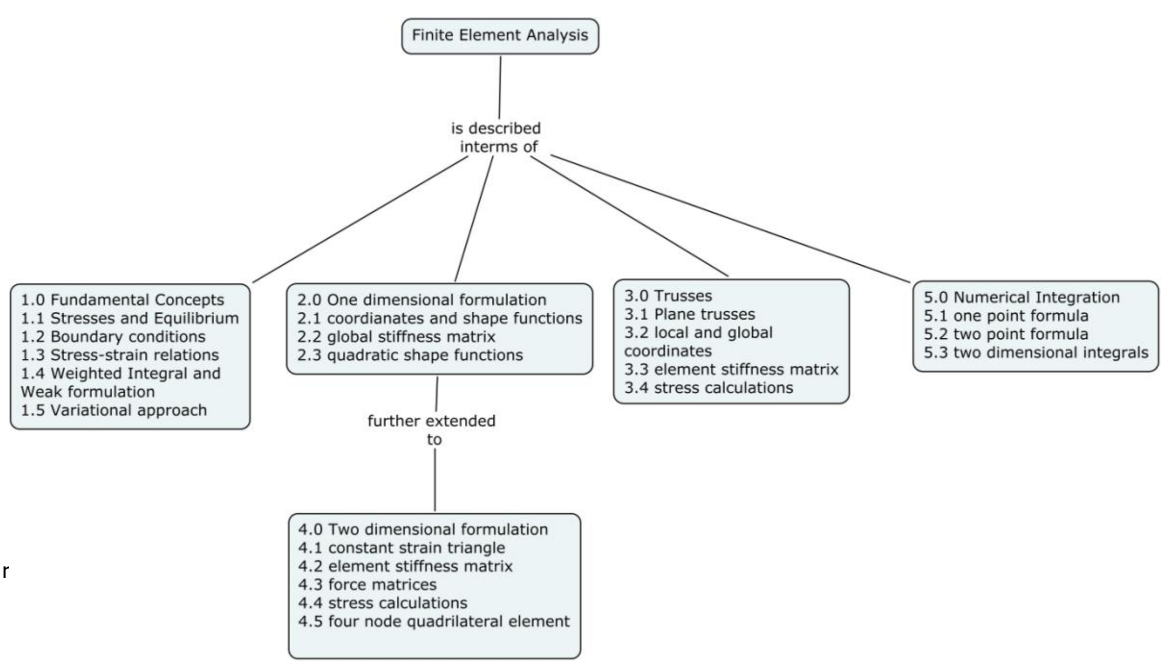
   $u = (-x^2 + 2y^2 + 6xy)\ 10^{-4}$

   $v = (3x + 6y - y^2)\ 10^{-4}$

   determine direct strain at x and y and shear strain at the point x = 1, y=0

6. Taking a differential equation, explain the step by step procedure of obtaining weak form and also explain the various boundary conditions.

Concept Map



Boar

Course contents and Lecture schedule:

S.NO	TOPICS	NO. OF PERIODS
1	**Fundamental Concepts**	
1.1	Introduction	1
1.2	Stresses and equilibrium	1
1.3	Boundary conditions – strain displacement relations	1
1.4	Stress – strain relations – potential energy and equilibrium	1
1.5	Weighted Integral and Weak formulation	2
1.6	Variational Approach	1
1.7	Rayleigh Ritz method	1
2	**One dimensional formulation**	
2.1	Introduction – Finite Element Modelling, coordinates and shape functions	1
2.2	The Potential Energy approach	1
2.3	Assembly of Global Stiffness Matrix and Load Vector	1
2.4	Properties of K, finite element equations and treatment of boundary conditions	1
2.5	One dimensional problems	3
2.6	Quadratic shape functions	1
3	**Trusses**	
3.1	Introduction – Plane trusses	1
3.2	Local and global coordinate systems	1
3.3	Element stiffness matrix	1
3.4	Stress Calculations	1
3.5	Problems in finding stresses in truss members	3
3.6	Introduction to three dimensional trusses	1
4	**Two dimensional formulation**	
4.1	Introduction - Finite Element Modeling of two dimensional problems	1
4.2	Constant strain triangle – Isoparametric representation	1
4.3	Potential energy approach – Element stiffness matrix	1

4.4	Potential energy approach – Force terms	1
4.5	Stress calculations	1
4.6	Problems in two dimensional stress field	3
4.7	Isoparametric elements	1
4.8	Four node quadrilateral – shape functions and element stiffness matrix	1
4.9	Four node quadrilateral – element force vectors	1
5	**Numerical Integration**	
5.1	One point formula	1
5.2	Two point formula	1
5.3	Two dimensional integrals	1
5.4	Problems in numerical integration using Gauss quadrature formula	2

Syllabus

Fundamental Concepts

Stresses and equilibrium – Boundary conditions – strain displacement relations – stress-strain relations – potential energy and equilibrium – weighted integral and weak formulation – variational approach – Rayleigh Ritz method

One dimensional formulation

Finite element modeling – coordinates and shape functions – Assembly of global stiffness matrix and global load vector – properties of K – finite element equations – treatment of boundary conditions – quadratic shape functions – temperature effects

Trusses

Plane trusses – local –global transformation - stiffness matrix – stress calculations

Two dimensional formulation

Finite element modeling – constant strain triangle – problem modeling and boundary conditions - stress calculations – Isoparametric elements – four node quadrilateral and nine node quadrilateral elements

Numerical Integration

One point formula and two point formula – two dimensional integrals

Text Book

1. Tirupathi R. Chandrupatla, Ashok D. Belegundu, "Introduction to finite elements in engineering", Prentice Hall of India, New Delhi, 2007.

Reference Books

1. Reddy, J.N, "An Introduction to the finite element method", McGraw Hill International Edition, New York, 2008.
2. Krishnamoorthy,C.S, "Finite Element Analysis Theory and Programming", Tata McGraw Hill Publishing Co.Ltd. New Delhi 2004.
3. Rajasekaran,S "Finite Element Analysis in Engineering Design", A.H. Wheeler publishing company, New Delhi 2003.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6B	3	0	0	3

B 6B Computational Methods of Structural Analysis 3:0

Preamble

This course deals with matrix method of analysis of beams, frames and trusses up to three degrees of freedom covering the fundamental concepts of indeterminacy, measurement of displacements, energy theorems etc.. Flexibility method, Stiffness method and Direct stiffness methods are included in this course. It also aims to determine the member forces and construction of bending moment diagrams.

Program outcomes addressed

- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will be able to communicate effectively in both verbal and written form
- Graduates will develop confidence for self education and ability for life long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to

1. Know the fundamental concepts of structures and measurement of forces and displacements
2. Apply the knowledge of the energy theorem in solving problems
3. Calculate the moments in beams, frames and trusses having sectional variations and initial yield using stiffness method.
4. Determine the induced forces in beams and frames having sectional variations and sway using flexibility method
5. Calculate the internal forces in beams, frames and trusses with sectional variation using direct stiffness method

Assessment Pattern

	Bloom's Category	**Test 1**	**Test 2**	**Test 3 / End Semester Examination**
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyze	-	-	-
5	Evaluate	-	-	-
6	Create	-	-	-

Course level learning objectives

Remember

1. Define degree of freedom
2. State degree of kinematic indeterminacy
3. What is meant by statically determinate structure?
4. State static indeterminacy
5. What is stiffness matrix?

Understand

1. Find the number of generalized coordinates and the degree of kinematic indeterminacy for each of the structures shown in figure-1 (Ref-P.2.1, P.2.2, P.2.3, and P.2.4)

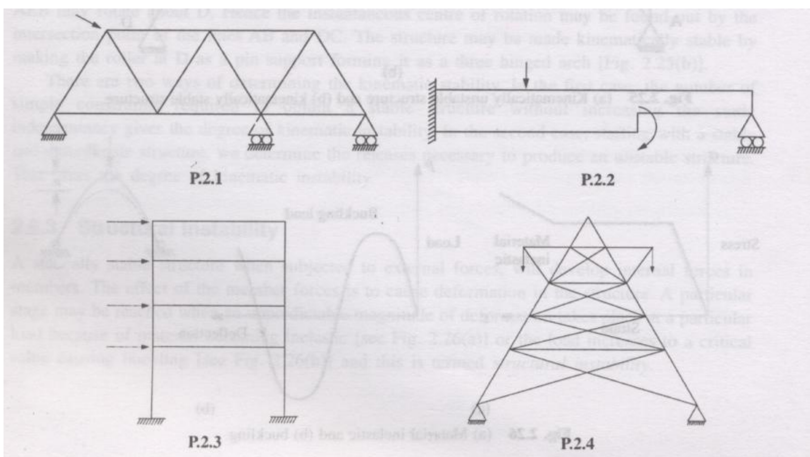


Figure-1

2. Determine the static indeterminacy of each of the structures as shown in figure-2 (Ref: P.3.1, P.3.2, P.3.3, P.3.4) and indicate them if any of them are unstable

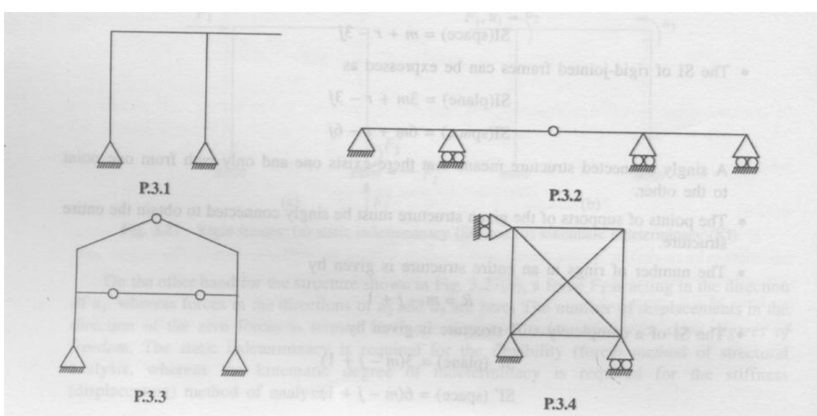


Figure-2

3. Compute the flexibility or stiffness matrix of a frame as shown in figure-3 (d, e)of the using the principle of superposition.

