CET281	BUILDING CONSTRUCTION AND STRUCTURAL SYSTEMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble:

This course provides the essential aspects of building construction such as components of buildings, materials of construction and structural systems to the students of other branches of Engineering.

Pre requisite: Nil

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the properties and testing methods of different materials used for building construction.	Understanding
CO2	Explain the construction details of different components of buildings.	Understanding
CO3	Explain construction practices such as prefabricated, cost effective and sustainable technologies	Understanding
CO4	Explain the details and behavior of structural systems and structural elements used in buildings.	Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		-	-	-	-	-	-	-	-	-	-
CO2	2		-	-	-	-	-	-	-	-	-	-
CO3	2		-	-	-	-	-	-	-	-	-	-
CO4	2		-	-	-	-	-	-	-	-	-	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

CO1 Explain the properties and testing methods of different materials used for building construction.

1. What is blended cement? What are its advantages?
2. Explain any one test performed on coarse aggregate.
3. Discuss the role of admixtures in concrete
4. Explain any one test performed in fresh concrete.
5. Explain any one test performed on hardened concrete.

CO2 Explain the construction details of different components of buildings.

1. What is a lintel? Why is it required?
2. Explain the different types of shallow foundations.
3. Explain the different types of deep foundations.
4. Explain the procedure adopted for laying marble flooring.

CO3 Explain construction practices such as prefabricated, cost effective and sustainable technologies

1. What is prefabrication? What are the advantages and disadvantages of prefabricated construction?
2. Explain the construction details of rat-trap bond masonry.
3. Explain the principles of filler slab.

CO4 Explain the details and behavior of structural systems and structural elements used in buildings.

1. What are the different forms of reinforcement used in columns? Explain the functions of each.
2. Distinguish between load bearing wall construction and moment resisting frame construction.
3. Sketch any two types of steel roof truss.
4. Sketch the reinforcement details of a simply supported beam.

SYLLABUS

Module -1

Cement – Types, Composition, manufacturing process, properties, tests. Aggregates – properties, tests. Mortar – types, properties, uses. Chemical admixtures – types, uses.

Module -2

Concrete – PCC, RCC. Properties of fresh concrete, Workability – tests. Properties of hardened concrete – tests for strength, Nominal mix and design mix.

Module - 3

Flooring and roofing materials, Lintels and arches, Types and construction details of doors, windows and ventilators. Finishing works, Timber products, Formwork

Module -4

Foundations – shallow and deep, Cost effective construction, Sustainable building technologies, Non destructive testing of concrete, Prefabricated construction.

Module -5

Structural elements - beams, columns and slabs. Principles of reinforced concrete, types of reinforcements, Reinforcement details of structural elements, Structural systems, Concrete floor systems.

Text Books

1. Punmia B. C, Building Construction, Laxmi Publications
2. Arora and Bindra, Building Construction, Dhanpath Rai and Sons.
3. Shetty M.S., Concrete Technology, S. Chand & company.

References

1. Madan Mehta, Walter Scarborough and Diane Armpriest, Building Construction – Principles, Materials and Systems, Pearson.
2. Daniel Schodek and Martin Bechthold, Structures, Pearson.
3. V. SankaraSubramaniyan, Construction Technology, Lakshmi Publications, Chennai.
4. S. S. Bhavikatti, Construction Technology, Chess Educational Publishers, Chennai.
5. Rangwala S C., Engineering Materials, Charotar Publishers.

6. P. C. Varghese, Building Materials, PHI Learning Pvt Ltd., Delhi.
7. Mehta and Monteiro, Concrete - Micro structure, Properties and Materials, McGraw Hill Professional.
8. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education.
9. R. Santhakumar, Concrete Technology, Oxford Publications.

Lecture Plan - Building Construction and Structural Systems

Module	*Topic*	*Course Outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	Cement – Types of cements, chemical composition. Blended cements	CO1	1
1.2	Manufacturing of cement	CO1	1
1.3	Properties and tests on cement, Hydration of cement	CO1	2
1.4	Aggregates – types, role of aggregates.	CO1	1
1.5	Properties of aggregates and tests. Grading requirements. Natural and synthetic aggregates	CO1	2
1.6	Mortar – types, Sand – properties, uses	CO1	1
1.7	Water quality for construction. Chemical admixtures – types and uses.	CO1	1
2	**Module II : Total lecture hours : 10**		
2.1	Concrete – PCC, RCC and Prestressed concrete (brief descriptions only)	CO1	1
2.2	Making of concrete – batching, mixing, transporting, placing, compacting, finishing and curing	CO1	2
2.3	Properties of fresh concrete – workability, segregation and bleeding.	CO1	1
2.4	Factors affecting workability and strength – tests on workability, demonstration of slump test.	CO1	2
2.5	Effects of aggregates on properties of concrete	CO1	1
2.6	Properties of hardened concrete – tests for strength of concrete in compression, tension and flexure.	CO1	2
2.7	Nominal mixes and design mixes, mix designations, ready mixed concrete	CO1	1
3	**Module III : Total lecture hours : 8**		
3.1	Flooring and roofing materials	CO2	1
3.2	Lintels and arches – types.	CO2	1
3.3	Doors, Windows and ventilators – types and construction	CO2	2