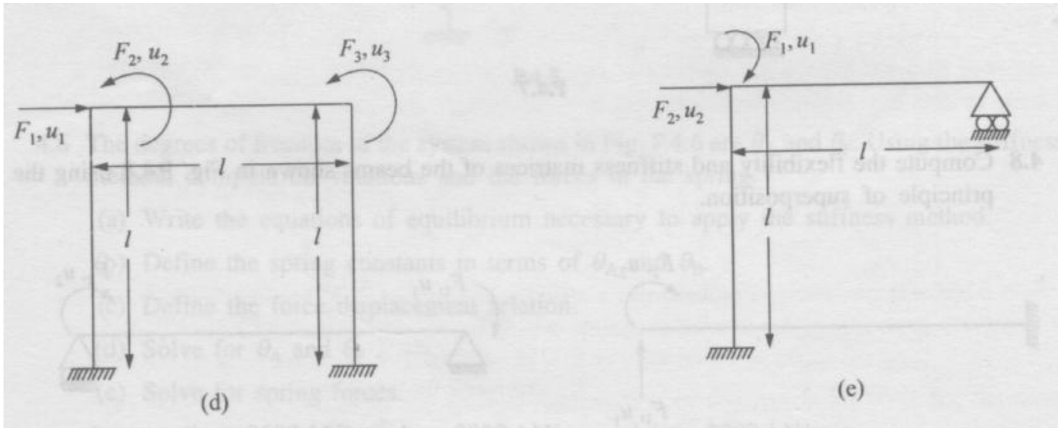


Figure-3

4. Find the stiffness matrix for the continuous beam as shown in figure-4 (Ref: P6.9) by considering the element stiffness

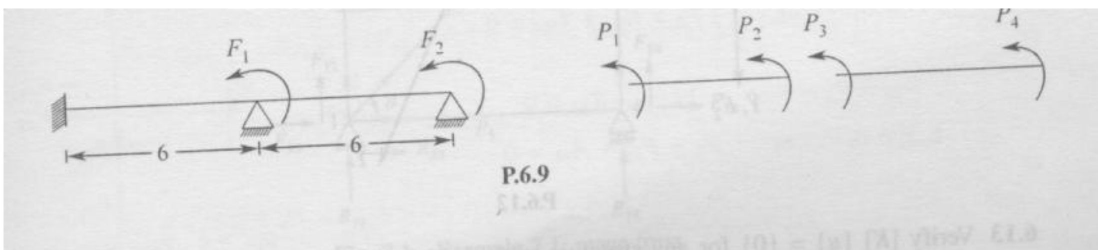


Figure-4

5. Construct and solve the equilibrium equation for the structure shown in figure-5 (Ref: P.7.1(a) , P.7.1(b))

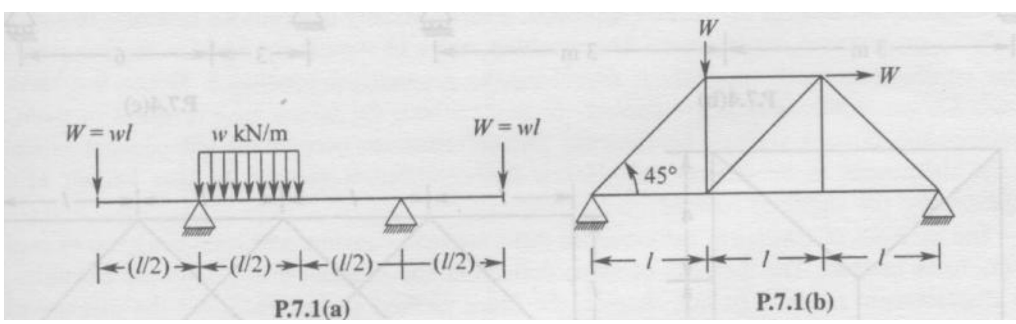


Figure-5

Apply

1. Draw the shear force and bending moment diagrams for the beams shown in figure-6 (Ref: P.8.14 (a) (b)) by force method

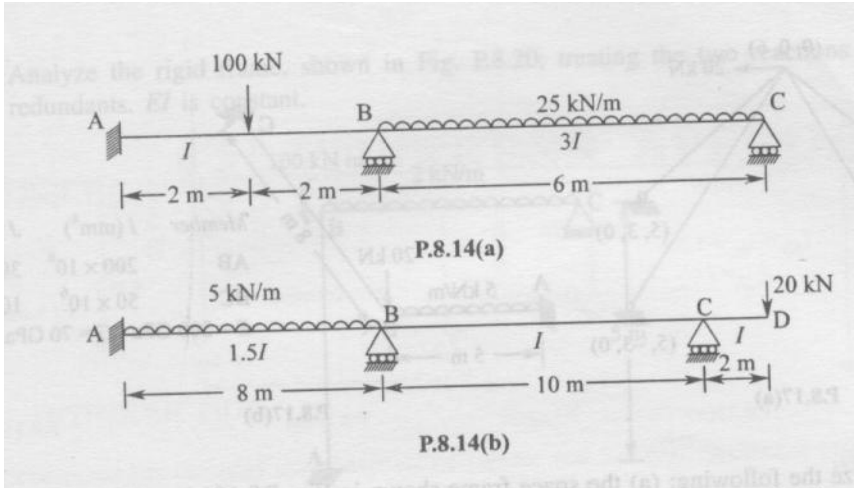


Figure-6

2. Analyse the frame shown in figure-7 (Ref: P.9.14) using stiffness method

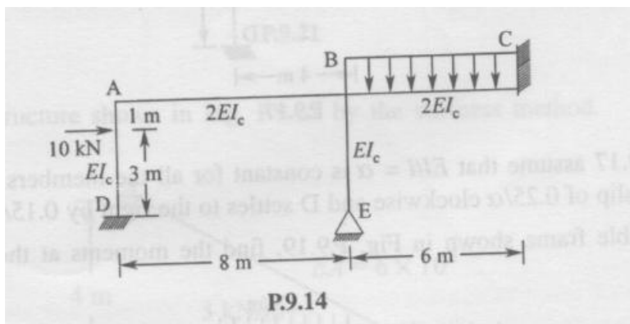


Figure-7

3. Apply the direct stiffness method to solve the truss shown in figure-8 (Ref: p.10.6)

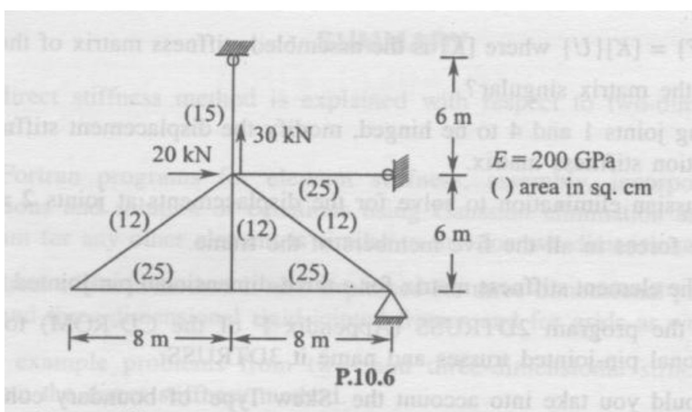
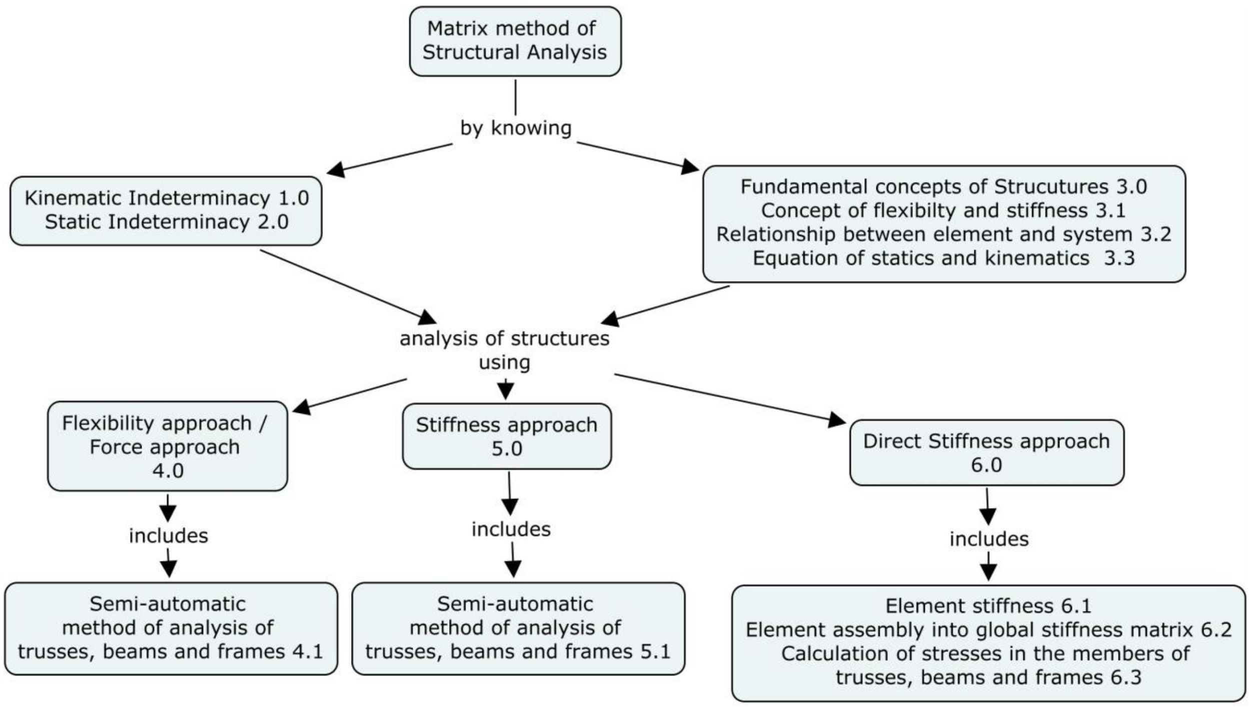


Figure-8

Concept Map



Syllabus

Kinematic indeterminacy – Introduction - Degree of freedom of beams, rigid frames, pinned connected plane frames- **Statical indeterminacy** – Introduction – Degree of static indeterminacy of beams, frames and pinned connected frames – Comparison of statical indeterminacy and kinematic indeterminacy

Fundamental Concepts of Structures – Measure of forces and displacements – Generalized or independent measurement – Constrained or dependent measurement – concept of flexibility and stiffness – concept of equivalent spring – relationship between stiffness and flexibility – Flexibility and stiffness in constrained measurement – Relationship between element and system – equation of statics and kinematics for statically determinate and indeterminate structures

Flexibility method of Force method – concept of force method for trusses, beams and frames – Semi-automatic method of analysis – statically determinate and indeterminate structures – problems

Stiffness method – Concept of stiffness- formation of system stiffness matrix for trusses and frames - Semi-automatic method of analysis – trusses, beams and frames – problems