	details		
3.4	Finishing works. Paint – types	CO1	1
3.5	Timber – seasoning	CO1	1
3.6	Timber products – properties and uses of plywood, fibre board and particle board	CO1	1
3.7	Formwork, Construction and expansion joints	CO2	1
4	**Module IV : Total lecture hours : 10**		
4.1	Types of shallow foundations.	CO2	1
4.2	Types of deep foundations.	CO2	1
4.3	Foundation failure – causes	CO2	1
4.4	Introduction to cost effective construction – principles of filler slab and rat-trap bond masonry.	CO3	2
4.5	Sustainable building technologies.	CO3	2
4.6	Non destructive testing of concrete – rebound hammer test and ultrasonic pulse velocity test.(with demonstrations)	CO1	2
4.7	Introduction to prefabricated construction- advantages, slip form construction	CO3	1
5	**Module V : Total lecture hours : 8**		
5.1	Introduction to structural systems – functions, Primary structural elements – beams, columns and slabs.	CO4	1
5.2	Principles of reinforced concrete, types of reinforcements – tension reinforcements, compression reinforcements and stirrups.	CO4	2
5.3	Reinforcement details of beams, columns and slabs.	CO4	2
5.4	Structural systems – load bearing walls, moment resisting frames	CO4	1
5.5	Structural systems – trusses, cables and membranes	CO4	1
5.6	Elevated concrete floor systems, beams supported concrete floors – one way and two way slabs, flat slabs.	CO4	1

MODEL QUESTION PAPER

Reg.No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET281

Course Name: BUILDING CONSTRUCTION AND STRUCTURAL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) What is hydration of cement?
   b) What is mortar? What are its uses?
   c) What are the advantages of prestressed concrete over conventional reinforced concrete?
   d) Distinguish between nominal mix and design mix.
   e) Name different types of paints and mention their use.
   f) List different types of timber products used in building construction.
   g) What is a raft foundation?
   h) Explain any one non destructive test used to assess the quality of concrete.
   i) What is a truss? How does a truss resist external loads?
   j) Why is reinforcement essential in concrete beams?

(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

2. a) What is mean by grading of aggregates? (5)
   b) Explain the process of manufacturing cement. (9)
3. a) Explain the role of admixtures in concrete (5)
   b) Explain the various tests used to assess properties of cement. (9)

Module II

4. a) What is curing of concrete? Why is it important? (5)
   b) What is meant by workability of concrete? Discuss the factors influencing workability of concrete. (9)
5. a) Distinguish between segregation and bleeding. (5)

	b)	Explain the various tests performed on hardened concrete.	(9)

Module III

6.	a)	Sketch a typical arch and mark its parts.	(5)
	b)	What is seasoning of timber? Explain different methods of seasoning.	(9)
7.	a)	What is a lintel? Why it is required?	(5)
	b)	Explain different types of scaffoldings.	(9)

Module IV

8.	a)	Explain with neat sketches any three types of foundations.	(6)
	b)	Describe the causes of foundation failure.	(8)
9.	a)	What is a slip form? Where are they used?	(6)
	b)	Explain the construction of filler slabs.	(8)

Module V

10.	a)	What are the functions of a structural system?	(5)
	b)	With the help of neat sketches, explain the different forms of reinforcement used in beams? Also explain the functions of each.	(9)
11.	a)	Distinguish between one way and two way slab systems.	(5)
	b)	Compare load bearing wall construction and moment resisting frame construction.	(9)

****

CET282	COURSE NAME BUILDING DRAWING	CATEGORY	L	T	P	CREDIT
		VAC	2	2	0	4

Preamble: Objective of the course is to give exposure to building rules, impart training in visualisation and planning of various types of buildings and their components.

Prerequisite: Engineering Graphics

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

CO 1	The student will be able to understand building drawing, scales and methods of dimensioning
CO 2	The student will be able draw the details of panelled door, glazed windows, joint details of roof truss
CO 3	The student will be able to draw plan and sectional elevation of reinforced concrete staircase
CO 4	Understand the basic concepts and methods of building drawing using AutoCAD Software
CO 5	The student will be able to prepare site plan, service plan, Septic tank and soak pit - detailed drawing

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	2	-	-	-	-	-	-	-
CO 2	3	3	-	-	3	-	-	-	-	-	-	-
CO 3	3	3	-	-	3	-	-	-	-	-	-	-
CO 4	3	3	-	-	3	-	-	-	-	-	-	-
CO 5	3	3	-	-	3	-	-	-	-	-	-	-

Mark distribution

Total marks	CIE Marks	ESE Marks	ESE duration
150	50	100	3 hours

Continuous internal evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern: ESE will be of **3 hour** duration on A2 size answer booklet and will be for 100 marks. (only manual drafting for ESE). 5 descriptive type questions of 2 marks each, one from each module. 2 drawing questions of 45 marks each, with choice from 4, from any 4 modules.

Syllabus

Module 1

General – Study of IS Codes of practice on building drawing – Scales- method of dimensioning.

Sectional plan, sectional elevation, front view and joint details of Panelled door and Glazed windows.

Module 2

Types of Roof- Roofing- Elevation and joint details-Roof truss in steel sections.

Types of Stairs- Plan and sectional elevation of reinforced concrete staircase.

Module 3

Building rules- Two storied and multi-storeyed building- Plan, section and elevation.

Public buildings like offices, bank, dispensary etc.

Module 4

Building rules -Industrial building- Plan, section and elevation.

Preparation of site plan and service plan.

Module 5

Preparation of Septic tank and soak pit -detailed drawing.

Course Content and lecturer Schedule:

No.	Course Plan	Course Outcome	No. ofHrs
	Module 1:		
1.1	General – Study of IS Codes of practice on building drawing	CO1	2
1.2	Scales- method of dimensioning		2
1.3	Sectional plan, sectional elevation, front view and joint details of	CO2	
	(a)Panelled doors		2
1.4			
1.5	(b)Glazed windows		2
	Module 2:		
2.1	Types of Roofs	CO2	2
2.2	Roof truss in steel sections		2
2.3	Types of Stairs	CO3	2
2.4	Reinforced concrete staircase		2
	Module 3:		
3.1	Building rules		2
	Plan, section and elevation of	CO4	
3.2	(a) Two storied building		2
3.3	(b) multi-storeyed building		2
3.4	(c) Public building		2

4.1 4.2	**Module 4:** Building rules and type of Industrial building Plan elevation and section of industrial building	CO4	2 2
4.3 4.4	Preparation of site plan service plan	CO5	2 2
5.1	**Module 5:** Preparation of Septic tank and soak pit -detailed drawing	CO5	2

Reference Books

1. National Building Code of India.

2. Kerala Municipal Building Rules.

3. Dr. Balagopal T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, Calicut.

Model Question Paper

QP CODE: Reg No:----------

Name:----------

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code**: CET282**

BUILDING DRAWING

Max. Marks: 100 Duration: 3 hours

Part A
(Answer all questions; each question carries 2 marks)

1. Draw neat sketches for following lines; (a) Section line (b) Hidden line (c) Dimension line (d) Extension line
2. What are the major components of a steel truss?
3. What is the difference between waist slab and folded slab stair?
4. What is FAR and FSI?
5. State the importance of site plan and openings schedule in civil engineering drawing.

PART B
(Answer Two full question, each question carries 45 marks)

6. (a) Draw the elevation and sectional view of a double leaf and six paneled door of size 2000x1200 mm

OR

(b)Plan a RCC stair case for a room dimension 450 cm x 300 cm. Draw plan view and sectional view. Take floor height =3m.

7. (a) a single stored residential house with the following requirements & draw plan, elevation and section.

(i) Verandah (ii) Bed room (3 no's), one with attached toilet (iii) living hall (iv) kitchen (v) work area (vi) common toilet

OR

(b) Draw the plan and elevation of a small hospital for the following requirements;

(i) Doctor's room (2) (ii) causality

(iii) Dressing area (iv) Pharmacy

(v) Laboratory (vi) Store room

(vii) Toilets (vii) ward (5 bed)

CET 283	INTRODUCTION TO GEOTECHNICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of soil mechanics and foundation engineering. After this course, students will be able to identify and classify the soil and to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : Nil

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

CO 1	Explain the basic concepts, theories and methods of analysis in soil mechanics and foundation engineering
CO 2	Solve the basic properties of soil by applying functional relationships
CO 3	Determine the engineering properties of soil by applying the laboratory test results and the fundamental concepts
CO 4	Estimate the design parameters of footings and retaining walls

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	10	10	20
Apply	25	25	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. The fundamental concepts of basic properties and index properties of soil
2. The fundamental concepts of engineering properties of soils related to Permeability, shear strength, consolidation & compaction
3. Concepts of Total, neutral and effective stress; and vertical stress below loaded areas
4. Basic theories of Earth pressure, Bearing Capacity and Settlement of footings

Course Outcome 2 (CO2):

1. Solve the basic properties of soil by applying functional relationships

Course Outcome 3 (CO3):

1. Calculate the engineering properties of soil related to Permeability, consolidation, compaction & shear strength by applying the laboratory test results
2. Calculate the engineering properties of soil by applying the concepts of soil mechanics related to total , neutral and effective stress; and vertical stress below loaded areas

Course Outcome 4 (CO4):

1. Estimate the earth pressure acting on the retaining walls
2. Estimate the bearing capacity of footings
3. Estimate the immediate and consolidation settlement of footings

Model Question Paper

QP CODE:

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 283

Course Name : INTRODUCTION TO GEOTECHNICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. Draw a three phase block diagram and define (i) Void Ratio, (ii) Water Content and (iii) Degree of saturation
2. Explain different types of soil structures.
3. Define (i) Well graded, (ii) Poorly graded and (iii) Gap graded soils
4. Define (i) Liquid Limit, (ii) Plastic Limit and (iii) Shrinkage Limit
5. Explain Mohr Coulomb shear strength theory.
6. Explain different types of earth pressures.
7. Explain the situations in which combined footings are provided.
8. List the assumptions of Terzaghi's theory of bearing capacity.
9. Define (i) pre consolidation pressure, (ii) Compression Index and (iii) Recompression Index.
10. Differentiate between Consolidation and Compaction.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Derive the relation between bulk unit weight, specific gravity, void ratio and degree of saturation from the fundamentals. (5 Marks)

    (b) A sample of wet silty clay soil weighs 1.26 kN. The following data were found from lab tests on the sample. Density γ = 21 kN/m3, Water content w = 15%, Specific Gravity G = 2.7. Determine (i) Dry density, (ii) Void Ratio, (iii) Porosity (iv) Degree of Saturation, (v) Saturated unit weight (vi) Submerged unit weight and (vii) Volume of soil. (9 Marks)

12. (a) Explain the procedures to determine the field density of soil. (5 Marks)