Direct stiffness method – concept – element stiffness – element assembly into global stiffness matrix – boundary condition – calculation of stresses in the members – trusses, beams and frames - problems

Text Books:

1. Rajasekaran, S., and Sankarasubramanian, G., 'Computational Structural Mechanics", Prentice-Hall of India Pvt. Ltd., NewDelhi (2001)

Reference Books:

1. Reddy,C.S.,"Basic Structural Analysis", Tata McGraw Hill Publishing Company Ltd., New Delhi,
2. Streling Kinney.J., "Indeterminate Structural Analysis", Addition-Wesley Publishing Company, Sydney,
3. Thandavamoorthy, "Analysis of Structures", Oxford &IBH Publishers, New Delhi,
4. Ping-Chun Wang, "Numerical and Matrix Methods in Structural Mechanics", John Wiley and Sons New York
5. Manikaselvam, Matrix method of structural analysis, , Khanna Publishers, NewDelhi
6. Wang., C.K.,"Indeterminate Structures" McGraw Hill Book Co., Newyork

Course content and Lecture schedule

S.NO.	TOPICS	PERIODS
	Kinematic indeterminacy	
1.0	Introduction to Kinematic indeterminacy, Degree of freedom	1
1.1	Degree of freedom of beams, rigid frames, pinned connected plane frames	1
	Statical indeterminacy	
2.0	Introduction to Statical indeterminacy, Degree of Redundancy	1
2.1	Degree of static indeterminacy of beams, frames and pinned connected frames	1
2.2	comparison of statical indeterminacy and kinematic indeterminacy	1
	Fundamental Concepts of Structures	
3.0	Concept of Structures and Measure of forces and displacements	1
3.1	Generalized or independent measurement	1
3.1.1	Constrained or dependent measurement	1
3.2	Concept of flexibility and stiffness	1
3.2.1	Concept of equivalent spring	2

3.2.2	Relationship between stiffness and flexibility	1
3.3	Flexibility and stiffness in constrained measurement	1
3.3.1	Relationship between element and system	1
3.3.2	Equation of statics and kinematics for statically determinate and indeterminate structures	1
	Flexibility method of Force method	
4.0	Concept of force method for trusses, beams and frames	2
4.1	Semi-automatic method of analysis- Statically determinate and indeterminate structures	4
	Stiffness method	
5.0	Concept of stiffness	1
5.1	Formation of system stiffness matrix for trusses and frames	2
5.2	Semi-automatic method of analysis of trusses, beams and frames	5
	Direct stiffness method	
6.0	Concept of Direct stiffness method	1
6.1	Formation of element stiffness matrix	2
6.2	Element assembly into global stiffness matrix	2
6.2.1	Boundary condition	1
6.3	Calculation of stresses in the members – trusses, beams and frames	5
	Total	40

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6C	3	0	0	3

B6C Structural Dynamics 3.0

Preamble

Develop the ability to formulate the equations of motion of Vibrating systems. Learn how to predict the dynamic response of linear single degree of freedom systems subject to initial excitations, harmonic and arbitrary excitations. Develop an understanding of the dynamic response of linear two degree of freedom systems with regard to natural frequencies and mode shapes. Develop skill in the simulation of the dynamic response of linear systems.

Programme outcome addressed:

- Demonstrate the ability to formulate the equations of motion of Vibrating systems.
- Demonstrate the ability to predict the dynamic response of linear single degree of freedom systems subject to initial excitations& harmonic excitation.
- Demonstrate an understanding of the dynamic response of linear two degree of freedom systems with regard to natural frequencies and mode shapes using linear algebra.

Competencies

Students will be able to

1. Anlayse the Response of single degree of freedom undamped systems to initial excitations
2. Anlayse the Response of single degree of freedom viscously damped systems to initial excitations
3. Anlayse the Response of single degree of freedom systems to harmonic excitations
4. Anlayse the Response of two degree of freedom undamped systems to initial excitations
5. Anlayse the Response of two degree of freedom systems to harmonic excitations
6. Anlayse the Response of Multi degree of freedom systems to harmonic excitations

Assessment Pattern:

Sl NO	Bloom's Category	Test 1	Test II	Test III / End Semester
1	Remember	10	10	10
2	Understand	10	10	10
3	Apply	80	80	80
4	Analyse	-	-	-
5	Evaluate	-	-	-
6	Create	-	-	-

Course level learning objectives:

Remember:

1. State Alembert Principle
2. What is logarithmic decrement?
3. What is displacement transmissibility?
4. What is Quality factor?
5. What is vibration absorber?
6. Write the general form of Lagrange's equation?
7. What is orthogonality principle?
8. What is the use of Rayleigh method in multi degree of freedom system
9. What is modal participation factor?
10. What is coupled modal equations?
11. Differentiate Damped and undamped vibration?
12. Differentiate Linear and Non linear vibration?

Understand:

1. Find the natural frequency of the system shown in fig1. The mass of the beam is negligible in comparison to the suspended mass.

E =2x 10^5 N / mm^2

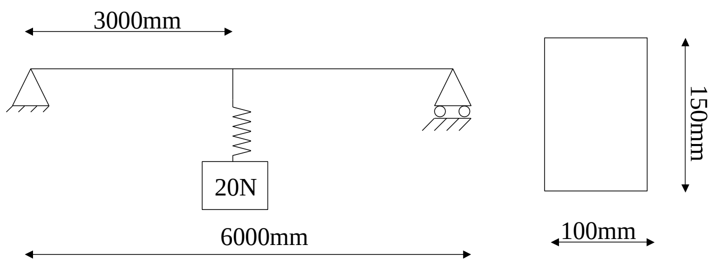
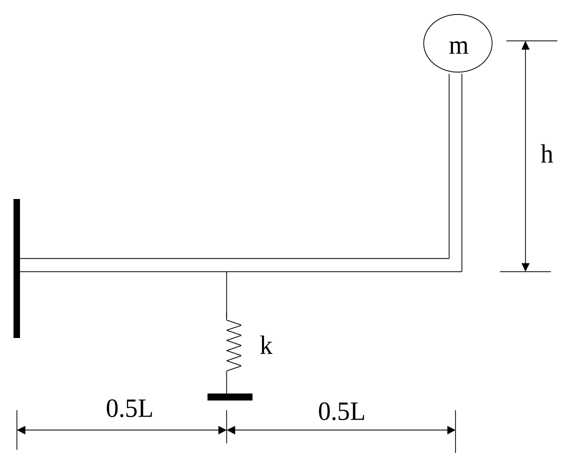


Fig 1

2. An L Shaped mass less rigid member with a mass m at the tip is supported by a spring of stiffness ‘K’ and hinged at point ‘O” as shown in fig2. Find the following
    i. Derive the equation for an angular motion u (t) about O
    ii. Determine natural frequency of the system



3. Derive the expression for Logarithmic decrement and prove that δ = 2Πξ for damped free vibration
4. Find the natural frequency and amplitude ratio of the system for two degree of freedom system of your choice by using Lagrange,s equation
5. Explain coordinate coupling of two degree of freedom system and derive amplitude ratio and frequencies
6. Derive duhamel integral for an arbitrary forcing function
7. Find undamped response of a system which is subjected to a stepped rectangular forcing function

8. Derive the expression for the response of Multi degree of freedom system for free undamped vibration.

Apply

1. A machine of mass one tonne is acted upon by an external force of 2450N at a frequency of 1500rpm.To reduce the effects of vibration, isolator of rubber having a static deflection of 2mm under the machine load and an estimated damping (=0.2) are used.

   Determine

   a) the force transmitted to the foundation

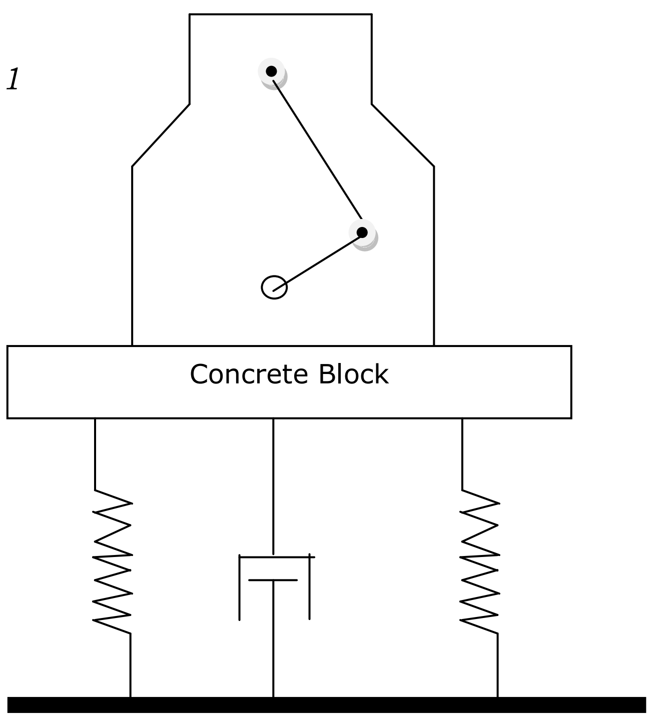
   b) the amplitude of vibration of Machine

2. An engine is mounted on a concrete block which is isolated from the floor as shown in fig1.The unbalanced force of the engine in Newton at r.p.m is given by

   F(t) = 100(n/1000)2 cos (2пnt/60)

   At 1000 rpm it is found that the force transmitted to the floor has an amplitude of 100Newtons.Determine the amplitude of the transmitted force at 1500 r.p.m when the damper is disconnected

Fig 1



3. In an experiment on forced vibration response of a single degree of freedom system, it is found that half power points lie at frequencies 40 and 44 Hz. Find the damping factor of the system
4. Find the natural frequency and amplitude ratio of the system for two degree of freedom system of your choice by using Lagrange,s equation
5. Explain coordinate coupling of two degree of freedom system and derive amplitude ratio and frequencies
6. A two degree of freedom system with masses m1 = 1.5kg and m2 = 0.80kg and stiffnesses are k1 = k2 = 40N/m. Determine the two natural frequencies of vibrations and the ratio of amplitudes of the motion of m1 and m2 for the two modes of vibration
7. Determine the frequency of the system shown in fig 3
   k1=k2=40 N/m
   k=60N/m,m1 =m2=10kg