    (b) 1000 cm3 core cutter weighing 9.46 N was used to find out the in-situ unit weight of soil in an embankment. The weight of core cutter with in-situ soil was noted to be 27.7 N. Laboratory tests on the sample indicated water content of 10% and specific gravity of solids of 2.63. Determine the bulk unit weight, dry unit weight, void ratio and degree of saturation. Also

calculate the saturated unit weight and the corresponding water content if the embankment is saturated during rain without change in volume. (9 Marks)

Module – 2

13. (a) Explain the factors affecting permeability of soil. (5 Marks)

(b) A soil sample of height 6 cm and area of cross section 100 cm^2 was subjected to constant head permeability test with head of 36 cm and 90 cc of water passes through the specimen during a test interval of 5 min. Compute the coefficient of permeability of the soil sample.
If the same sample is subjected to falling head permeability test and found that head drops from 60 cm to 20 cm in 4 min. Determine the cross sectional area of the stand pipe. (9 Marks)

14. (a) A concentrated load of 500 kN is applied at ground surface. Compute the vertical pressure (i) at a depth of 5m below the load, (ii) at a distance of 3m at the same depth. Use Boussinesq's theory. (5 Marks)

(b) A sand deposit of 8 m thick was loaded with a uniform surcharge of 10 kN/m^2. Water table (WT) is at 3 m below GL. Density of sand is 18 kN/m^3 above WT and 19 kN/m^3 below WT. Draw Total, Neutral and Effective Stress Diagrams up to 8 m below GL. Take $\gamma_w = 10$ kN/m^3. (9 Marks)

Module – 3

15. (a) List the advantages and disadvantages of Direct Shear Test. (7 Marks)

(b) A cylindrical specimen of soil fails under axial vertical stress of 150 kN/m^2, when it is laterally unconfined. Failure plane makes an angle of 53° with the horizontal. Determine shear strength parameters c & ϕ. (7 Marks)

16. (a) Explain critical depth of an unsupported cut in a cohesive soil. (5 Marks)

(b) A retaining wall 8m high with a smooth vertical back retains a sandy backfill (ϕ =340 , Density of soil above water table is 18 kN/m3 and below water table is 19 kN/m3). Water table is at 3 m below ground level. Find the total active pressure per metre length of the wall and its point of application above the base by Rankine's theory. (9 Marks)

Module – 4

17. Explain different types of shallow foundations and list the advantages and disadvantages of each type of footings. (14 Marks)

18. (a) Explain various factors that affect ultimate bearing capacity of a shallow footing? (5 Marks)

(b) A square footing of 2 m x 2 m is to be founded at a depth of 1.5 m in a soil with following data:

γ = 19 kN/m^3 ; C = 30 kN/m^2 ; $\phi = 40^0$

N_c = 95.7 ; N_q = 81.3 ; N_γ = 100.4

Determine the net safe bearing capacity with a factor of safety of 3, when Water table is at
(i) 0.75 m from ground level. (ii) 2.5 m from ground level. (9 Marks)

Module – 5

19. (a) What is meant by Immediate Settlement? How to determine this. (5 Marks)

(b) A 3m square footing at a depth of 2m from ground level carries a net load intensity of 150 kN/m^2. If a compressible clay layer 3m thick exists at a depth of 5m below the footing, determine the settlement of the footing due to consolidation of clay layer. Assume the water table at a depth of 3m below GL. For sand, density = 18 kN/m^3 above water table and

19 kN/m^3 below water table. For clay layer, LL = 65%, w_n = 40% and G = 2.7. Take γ_w = 10 kN/m^3. (9 Marks)

20. (a) What is meant by Allowable settlement? (5 Marks)

(b) The following are results of a standards proctor compaction test performed on a sample of soil

Water Content %	6	8	10	12	14	16
Bulk Density (kN/m^3)	17.7	19.8	21	21.3	20.9	20.2

Plot the water content – dry density curve and obtain Moisture content and Maximum dry density. Also plot the zero air voids curve. Take G = 2.65. (9 Marks)

SYLLABUS

Module	Contents
1	Introduction to soil mechanics - Soil types -Major soil deposits of India - 3 phase system - Basic soil properties: Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight - Relationship between basic soil properties - numerical problems. Laboratory Determination of Water content by oven drying; Specific gravity using pycnometer & specific gravity bottle and Field density by sand replacement method – Field density by Core Cutter method - Soil Structure: single grained, honey combed, flocculated and dispersed structure and their effects on the basic soil properties – Sensitivity and Thixotropy.
2	Index properties - Sieve analysis – Well graded, poorly graded and gap graded soils - Consistency - Atterberg Limits and Plasticity Index – Plasticity Chart –I.S. classification. Permeability of soils - Darcy's law – Numerical Problems - Factors affecting permeability Principle of effective stress - Total, neutral and effective stress – Pressure diagrams - numerical problems Stress distribution - Boussinesq's equations for vertical pressure due to point loads – Approximate methods for Vertical Pressure beneath rectangular shape: 2:1 Distribution Method - numerical problems -Isobars- Pressure bulbs
3	Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion – Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses [no derivation required] – Numerical Problems - Brief discussion of Direct shear test & UCC Lateral earth pressure – At-rest, active and passive earth pressures – Rankine's theories [no derivation required] - Influence of surcharge, layered backfill and water table on earth pressure- numerical problems
4	Foundation - general consideration : Functions of foundations - Definition of shallow and deep foundations - Different types of foundations : Strip Footings; Isolated Footings; Combined Footings – Rectangular and Trapezoidal; Raft Foundations and Pile Foundations - Selection of type of foundation - Advantages and limitations of various types of foundations Bearing capacity of shallow foundations – Ultimate, safe and allowable bearing capacity. - Failure mechanism, assumptions and equation of Terzaghi's bearing capacity theory for strip footing [no derivation required] – Bearing capacity factors and charts - Terzaghi's formulae for circular and square footings - numerical problems - Local and general shear failure - Factors affecting bearing capacity – Effect of water table on bearing capacity - numerical problems -
5	Settlement analysis: Introduction - causes of settlement – immediate, consolidation and total settlement –Estimation of immediate settlement – Numerical Problems – Consolidation - Definition – Spring analogy for primary consolidation - Void ratio versus pressure relationship - Coefficient of compressibility and volume compressibility – Pre consolidation Pressure - Compression index-Estimation of magnitude of settlement of normally consolidated clays - Numerical problems Allowable settlement - Total and differential settlements as per Indian standard Compaction of soils - Difference between consolidation and compaction - IS Light & Heavy Compaction Tests – OMC and MDD

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.

References:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Indersley (India) Pvt. Ltd., 2013
6. Taylor D.W., Fundamentals of Soil Mechanics, Asia Publishing House, 1948.

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	Nature of soil and functional relationships : Introduction to soil mechanics – Soil types – Major soil deposits of India	CO 1	1
1.2	3 phase system – Basic soil properties : Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight	CO 1	1
1.3	Relationship between basic soil properties	CO 1	1
1.4	Numerical problems	CO 2	2
1.5	Determination of Water content by oven drying, Specific gravity using pycnometer & specific gravity bottle	CO 1	1
1.6	Determination of Field density by sand replacement method & Core Cutter method	CO 1	1
1.7	Numerical problems	CO 2	1
1.8	Soil Structure and their effects on the basic soil properties – Sensitivity and Thixotropy	CO 1	1
2	**Module 2**		**9**
2.1	Index properties - Sieve analysis – Well graded, poorly graded and gap graded soils	CO 1	1
2.2	Consistency - Atterberg Limits and Plasticity Index	CO 1	1
2.3	Plasticity Chart –I.S. classification	CO 1	1
2.4	Permeability of soils - Darcy's law – Factors affecting permeability	CO 1	1
2.5	Principle of effective stress - Total, neutral and effective stress – Pressure diagrams	CO 1	1
2.6	Numerical problems	CO 3	1
2.7	Stress distribution - Introduction - Boussinesq's equations for vertical pressure due to point loads – Numerical problems	CO 1 & CO 3	1
2.8	Approximate methods for Vertical Pressure beneath rectangular shape: 2:1 Distribution Method - numerical problems	CO 1 & CO 3	1
2.9	Isobars- Pressure bulbs	CO 4	1
3	**Module 3**		**9**
3.1	Shear strength of soils- Practical Applications - Mohr-Coulomb failure criterion	CO 1	1
3.2	Mohr circle method for determination of principal planes and stresses– relationship between shear parameters and principal stresses [no derivation required]	CO 1	1
3.3	Numerical Problems	CO 3	
3.4	Brief discussion of Direct shear test & UCC	CO 1	1

3.5	Lateral earth pressure – At-rest, active and passive earth pressure	CO 1	1
3.6	Rankine's theories [no derivation required]	CO 1	1
3.7	Influence of surcharge and water table on earth pressure	CO 1	1
3.8	Numerical problems	CO 4	1
3.9	Earth pressure on retaining walls with layered backfill – Numerical Problems	CO 1 & CO 4	1
4	**Module 4**		**9**
4.1	Foundations : Functions of foundations - Definition of shallow and deep foundations	CO 1	1
4.2	Different types of foundations : Strip Footings; Isolated Footings; Combined Footings – Rectangular & Trapezoidal; Raft Foundations and Pile Foundations	CO 1	1
4.3	Selection of type of foundation - Advantages and limitations of various types of foundations	CO 1	1
4.4	Bearing capacity of shallow foundations – Ultimate, safe and allowable bearing capacity.	CO 1	1
4.5	Failure mechanism, assumptions and equation of Terzaghi's bearing capacity theory for strip footing [no derivation required]	CO 1	1
4.6	Bearing capacity factors and charts - Terzaghi's formulae for circular and square footings -	CO 1	1
4.7	Numerical problems	CO 4	1
4.8	Effect of water table on bearing capacity - numerical problems	CO 1 & CO 4	1
4.9	Local and general shear failure - Factors affecting bearing capacity	CO 1	1
5	**Module 5**		**9**
5.1	Settlement analysis: Introduction - causes of settlement – immediate, consolidation and total settlement	CO 1	1
5.2	Estimation of immediate settlement – Numerical Problems	CO 1 & CO 4	1
5.3	Consolidation - Definition – Spring analogy for primary consolidation	CO 1	1
5.4	Void ratio versus pressure relationship - Coefficient of compressibility and volume compressibility – Pre consolidation Pressure - Compression index	CO 1	1
5.5	Estimation of magnitude of settlement of normally consolidated clays - Numerical problems	CO 4	1
5.6	Allowable settlement - Total and differential settlements as per Indian standard	CO 1	1
5.7	Compaction of soils - Difference between consolidation and compaction	CO 1	1
5.8	IS Light & Heavy Compaction Tests – OMC and MDD	CO 1	1
5.9	Numerical Problems	CO 3	1