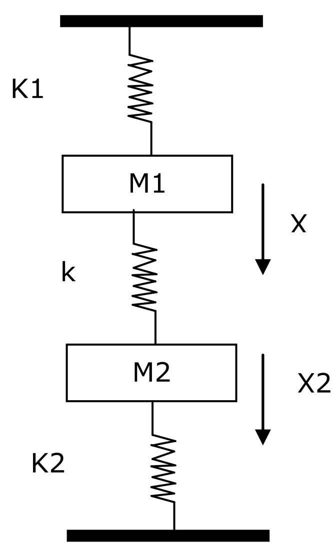


Fig 3

8. Using matrix method, determine the natural frequencies of the system as shown in fig 2

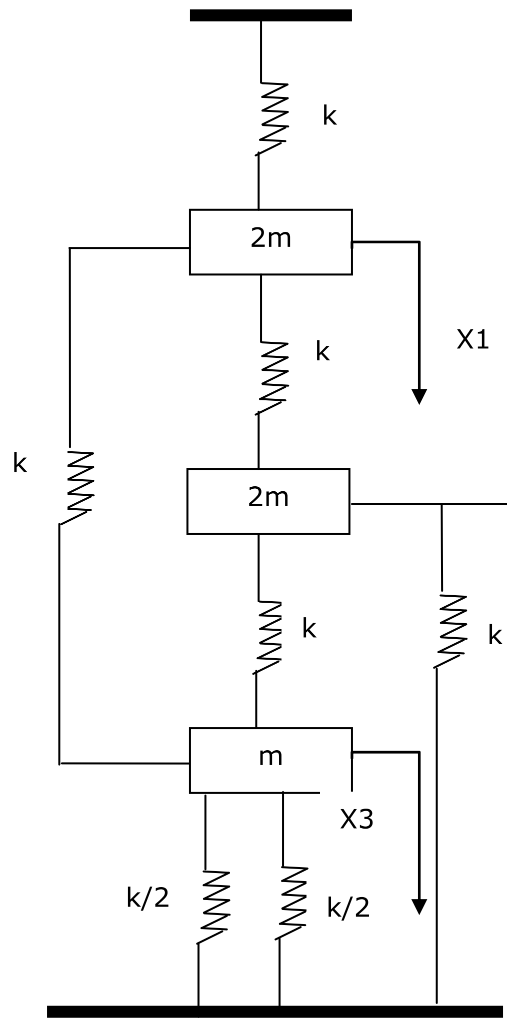
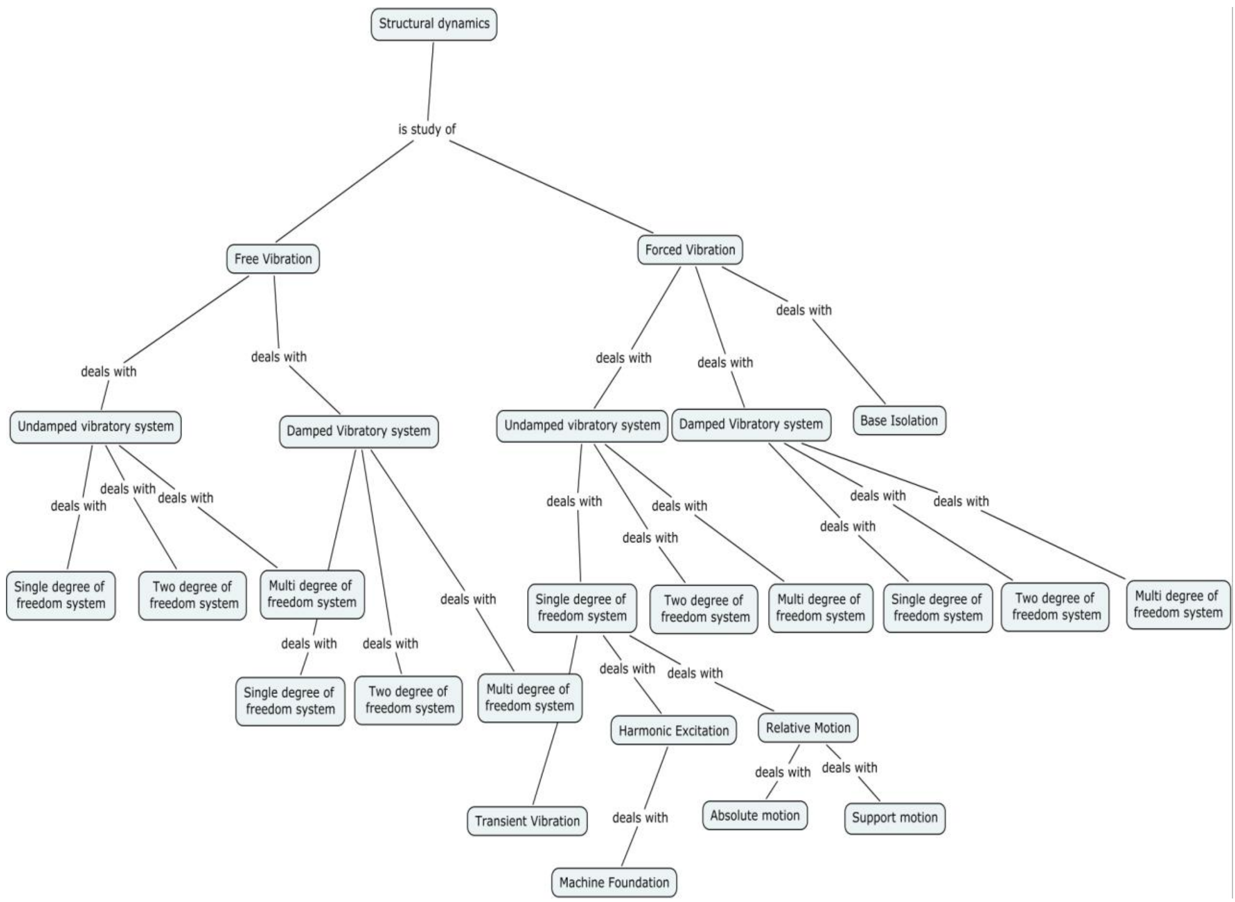


Fig2

Concept Map:



Course Content and Lecture Schedule:

Sl No	Topics	Periods
	Introduction to vibration and Damping	
1	Simple Harmonic motion	01
2	Longitudinal Vibrations Equation of motion, SDOF analysis	01
3	Undamped SDOFs- dynamic equation of motion	01
4	Newtons law of motion, D'Alemberts principle- equivalent stiffness	01

5	Springs are connected in series and parallel, frequency and period, problems	01
6	Amplitude of motion, Energy method for the equation of motion	01
7	Damped SDOFs- underdamped and overdamped	01
8	Damped SDOFs- critically damped	01
9	Logarithmic decrement ,method of determining damping	02
	Forced vibration of single degree of freedom system	
10	Undamped harmonic excitation	01
11	Damped harmonic excitation	01
12	Evaluation of damping at resonance	01
13	Response to support motion	01
14	Torsional vibration	01
15	Dynamic Magnification Factor	01
16	Impulsive loading,	02
17	Numerical evaluation of Duhamel's integral for damped system	02
	Two degrees of freedom	
18	Principle modes of vibration and equation of motion for two degree of freedom	01
19	Two degrees of freedom for torsional system	02
20	Vibrations of undamped Two degrees of freedom	02
21	Forced Vibrations	01
22	Undamped forced vibration for two degrees of freedom	02
23	Orthogonality Principle	01
24	Vibration isolation	01

	Multi degree of freedom system	
25	Equation of motion of multi degree of freedom	01
26	Stiffness, mass and damping matrices	01
27	Influence Coefficient, Eigen vector normalisations, problems	01
28	Matrix Method	01
29	Holzer Method	01
30	Rayleigh Method	01
31	Dunkerleys method	01
32	Modal analysis – damped undamped free vibration	03
	Base Isolation and Machine foundation	
33	Base Isolation techniques, Types of bearings,	01
34	Seismic Instruments	03
35	Introduction to Machine Foundation	01
36	Forces transmitted to the foundations	01
37	Examples on Machine foundation	02
38	Structure to soil interaction	01
39	Introduction to random vibrations	01

Syllabus:

Introduction to vibration and Damping: Simple Harmonic motion-Longitudinal Vibrations Equation of motion- SDOF analysisUndamped SDOFs- dynamic equation of motion Newtons law of motion- D'Alemberts principle- equivalent stiffness Springs connected in series and parallel- frequency and period Amplitude of motion- Energy method for the equation of motion-Damped SDOFs- underdamped and overdamped Damped SDOFs- critically damped Logarithmic decrement ,method of determining damping

Forced vibration of single degree of freedom system: Undamped harmonic excitation

Damped harmonic excitation-Evaluation of damping at resonance-Response to support motion Torsional vibration-Dynamic Magnification Factor

Two degrees of freedom: Principle modes of vibration and equation of motion for two degree of freedom-Two degrees of freedom for torsional system-Vibrations of undamped Two degrees of freedom-Forced Vibrations-Undamped forced vibration for two degrees of freedom Orthogonality Principle

Multi degree of freedom system:

Equation of motion of multi degree of freedom-Stiffness, mass and damping matrices Influence Coefficient-Eigen vector normalisations, problems-Modal co-ordinates, solution of eigen value problems-Matrix Method –Rayleigh Method – Holzer Method - Dunkerleys method -Natural frequencies and mode shapes-Modal analysis – damped undamped free vibration

Base Isolation and Machine foundation

Base Isolation - Types of bearings – case studies on base isolation –Seismic Instruments - Theory of Machine foundation –Forces transmitted to the foundations -Structure to soil interaction - Random Vibrations

Text books

1. Mario Paz, "Structural Dynamics: Theory and Computation", CBS Publications, New Delhi, 1994.
2. Anil K.Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Prentice Hall, Englewood Cliffs, New Jersy, Second Edition, 2001.

Reference books

1. Manicka Selvam K., "Elementary Structural Dynamics", Dhanpatrai and sons, New Delhi.
2. Clough, R.W.and Penzien,J., " Dynamics of Structure",McGraw-Hill,inc.,New York,1993.
3. Hurty.W.C, Rubinstein.M.F,"Dynamic of Structure", Prentice Hall of India Pvt Ltd.New Delhi.
4. Grover.G.K, "Mechanical vibrations, "New Chand and Bros., Roorkee.
5. Cheng, F.Y., "Matrix Analysis of Structure Dynamics", Marcel Dekker, New York, 2001.
6. Berg. Glen v., "Elements of Structure Dynamics" 'Prentice Hall Englewood Cliffs, New Jersy.1989.
7. Warburton, G.B., "The Dynamical Behaviour of Structures", Pergamon Press, New York, 1964.
8. William Thomson, "Theory of Vibration and its applications", George Allen Pub.

Course designers

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6D	3	0	0	3

B6D Hydrology **3.0**

Preamble

It is the science that treats the waters of the earth, their occurrence, circulation and distribution, their chemical and physical properties and their reaction with environment including their relation to living things.