CET284	INTRODUCTION TO TRANSPORTATION ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	4	0	0	4	2019

Preamble

Objective of the course is to introduce the principles and practice of Highway,Traffic Engineering and Transportation Planning.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
1	**Discuss** the basic characteristics of Highways and basics of geometric design.
2	**Analyse** the features of highway materials , various types of pavements, and construction techniques
3	**Interpret** the basics of traffic characteristics, describe how to conduct traffic surveys and interpret data, understand the various traffic control devices
4	**Establish** the basics of different modes of transportation and their characteristics including rail, water and air.
5	**Appraise**Travel Demand Estimation process and the sustainable transportation measures and its application through promoting public transportation modes.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	2			1	1	1		1		1
2	3	1				1	1	1		1		1
3	3	1	1			1	1	1	1	1		1
4	2	1				1	1	1		1	1	1
5	3	3				2	3	1	1	1	1	1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**10**	**10**	**30**
Understand	**10**	**10**	**30**
Apply	**5**	**5**	**40**
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 5 questions with 5 marks for each (one questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 15 marks and can have maximum 3 subdivisions.

Course Level Assessment Questions:

Course Outcome 1 (CO1): What are the basic requirements for an ideal highway alignment? Describe thefactors considered in finalising the alignment.

Course Outcome 2 (CO2): Describe the specifications of materials and construction steps of bituminous concrete pavements.

Course Outcome 3 (CO3): Explain the effect of various vehicular characteristics on traffic stream behaviour.

Course Outcome 4 (CO4): Sketch the typical layout of an airport showing the location of taxiways, runways, apron and terminal building for a two open parallel runways.

Course Outcome 5 (CO5): What are the options available in present day society to make transportation sustainable? What are the steps to be adopted by the stakeholders to implement it in India?

SYLLABUS

Mod	Contents	Hrs
1	Introduction to Transportation Engineering, Role of transportation in the development of a society, Classification of roads, Typical cross sections of roads in urban and rural area, Introduction to geometric design of highways, highway cross section elements	9
2	Introduction of flexible and rigid pavements. Introduction to highway materials, Desirable properties and testing of road aggregates, bituminous materials and sub grade soil. Construction of bituminous pavements and rigid pavements (Basics only)	9
3	Introduction to traffic engineering, Traffic characteristics, Capacity and Level of Service, Design Speed, Traffic signals and markings, Types of road intersections, Traffic control devices (introduction only)	8
4	Railway Engineering - Component parts of a railway track - functions, concept of Gauges, coning of wheels Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only) Airport Engineering:- Components of airport and airport layout, Runway orientation, Taxiways, aprons. and Terminal Building (Introduction only)	12
5	Transportation Planning:-Need for Transportation planning, Transport- land use interaction, Travel Demand Estimation –(Introduction only) Sustainable urban transport; issues and challenges, Emerging concepts in sustainable transportation: green vehicles and green roads, green and alternate fuels;	7

Text Books

1. Khanna, S.K. & Justo E.G., Highway Engineering, Nem Chand & Bros., 2000
2. Kadiyali, L. R., Traffic Engineering& Transportation Planning, Khanna Publishers, 2017
3. Khanna, S. K. and Arora. M. G., Airport Planning and Design, Nemchand& Bros
4. Rangawala, S.C. , Railway Engineering, Charotar Publishing House
5. Rao G. V, Principles of Transportation and Highway Engineering, Tata McGrawHill, 1996
6. Srinivasan,R., Harbour, Dock & Tunnel Engineering, Charotar Publishing House, 28e, 2016

References

1. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering,
2. IRC: 37-2001, Guidelines for the Design of Flexible Pavements, IRC 2001, New Delhi
3. IRC:37-2012, Tentative Guidelines for the Design of Flexible Pavements , PHI, 2017
4. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier, 1997
5. C S Papacostas and P D Prevedouros, Transportation Engineering and Planning, 2007
6. Yoder, E. J &Witezak, M. W, Principles of Pavement Design, John Wiley & Sons, 1991
7. Sustainable Urban Transport Shanghai Manual – A Guide for Sustainable Urban Development in the 21st Century

Course Content and lecture Schedule:			
No.	**Topic**	**Course Outcome**	**No. of Hrs**
1	**Module 1**		Total: 9
1.1	Introduction to Transportation Engineering, Role of transportation in the development of a society, Various fields of Transportation Engineering	CO1	2
1.2	Classification of roads, Typical cross sections of roads in urban and rural area,	CO1	3
1.3	Introduction to geometric design of highways, highway cross section elements, Horizontal alignment and Vertical alignment (introduction only)	CO1	4
2	**Module 2**		Total:9
2.1	Introduction of flexible and rigid pavements	CO2	2
2.2	Introduction to highway materials, Desirable properties and testing of road aggregates	CO2	4
2.3	Construction of bituminous pavement sand rigid pavements (Basics only)	CO2	3
3	**Module 3**		Total: 8
3.1	Introduction to traffic engineering, Traffic characteristics	CO3	2
3.2	Capacity and Level of Service, Design Speed	CO3	2
3.3	Traffic signals and markings	CO3	2
3.4	Types of road intersections, Traffic control devices (introduction only)	CO3	2
4	**Module 4**		Total: 12
4.1	Railway Engineering - Component parts of a railway track functions, concept of Gauges, coning of wheels	CO4	4
4.2	Harbours – classification, features, requirements. Break waters - necessity and functions, classification. Docks – Functions and types - dry docks, wet docks (Introduction only)	CO4	4
4.3	Introduction to Airport Engineering, Components of airport, Runway orientation, Taxiways and aprons and Terminal Building	CO4	4
5	**Module 5**		Total: 7
5.1	Need for Transportation planning, Transport- land use interaction	CO5	1
5.2	Travel Demand Estimation - Steps in 4 stage planning process	CO5	2
5.3	Sustainable urban transport; issues and challenges	CO5	1
5.4	Policy options for urban transport- Push and pull approach, NMT planning, Transit oriented development	CO5	2
5.5	Emerging concepts in sustainable transportation: green vehicles and green roads, green and alternate fuels;	CO5	1