Program outcomes addressed

- Graduates will demonstrate knowledge of mathematics, science, and engineering
- Graduates will demonstrate an ability to identify, formulate and solve complicated Engineering problems.
- Graduates will demonstrate skills to use modern engineering tools, sophisticated instruments to analyse engineering problems.

Competencies

At the end of the course the student should be able to

1. Understand the hydrologic cycle
2. Estimate the rainfall over a region
3. Estimate losses by infiltration, evaporation and evapotranspiration in surface water resources
4. Assess the surface and ground water resources in any given region.
5. Explain the measurement of stream flow
6. Suggest ways of augmenting surface and ground water resources.

Assessment Pattern

S.No.	Bloom's Category	Test 1	Test 2	Test 3/End semester Examination
1	Remember	20	20	10
2	Understand	40	40	40
3	Apply	40	40	50
4	Analyse	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. Define hydrologic cycle
2. What are the advantages of recording rain gauge?
3. What is hyetograph?
4. What is watershed?
5. Define runoff.
6. What is synthetic unit hydrograph?
7. List out the assumptions made in the analysis of steady radial flow into well
8. What is meant by overdraft?
9. What are the precautions to be taken in selecting a site for the location of a rain gauge?
10. What is infiltration capacity?

Understand

1. Distinguish between catchment and watershed
2. Describe the principle of working of a tipping bucket type recording rain gauge with a neat sketch. What are its advantages and disadvantages?
3. How is the double mass curve techniques used to check the consistency and adjust the rainfall record at a suspicious station?
4. Explain clearly how various factors will affect the runoff.
5. Under what condition you will adopt SCS method of runoff estimation?
6. Describe the step by step procedure of the derivation of a unit hydrograph from an isolated storm.
7. What do you understand by safe yield of a ground water basin?
8. Distinguish between surface runoff and subsurface runoff
9. Explain why rainfall-runoff relationships are needed.
10. Describe how infiltration capacity rate can be measured using double ring infiltrometer. How is it better than a tube infiltrometer?

Apply

1. A catchment has six rain gauge station. In a year, the annual rainfall recorded by the gauges are given below. For a 10% error in the estimation of the mean rainfall, calculate the optimum number of stations in the catchment.

Station	A	B	C	D	E	F
Rainfall (cm)	120.2	118.6	119.3	125.2	100.2	119.9

2. For a drainage basin of 700 km^2, isohyetals drawn for a storm gave the following data. Estimate the average depth of precipitation over the catchment.

Isohyetals (Interval) (cm)	15-12	12-9	9-6	6-3	3-1
Inter-isohyetal area (km^2)	92	128	120	175	85

3. The annual rainfall at a place for a period of 21 years is given below. Draw the rainfall frequency curve and determine (a) The rainfall of 10-year and 20 year recurrence interval (b) The rainfall which occurs 50% of the times (c) The rainfall of probability of 0.75 (d) The probability of occurrence of rainfall of 75cm and its recurrence interval.

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Rainfall in cm	52	62	42	29	32	40	72	62	37	57
1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
42	58	54	44	40	29	42	102	92	46	35

4. A 6h storm produced rainfall intensities of 7, 18, 25, 12, 10, and 3mm/h in successive one hour intervals over a basin of 800 sq.km. The resulting runoff is observed to be 2640 hectare-metres. Determine Φ-index for the basin.
5. Rainfall of magnitude 4cm and 3.5cm occurring on two consecutive 4-h durations on a catchment of area 28 sq.km produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and Φ-index.

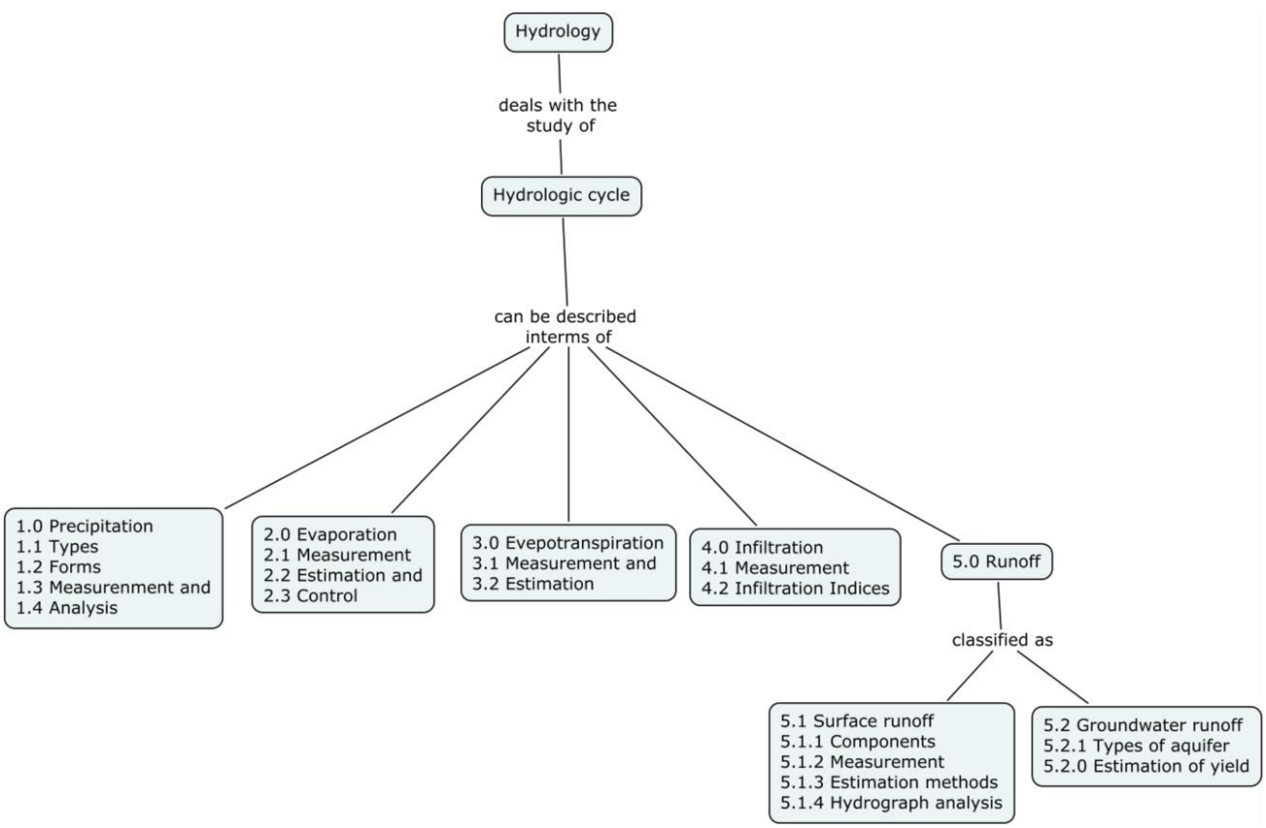
Time from start of rainfall(h)	-6	0	6	12	18	24	30	36	42	48	54	60	66
Observed flow (m^3/s)	3	2	8	20	18	14	10	7	5	3	3	3.5	3.5

6. Given below are the ordinates of a 6-h unit hydrograph for a catchment. Calculate the ordinates of the DRH due to a rainfall excess of 3.5cm occurring in 6hr.

Time (h)	0	3	6	9	12	15	18	24	30	36	42	48	54	60	69
UH Ordinates (m^3/s)	0	22	48	85	125	158	182	158	109	58	34	22	14	6	0

7. A 40cm diameter well completely penetrates a confined aquifer of permeability 48m/day. The length of the strainer is 20m. Under steady state of pumping the drawdown at the well wall was found to be 3m and the radius of influence was 300m. Calculate the discharge.

Concept Map



Course content and Lecture schedule

No	Topic	No. of Lectures
1.0	**Precipitation**	
1.1	Introduction, definition and scope, hydrologic cycle, and Types of precipitation	1
1.2	Forms of precipitation	1
1.3	Measurement of Precipitation - Recording and Non-recording rain gauges, Adequacy of rain gauges, Estimation of missing rainfall data, and Mean precipitation over an area.	3
1.4	Analysis of Precipitation - Frequency analysis- Rainfall hyetograph, and Rainfall mass curve	3
2.0	**Evaporation**	
2.1	Measurement of evaporation	3
2.2	Estimation of evaporation	3
2.3	Evaporation control	1
3.0	**Evapotranspiration**	
3.1	Measurement of evapotranspiration	2
3.2	Estimation of evapotranspiration	2
4.0	Infiltration	
4.1	Measurement of infiltration	2
4.2	Infiltration indices	1
5.0	**Runoff**	
5.1	Surface runoff	
5.1.1	Components of runoff	2
5.1.2	Measurement of runoff	2

5.1.3	Methods of estimation of runoff - SCS method	2
5.1.4	Hydrograph analysis - Methods of base flow separation, Unit hydrograph, Synthetic unit hydrograph, S-curve	5
5.1.5	Floods- Flood control measures, Flood routing by Muskingum method, Hydraulic Routing	2
5.2	Ground water runoff	
5.2.1	Types of aquifer- Definition, Properties and types of aquifer, Aquifer parameters, Rain water harvesting from roof top and open space and Methods of artificial reacharge	3
5.2.2	Estimation of yield - Steady flow to wells for confined and unconfined aquifer and Pumping test	2

Syllabus

Hydrologic processes: Introduction, definition and scope, hydrologic cycle, Types and form of precipitation, Adequacy of rain gauges, Recording and Non-recording rain gauges, Estimation of missing rainfall data, Mean precipitation over an area, Frequency analysis, Rainfall hyetograph, Rainfall mass curve, Evaporation and its control, Evapo transpiration, Infiltration and other abstractions.

Surface runoff: Definition of runoff, factors affecting ruoff and its components, SCS method, Hydrograph analysis, Components of hydrograph, Methods of base flow separation, Unit hydrograph, Synthetic unit hydrograph, S-curve and Stream flow measurements. **Floods**: Definition, Flood control measures, Flood routing by Muskingum method, Hydraulic Routing, Methods of artificial reacharge, Rain water harvesting from Roof top and open spaces. **Ground water:** Definition, Properties and types of aquifer, Aquifer parameters, Steady flow to wells for confined and unconfined aquifer and Pumping test.

Course designers:

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6E	3	0	0	3

B6E Municipal Solid waste Management 3:0

Preamble

This course work aims at imparting the knowledge on types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste. The engineering and scientific details of solid waste management that meets public health and environmental concerns are well addressed.