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code:**CET284**
Course Name: **INTRODUCTION TO TRANSPORTATION ENGINEERING**
Model Question Paper

Marks:100 Duration: 3 hrs

PART A
(Answer all Questions: Each question carries 3 marks)

1 What is the role of roads in Indian economy?
2 Explain briefly the classification of highways in India.
3 Differentiate flexible and rigid pavement
4 Differentiate tack coat and prime coat. What are the objectives of application of each?
5 Distinguish between traffic capacity, basic capacity and practical capacity.
6 Discuss about the requirements of traffic control devices.
7 List and define the component parts of a railway track.
8 What are the detrimental forces acting on a break water?
9 List the role of transportation planning to society
10 What are the advantages of green fuel?

(3 x 10=30 marks)

PART B
(Answer one full question from each module)

11	a.	What are the factors controlling the alignment of highways? Explain the influence each of them in detail?	7
	b.	Discuss about the various cross section elements to be considered in the geometric design of highways?	7
		OR	
12	a.	Design the rate of super elevation for a horizontal highway curve of radius 500 m and speed 100 kmph	7
	b.	What is overtaking sight distance? Derive the equation for OSD.	7
13	a.	Differentiate flexible and rigid pavements. Sketch a typical section for each.	7
	b.	Discuss the desirable properties of aggregates used for road construction.	7
		OR	
14	a.	Discuss any three properties of bitumen and their effect on the performance ofbituminous mixes in pavements.	7
	b.	What are the factors to be considered in design of flexible pavements and indicate their significance?	7

15	a.	Explain the effect of various vehicular characteristics on traffic stream behaviour.	7
	b.	Draw a typical Speed-flow diagram and indicate the Levels of service as per IRC.	7
		OR	
16	a.	What are the advantages and disadvantages of traffic signals?	7
	b.	Enumerate the basic types of intersections and basic principles involved.	7
17	a.	Explain with neat sketches the concept of coning of wheels.	7
	b.	How are harbours classified? Explain with sketches any two types.	7
		OR	
18	a	Distinguish between wet docks and dry docks? What are its functions?	7
	b.	Enumerate the factors that are to be considered for site selection of an airport?	7
19	a.	Enumerate how land use and transportation planning are inter related.	7
	b.	Briefly explain the various stages in travel demand estimation	7
		OR	
20	a.	What are the ways to overcome the issues and challenges in transportation?	7
	b.	How can green vehicles and green roads contribute to sustainable transportation?	7

CODE: CET 285	Course Name INFORMATICS FOR INFRASTRUCTURE MANAGEMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: This course is aimed at exposing the students to the scope of Informatics and Internet of Things (IoT) in Civil Engineering. It introduces students to the fundamentals of data analytics, informatics &IoT as it is applicable to civil engineering field.After this course, students will be in a position to appreciate the use of informatics &IoTin civil engineering projects and follow the future developments in this sector.

Prerequisite: NIL

Course Outcomes:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	To understand the fundamental concepts of data science, informatics & internet of things	Remembering, Understanding
CO 2	To learn the use of geomaticsin planning and site selection of infrastructure projects	Applying & Analysing
CO 3	To apply building informatics in construction, monitoring and project management	Applying& Analysing
CO4	To learn the role of IoT technology in infrastructure management	Applying& Analysing

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	2	-	-	-	-	-	-	2
CO 3	2	-	-	-	2	-	-	-	-	-	-	2
CO4	2	-	-	-	2	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	15
Understand	10	10	15
Apply	15	15	35
Analyse	15	15	35
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):*To understand the fundamental concepts of data science, informatics & internet of things.*

1. ExplainDIKW pyramid.
2. Explain the data mining techniques
3. Discuss different data models
4. Discuss the vector data analysis techniques
5. Explain COBie standard
6. List IoT protocols
7. What are the elements of BIM?

Course Outcome 2 (CO2): *To learn the use of geomatics for planning and site selection of infrastructure projects.*

1. Discuss how geomatics help in site selection of a solid waste management facility
2. Discuss how terrain modeling is an important geographic information for project planning

Course Outcome 3 (CO3): *To apply building informatics in construction, monitoring and project management.*

1. How BIM helps inreducing the cost of construction?
2. Discuss the steps in developing a BIM for an infrastructure project.

Course Outcome 4 (CO4): *To learn the role of IoT technology in infrastructure management.*

1. How a water supply system could benefit by IoT technology?
2. Monitoring infrastructure projects could leverage from IoT technologies! Discuss.