Programme outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will identify, formulate, research literature and solve complex engineering problems, reaching substantiated conclusions using first principles of mathematics and engineering sciences.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the end of the course, the student should be able to

1. Estimate the waste generated by a community
2. Understand the factors that affect generation of waste
3. Explain the frame work of resource management such as 4R concepts.
4. List the collection methods, collection vehicles & man power requirement.
5. Identify the optimum collection routes.
6. Identify the location of transfer station and disposal site.
7. Explain the engineering and scientific details of processing of solid wastes and resource recovery.
8. Plan the methods of disposing solid waste.
9. Understand the treatment, storage, and disposal facility for hazardous waste.

Assessment Pattern

S.No.	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	10
2	Understand	40	40	40
3	Apply	40	40	30
4	Analyze	0	0	10
5	Evaluate	0	0	10
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. What are the different functional elements in municipal solid waste management?
2. What is the composition of a typical municipal solid waste?
3. List the chemical characteristics of a municipal solid waste?
4. List the adverse health and environment impacts due to improper handling of solid waste.
5. What are the types of containers and collection vehicles used for solid waste management?
6. What are the attributes of hazardous wastes?

Understand

1. Based on the source and type, classify the waste generated in your locality.
2. Discuss the factors that contribute to the generation of solid waste in a community?
3. State the factors to be considered while finalizing a collection route.
4. Explain the role of a transfer station in solid waste management?
5. Explain the need for source reduction in waste management?
6. Differentiate recycling and reuse?

Apply

1. Find the current waste collection practice in your locality and state its role in waste management?
2. Discuss the various constraints faced by municipal authorities in identifying a disposal site?
3. Do you think a sanitary landfill is possible to manage wastes in your locality? List at least three reasons to support your answer.
4. How will you control leachate generation from a landfill?
5. Compare sanitary landfill and open dumping from the point of view of public health & environment?
6. Suggest the best disposal option for the municipal solid waste generated from your locality.

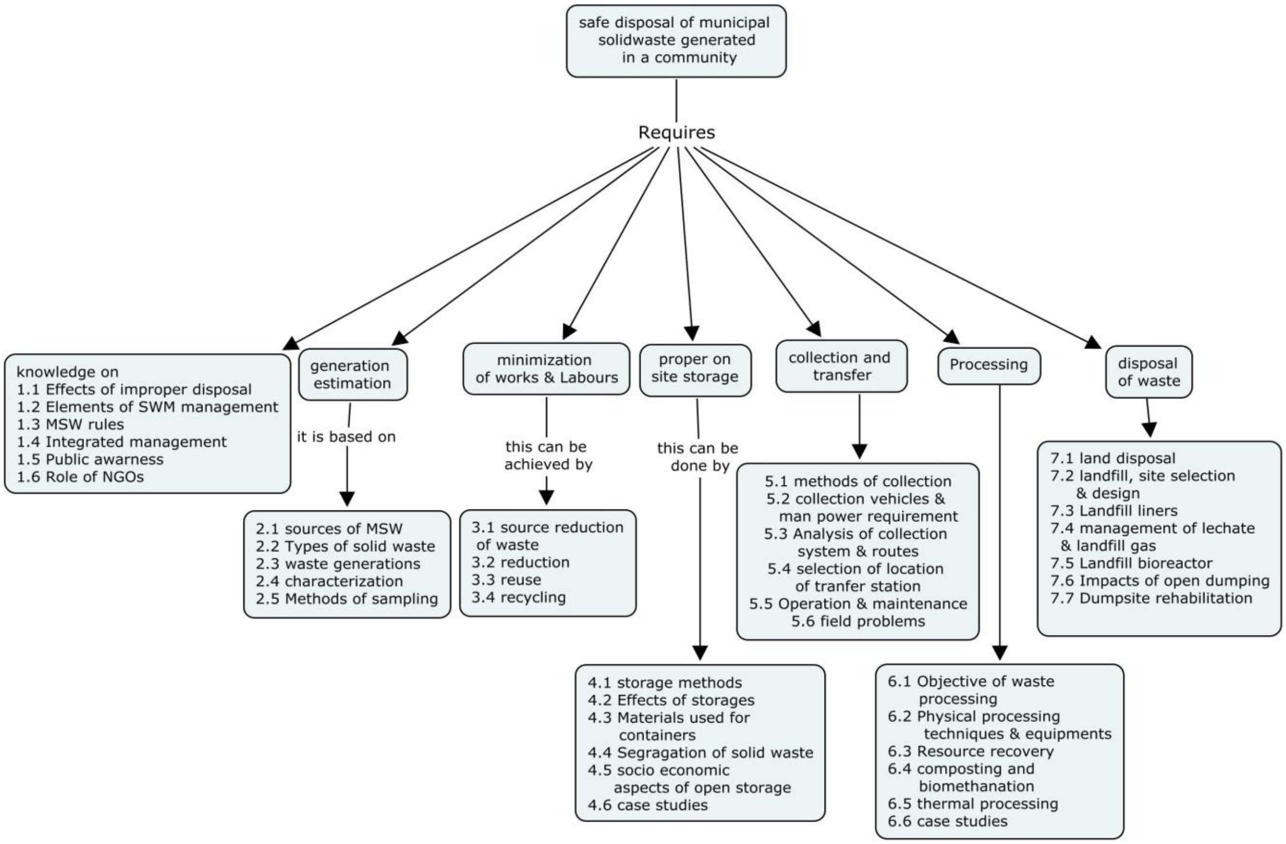
Analyze

1. Compare the various recovery options and processing technologies for the Municipal solid waste?
2. Analyze the environmental effects of composting and bio-gasification.
3. Discuss the various options for disposal of wastes and their selection criteria.
4. Assess the technical viability of various processing techniques.
5. Waste generation rate is normally high in bigger cities - why?
6. What are the factors contribute to the variations in composition of municipal solid waste.

Evaluate

1. Evaluate various options present before implementing a source reduction policy?
2. Assess the energy generation potential of a MSW.
3. How will you choose a solid waste collection system to a city?
4. Determine the most viable disposal options for join locality?
5. Evaluate the potential of solid waste to be used as a fuel for incineration process.
6. Comment on the current waste collection practice in your town.

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Solid Waste Management Overview	
1.1	Elements of solid waste management	1
1.2	Municipal solid waste (M & H) rules	1
1.3	Integrated solid waste management	1
1.4	Public awareness & Role of NGO's	1
1.5	Effects of improper disposal of solid wastes	1
	Sources & Generation	

2.1	Source and Types of solid waste	1
2.2	Waste generation rate & Characterization of waste	1
2.3	Methods of sampling	1
	Source Reduction	
3.1	Source reduction of waste	1
3.2	3R concepts - Reduction concept	1
3.3	Reuse concept	1
3.4	Recycling concept	1
	Storage & Segregation	
4.1	Storage methods & Effects of storage	1
4.2	Materials used for containers	1
4.3	Segregation of solid waste	1
4.4	Socio economic aspects of open storage	1
4.5	Case studies – regarding site storage	1
	Collection & Transfer of Solid waste	
5.1	Methods of collection	1
5.2	Collection vehicles and manpower requirement	1
5.3	Analysis of collection system and routes	3
5.4	Selection of location of transfer station	1
5.5	Operation and maintenance of transfer station	1
5.6	Field problems during transfer	1
	Processing	
6.1	Objectives of waste processing	1
6.2	Physical processing techniques and equipments	1
6.3	Resource recovery	1
6.4	Composting and biomethanation	1

6.5	Thermal processing of solid waste	1
6.6	Case studies - processing	2
Disposal of solid waste		
7.1	Land disposal	1
7.2	Landfill site selection and design	1
7.3	Landfill liners	1
7.4	Management of leachate and landfill gases	1
7.5	Bioreactor Landfill	1
7.6	Impacts of open dumping – on surface, ground water, Green house effect	2
7.7	Dumpsite rehabilitation	1
		40

Syllabus

Solid Waste Management Overview Sources and types of municipal solid wastes-Waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes – Public health and environmental effects. Elements of solid waste management – Municipal solid waste (M & H) rules – integrated management – Social and Financial aspects; Public awareness; Role of NGO's.

Source Reduction Source reduction of waste -Reduction, Reuse and Recycling-On-site **Storage & Segregation** storage methods-Effect of storage, materials used for containers-segregation of solid wastes-Public health and economic aspects of open storage-waste segregation and storage-case studies under Indian conditions.

Collection & Transfer of Solid waste Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection system; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems.

Processing Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste - composting and biomethanation; Thermal processing options – case studies under Indian conditions.

Disposal of solid waste Land disposal of solid waste - Sanitary land fills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gases –bioreactor Landfill – Impacts of open dumping – on surface, ground water, Green house effect - Dumpsite Rehabilitation.

Text Book

1. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, " Integrated Solid waste management", McGraw Hill Publishers, New York, 1993.

Reference Books

1. "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000
2. Bhide A.D and Sundaresan, B.B. "Solid Waste Management Collection, Processing and Disposal", 2001, ISBN 81-7525-282-0
3. Paul T Williams (200). "Waste Treatment and Disposal", John Willey and Sons.

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CURRICULUM AND DETAILED SYLLABI

FOR

B.E DEGREE (Civil Engineering) PROGRAM

SIXTH SEMESTER – GENERAL ELECTIVE

FOR THE STUDENTS ADMITTED FROM THE

ACADEMIC YEAR 2008-2009 ONWARDS

THIAGARAJAR COLLEGE OF ENGINEERING
(A Government Aided ISO 9001-2000 certified
Autonomous Institution affiliated to Anna University)

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Sub Code	Lectures	Tutorial	Practical	Credit
B6AG	3	0	0	3

B6AG SUSTAINABLE DEVELOPMENT 3:0

Preamble

This course work aims at imparting the knowledge on Sustainable development for a sustainable future. Starting from minimizing the causes for various Environmental issues (like resource degradation, green house gases, industrialization) implementing eco development programmes, promoting Environmental awareness among public/individuals for resource protection and technological innovations for sustainable development are well addressed. The student is expected to understand the Environmental issues and demonstrate knowledge of and need for sustainable development, apply knowledge of technological innovations, range of technology and an engineering specialization for achieving sustainable development, and understand the effects of various technologies on global health as they interact with society and culture.

Programme outcomes addressed

- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models.
- Graduates will demonstrate understanding of the societal, health, safety, legal and cultural issues and consequent responsibilities relevant to engineering practice.
- Graduates will understand the impact of engineering solutions in a societal context and demonstrate knowledge of and need for sustainable development.
- Graduates will understand and commit to professional ethics and responsibilities and norms of engineering practice.

Competencies

At the End of the Course, the student should be able to

1. Understand the concept of Sustainable Development.
2. Understand the socio-economic policies for sustainable development.
3. Identify the strategies for implementing eco development programmes.
4. Review technological innovations for their impact on integrated in different settings.
5. Suggest action plans for implementing sustainable development.
6. Identify different approaches for resource protection and management.

Assessment Pattern

S.No	Blooms Category	Test – 1	Test – 2	Test – 3 / End semester examination
1	Remember	20	20	20
2	Understand	50	50	50
3	Apply	30	30	30
4	Analyze	0	0	0
5	Evaluate	0	0	0
6	Create	0	0	0

Course Level Learning Objectives

Remember

1. Define sustainable development.
2. What are the principles of Sustainable Development?
3. What are the Indicators for Sustainable Development?
4. Define Desertification.
5. What are the effects of green house gases?
6. What are the concepts of Sustainable Development?

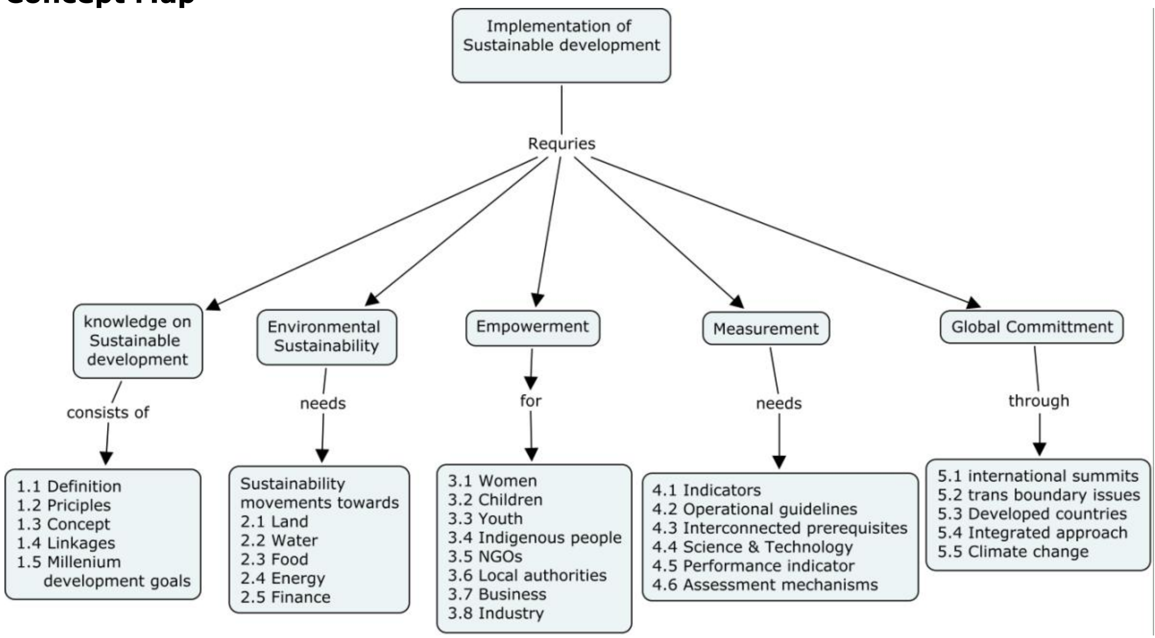
Understand

1. Explain the current Environmental issues.
2. Explain in detail about green house gases.
3. Explain the concept of sustainable development.
4. Describe in detail about global warming.
5. Discuss the role of fossil fuels in climate change.
6. Explain the strategies for implementing ecodevelopment programmes.

Apply

1. How will you minimize the environmental impact to achieve sustainable development?
2. How will you achieve sustainable development in global trading?
3. How will you promote Environmental awareness?
4. How will you minimize the effects on plants and animals due to green house gases?
5. How will you select the approach for resource protection?
6. How will you minimize the non renewable energy source in future?

Concept Map



Course content and Lecture schedule

S.No	Topics	Periods
	Introduction to Sustainable Development	
1.1	Definitions	1
1.2	principles of Sustainable Development	1
1.3	concept of Sustainable Development	1
1.4	Environment and Development linkages	1
1.5	Millennium Development Goals	1
	Environmental Sustainability	
2.1	Movement towards Sustainability	1
2.2	Role of Land, Water, food production in Sustainability	3
2.3	Energy and Sustainable development	1
2.4	Financing the environment	1

	Empowerment	
3.1	Women	1
3.2	Children	1
3.3	Youth	1
3.4	Indigenous people	1
3.5	NGOs	1
3.6	Local authorities	1
3.7	Business	1
3.8	Industry	1
	Measurements	
4.1	Sustainability Indicators	1
4.2	Operational guidelines	1
4.3	Interconnected prerequisites for sustainable development	1
4.4	Science and Technology for sustainable development	1
4.5	Performance indicators of sustainability	1
4.6	Assessment mechanism	1
4.6.1	Constraints and barriers for sustainable development	1
	Global Commitment	
5.1	Developed countries	1
5.2	International summits	1
5.3	Transboundry issues	1
5.4	Integrated approach for resource protection and management	1
5.5	Climate change	1
5.5.1	Chemistry of atmosphere	1
5.5.2	Chemistry of green house gases	1
5.5.3	effects on plants and animals	1
5.5.4	Global warming, Sea level rise, Ozone problem	1

5.5.5	ecosystems and species interactions	1
5.5.6	changes in agricultural production, droughts, spread of epidemics	1
5.5.7	wildfires and other extreme weather events	1
5.5.8	Role of fossil fuels in climate change, future use of renewable energy	1
5.5.9	Role of governments, industries and individuals	1
5.5.10	International agreements and protocols	1
		40

Syllabus

Introduction to Sustainable Development Definitions and principles of Sustainable Development – History and emergence of the concept of Sustainable Development – Environment and Development linkages – Globalization and environment – Millennium Development Goals: Status (global and Indian) Impacts on approach to development policy and practice in India, future directions.

Environmental Sustainability Land, Water and Food production – Moving towards sustainability: Energy powering Sustainable Development – Financing the environment and Sustainable Development.

Empowerment - Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - **Measurements** - Sustainability indicators – Hurdles to sustainability – Operational guidelines – Interconnected prerequisites for sustainable development – Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Global Commitment - Role of developed countries in the development of developing countries – International summits, Transboundry issues – Integrated approach for resource protection and management.

Climate change - Chemistry of atmosphere, Chemistry of green house gases, effects on plants and animals. Global warming, Sea level rise, Ozone problem. The green house effect- ecosystems and species interactions, changes in agricultural production, droughts, spread of epidemics, wildfires and other extreme weather events. Role of fossil fuels in climate change, future use of renewable energy, role of governments, industries and individuals, International agreements and protocols.

Text Book

1. "Sustainable development" Kirkby. J, O'Keefe P. and Timberlake, Earth Scan Publication, London, 1996.

Reference Books

1. "Achieving Broad-Based Sustainable Development: Governance, Environment, and Growth with Equity" James H. Weaver, Michael T. Rock, Kenneth Kustere. Kumarian Press, West Hartford, CT. Publication Year: 1997.
2. Sustainable Environmental Management: Principles and Practice by R. Kerry Turner. 292 pgs. Publisher: Belhaven Press, ISBN:1852930039.
3. "Introduction to Sustainability", N. Munier ,Springer 2005
4. Rural Change and Sustainability - Agriculture, the Environment and Communities, Edited by S J Essex, A W Gilg and R Yarwood CABI September 2005.
5. Environmental Concerns and Sustainable development: Some perspectives from India,Editors: Ganesha Somayaji and Sakarama Somayaji, publisher TERI Press, ISBN 8179932249.

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Sub Code	Lectures	Tutorial	Practical	Credit
B 6BG	3	0	0	3

B6BG PROJECT MANAGEMENT 3:0

Preamble

An engineering student needs to have some exposure to the basic steps involved in the formulation of a project, project management concepts, importance of network techniques and its applications to a project.

Program Outcomes Addressed

- Graduates will demonstrate knowledge of mathematics, science and engineering
- Graduates will demonstrate an ability to identify, formulate and solve engineering problems
- Graduates will apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the conceptualization of engineering models
- Graduate will develop confidence for self education and ability to engage in life – long learning
- Graduates who can participate and succeed in competitive examinations

Competencies

At the end of the course, the students will be able to:

1. Understand the concepts of project Formulation & Financing
2. Understand the conditions to be satisfied for the sanction of projects
3. Get an exposure to the concepts of Project Management and its functions
4. Understand the traditional method of analyzing projects with merits and limitations
5. Represent projects in the form of Network diagrams
6. Understand the scientific tools for analyzing projects namely PERT and CPM
7. Apply the principles of CPM for balancing of resources, updating and cost crashing in projects

Assessment Pattern

S. No.	**Blooms Category**	**Test-1**	**Test-2**	**Test-3/ End semester Examination**
1.	Remember	20	10	0
2.	Understand	20	10	10
3.	Apply	50	40	40
4.	Analyze	0	20	30
5.	Evaluate	10	20	20
6.	Create	0	0	0

Course Level Learning Objectives

Remember

1. What is meant by project management? Mention its need
2. List the conditions to be satisfied for the sanction of projects
3. What is meant by administrative approval? When is it accorded for projects?
4. Mention the goals of project management
5. Define the term planning of projects
6. Define the term updating of projects? Write its need and importance
7. What do you understand by the term work break down structure of projects?
8. Mention two advantages of network techniques of analyzing projects
9. Define the term total float. Mention its importance
10. Define the term direct cost in projects with examples
11. List the resources for a project
12. List the components of DPR
13. Write the essential contents of a TOR
14. Define BOOT, BOLT, BOT

Understand

1. Discuss the functions of project management
2. Write the objectives of project management
3. Discuss the different methods of project financial
4. Discuss the merits and limitations of bar-chart technique
5. Discuss the procedure of preliminary planning of schemes
6. Compare CPM and PERT
7. Compare GERT with CPM and PERT techniques
8. Why should resources be balanced in project? Write its significance
9. Compare the smoothing and leveling methods of resource balancing
10. Write the significance of optimum time minimum cost relationship of a project
11. Compare direct and indirect costs of a project with examples of each
12. Discuss the essential conditions to be satisfied for sanction of projects
13. Discuss the rules of Fulkerson for drawing of network diagram

Apply

1. A project consists of six activities with the following logical relationships. Draw a network for the project and determine the critical path using the traditional method

- A and B are the initial activities and can be performed concurrently
- C follows A but cannot start until B is over
- D and E succeed B
- C and D precede F
- E and F are terminal activities

Activity	A	B	C	D	E	F
Duration (Days)	2	4	7	1	6	3

2. A project consists of 5 activities with the following relationship, draw a bar chart assuming the project commences on 15 April wednesday with five working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion

3. A project consists of six activities with the following logical relationships. Draw a network for the project and determine the critical path using the traditional method

- A and B are the initial activities and can be performed concurrently
- C follows A but cannot start until B is over
- D and E succeed B
- C and D precede F
- E and F are terminal activities

Activity	A	B	C	D	E	F
Duration (Days)	7	8	3	2	7	4

Find the status of the project on 10^{th} day of its commencement?

4. Conduct Activity oriented network analysis for the following project and determine:
- ES, EF, LS & LF times for the project
- Total , Free and interfering floats for the project
- Critical path and critical activities
- Draw the square network diagram for the project

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
Duration days	2	3	4	0	7	2	4

5. Conduct Event oriented network analysis for the following project and determine:
- Earliest and latest allowable occurrence times for the events
- Expected time and standard deviations for activities
- Project completion time and its degree of variability
- What is the probability of completing the project 2 days ahead of schedule?
- What is the probability of not completing the project 1 day behind schedule?
- Find the due date that has 75% chance of being met?

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
t_0 days	2	3	4	0	7	2	4
t_m days	3	3	10	0	12	7	6
t_p days	5	3	12	0	15	9	8

6. Write the DPR for converting your office with e- governance

Analyze

1. Which of the three methods of project financing (BOT, BOLT, BOOT) is the best from economy point of view? Substantiate with reasons
2. Why bar charts are suitable only for smaller magnitude project? Justify?

3. A project consists of 6 activities with the following relationship, draw a bar chart assuming the project commences on 8 July Thursday with six working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion
- C can start after E and F are completed

Find the completion date and day of the project. What would happen to the completion time of the project if B is delayed by 5 days?

4. A project consists of 6 activities with the following relationship, draw a bar chart assuming the project commences on 27 January Monday with five working days a week. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 2 days and 5 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion
- C can start after E and F are completed

Find the completion date and day of the project. What would happen to the completion time of the project if D is delayed by 2 days?
Find the status of the project on 10th February?

5. A project consists of 5 activities with the following relationship, draw a bar chart. Determine the project completion day and date. What is the total duration of the project

- A is the initial activity with duration 7 days for completion
- A is followed by B and D with 5 days and 4 days respectively
- E can start after half the work of B is over and it takes 9 days for completion
- D and B precede F which takes 5 days for completion

If on the 11th day of commencement the following status occurs, update the project and determine the revised completion time if any?

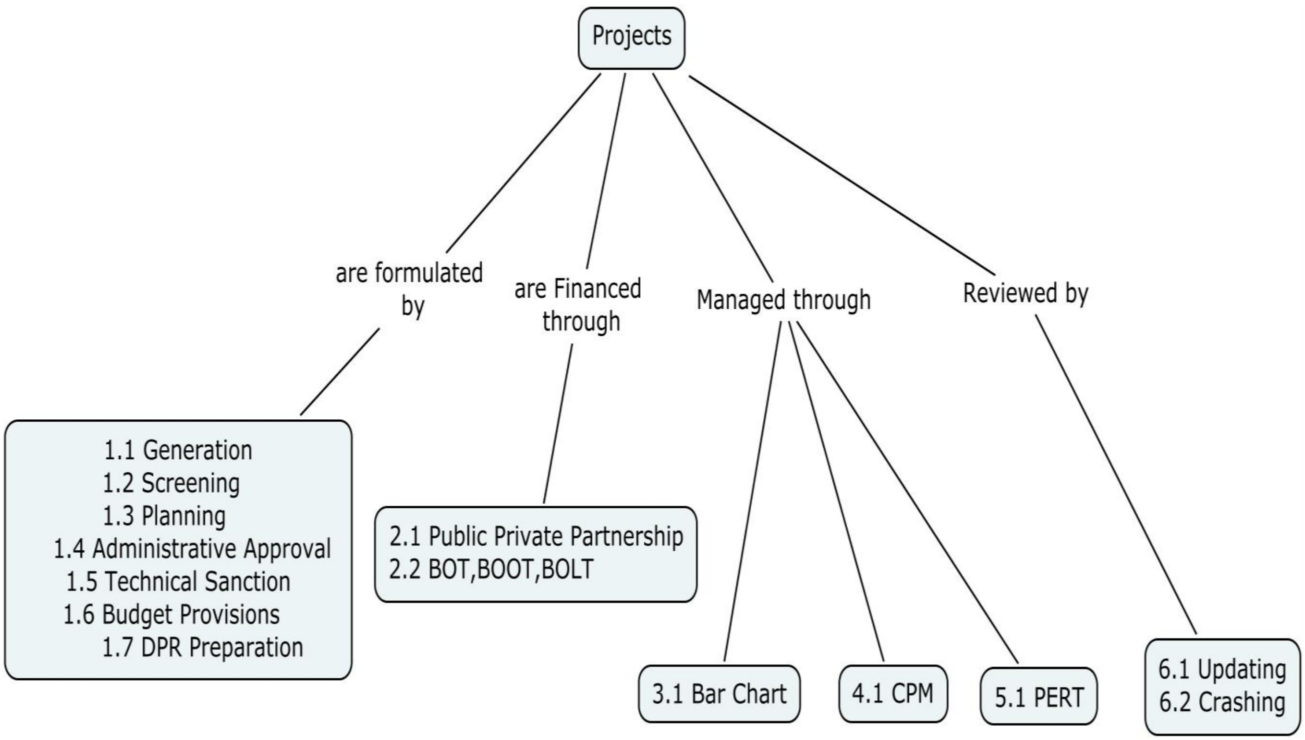
- A is completed as per schedule
- B is in progress and requires 2 more days for completion
- D is delayed by 7 days and it requires 8 more days for its completion
- E is in progress and the original time will hold good
- F is yet to start

Evaluate

1. A project consists of 7 activities with costs and times gives as shown in table. Crash the project and determine the optimum time and minimum cost relationship for the project. Assume the indirect cost to vary at Rs.500/- per day.

Activity i-j	1-2	1-3	2-4	3-4	3-5	4-5	5-6
Normal time days	5	7	4	2	5	3	4
Crash time days	3	4	2	1	3	2	1
Normal cost Rs.	500	100	200	400	350	380	50
Crash cost Rs.	800	300	500	750	800	900	150

Concept Map



Course Content and Lecture Schedule

S. No.	Topics	Periods
Project Formulation		
1.1	Generation and screening of project ideas, project identification, preliminary analysis	1
1.2	Preliminary planning of schemes, investigation, preliminary estimate	2
1.3	Administrative approval, Technical sanction and Budget sanctions for projects, DPR preparation, TOR	2
Project Financing, Private Sector Participation		
2.1	Project Financing, means of finance, Private Sector participation	2

2.2	BOT, BOLT, BOOT, Technology transfer	2
Project Management		
3.1	Introduction to Project Management concepts, background of management, purpose, goal and objectives	1
3.2	Characteristics of projects and different functions of management	1
3.3	Traditional Management system, Gantt's Approach, Progress-chart – problems, merits and limitations of bar chart	2
3.4	Work study, work break down structure, time estimates, project programming, phasing of activities programmes	1
3.5	Scheduling project control, reviewing, updating and monitoring –concept	1
3.6	Problems in updating and monitoring of projects	1
Network techniques of Project Management		
4.1	Introduction to modern management concepts, uni-dimensional management techniques - introduction to network concepts, network elements and inter-relationships	2
4.2	Network techniques, network logic- inter-relationships activity information, data sheets and development of network- problems in drawing of network diagrams	2
4.3	PERT network, introduction to the theory of probability and statistics, probabilistic time estimate for the activities, analysis of PERT network	2
4.4	Problems in PERT analysis of projects	2
4.5	CPM for management, CPM network analysis, identification of critical path, floats, square network diagrams	2
4.6	Problems in CPM analysis of projects	2
4.7	GERT- Merits, comparison with PERT and CPM, Comparison of CPM and PERT	1
Network techniques of Project Management		
5.1	Resource balancing- Objective, resource smoothing and resource leveling techniques	1

5.2	Problems in resource smoothing	2
5.3	Problems in resource levelling	2
5.4	Introduction to two dimensional network analysis, activity cost information. Cost time relationship, crashed estimates for the activities, compression potential, cost slope utility data sheet, project direct and indirect costs	2
5.5	Crashed programme, network compression least cost solution, least time solution and optimum time solution	2
5.6	Problems in cost crashing	2

Syllabus

Project Formulation

Generation and screening of project ideas – project identification- preliminary analysis- planning of schemes, estimates – investigation –estimate -Administrative approval - Technical and budget sanctions, DPR, TOR.

Project Financing, Private Sector Participation

Project Financing- means of finance- Private Sector Participation – BOT, BOLT, BOOT- Technology transfer.

Project Management

Introduction to Project Management concepts- Background of management, purpose, goal and objectives, characteristics of projects and different functions of management.

Traditional Management system, Gantt's Approach, progress- Chart, Bar-Chart merits and limitations. Work study, work break down structure, time estimates.

Project programming, phasing of activities programmes, scheduling project control, reviewing, updating and monitoring.

Network techniques of Project Management

Introduction to modern management concepts, introduction to network concepts, network elements.

Network techniques, network logic- inter-relationships activity information, data sheets and development of network.

PERT network, introduction to the theory of probability and statistics, probabilistic time estimate for the activities, analysis of PERT network

CPM for management, CPM network analysis, identification of critical path, floats, square network diagrams. Generalized activity networks – GERT- Merits, comparison with PERT and CPM – updating a projects.

Balancing of resources and Crashing of cost in projects

Resource balancing- Objective, resource smoothing and resource leveling techniques.

Introduction to activity cost information. Cost time relationship, crashed estimates for the activities, compression potential, cost slope utility data sheet, project direct and indirect costs.

Crashed programme, network compression least cost solution, least time solution and optimum time solution.

Text Books:

1. Punmia B. C. and Khandelwal K.K., "Project Planning and Control with PERT/CPM", Laxmi publications, New Delhi, 1987.

Reference Books:

1. Jerome D. Wiest and Ferdinand K. Levy, (1982) "A Management Guide to PERT/CPM", Prentice Hall of India Publishers Ltd., New Delhi.
2. Srinath L.S., "PERT & CPM- Principles and Applications", Affiliated East West Press Pvt., Ltd., New Delhi
3. Sengupta. B and Guha. H, "Construction Management and Planning", Tata McGraw Hill, New Delhi, 1995
4. Sanga Reddi. S and Meiyappan. PL, "Construction Mangement", Kumaran Publications, Coimbatore, 1999

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