Syllabus

Module 1 Data to Information

History of informatics, DIKW pyramid, data management- data types, Meta data, database management systems; Data analysis techniques-spatial and non-spatial data, trends and patterns; Data mining techniques, data processing for information

Module 2 Geoinformatics

Fundamental concepts in Geo-informatics- Components, Spatial data and attributes, vector and raster data models, Methods of data input, Spatial data editing; Vector data analysis- buffering, overlay; Raster data analysis- local operations, neighborhood operations, zonal operations ; GIS output: cartographic and non-cartographic output

Module 3 Planning and Site selection

Site suitability analysis for Residential area, Industrial area, Recreational Area, Solid Waste Disposal, Water treatment plant, reservoirs;
Land use/ Land cover mapping, Ground Water Potential Zonation Mapping, Hazard Zonation Mapping, Terrain modelling
Network Analysis- Water supply line, Sewer line, Power line, Telecommunication, Road network

Module 4 Building Informatics

Building Information Modelling- Definition, Elements of BIM, steps in BIM development, COBie standard, potential and applications of BIM, Case studies

Module 5 Internet of Things (IoT) in Civil Infrastructure

IoT Standards& Protocols, Concept of IoT in civil engineering- Applications in construction, product monitoring and project Management
Smart Buildings- sensors & devices, selection criteria, data integration
Management Applications- Traffic Regulation, Water Supply, Pollution control, HVAC, Energy use

Text Books

1. J. Campbell, Essentials of Geographic Information Systems, Saylor Foundation, 2011.
2. RamezElmasri, ShamkantB.Navathe, "Fundamental of Database Systems", Pearson Addison Wesley, 2003.
3. BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, Publisher: John Wiley & Sons; 2nd edition (1 July 2011), Language: English, ISBN-10: 9780470541371

Reference Books

1. Raja R. A. Issa and Svetlana Olbina,Building Information Modeling: Applications and Practices, ASCE, 2015.

2. Samuel Greengard, The internet of things, The MIT Press Essential Knowledge Series, 2015, ISBN: 978-0-262-52773-6.
3. ShashiShekhar and Sanjay Chawla,"Spatial Databases:A Tour", Prentice Hall, 2003.
4. Building Information Modeling: BIM in Current and Future Practice, Publisher: John Wiley & Sons; 1 edition (15 August 2014), Language: English, ISBN-10: 9781118766309

Lecture Plan – Informatics for Infrastructure Management

Module	*Topic*	*Course outcomes addressed*	*No. of Lectures*
1	**Module I : Total lecture hours : 9**		
1.1	History of informatics	CO1	Lecture 1
1.2	DIKW pyramid& Meta data	CO1	Lecture 2
1.3	Data management	CO1	Lecture 3
1.4	Data types & Meta data	CO1	Lecture 4
1.5	Database management systems	CO1	Lecture 5
1.6	Data analysis techniques	CO1	Lecture 6
1.7	Trends & Patterns in data analysis	CO1	Lecture 7
1.8	Data mining techniques	CO1	Lecture 8
1.9	Data processing for information	CO1	Lecture 9
2	**Module II : Total lecture hours : 9**		
2.1	Fundamental concepts in Geo-informatics-	CO1	Lecture 1
2.2	Components of GIS	CO1	Lecture 2
2.3	Spatial data and attributes	CO1	Lecture 3
2.4	Data models- vector & raster	CO1	Lecture 4
2.5	Methods of data input	CO1	Lecture 5
2.6	Spatial data editing	CO1	Lecture 6
2.7	Vector data analysis	CO1	Lecture 7
2.8	Raster data analysis- local & neighbourhood analysis	CO1	Lecture 8
2.9	Raster data analysis- zonal analysis& GIS output	CO1	Lecture 9

3	**Module III : Total lecture hours : 9**		
3.1	Site suitability analysis for Residential area,& Industrial area	CO2	Lecture 1
3.2	Site suitability analysis for recreational area & solid waste disposal	CO2	Lecture 2
3.3	Site suitability analysis for water treatment plant & reservoir	CO2	Lecture 3
3.4	Land use&land cover mapping	CO2	Lecture 4
3.5	Ground water potential zonation& Hazard zonation mapping	CO2	Lecture 5
3.6	Terrain modelling	CO2	Lecture 6
3.7	Network analysis for water supply & sewer lines	CO2	Lecture 7
3.8	Network analysis for power line & telecommunication	CO2	Lecture 8
3.9	Network analysis for road network	CO2	Lecture 9
4	**Module IV : Total lecture hours : 9**		
4.1	Building Information Modelling- Definition	CO3	Lecture 1
4.2	Elements of BIM	CO3	Lecture 2& 3
4.3	Steps in BIM development	CO3	Lecture 4 & 5
4.4	COBie standard	CO3	Lecture 6
4.5	Potential & applications of BIM	CO3	Lecture 7
4.6	Case studies of BIM	CO3	Lecture 8& 9
5	**Module V : Total lecture hours : 9**		
5.1	IoT Standards & Protocols, Concept of IoT in civil engineering	CO4	Lecture 1
5.2	Application of IoT in construction, product monitoring & project management	CO4	Lecture 2,3 & 4
5.3	Smart buildings	CO4	Lecture 5
5.5	Selection criteria of sensors & devices, Data integration	CO4	Lecture 6
5.7	Management applications of IoT- Traffic, water supply, pollution control, HVAC & energy use	CO4	Lecture7,8 & 9

Model Question Paper

QP CODE:

Reg No.:_____ **Name:_____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code:CET 285

Course Name: INFORMATICS FOR INFRASTRUCTURE MANAGEMENT

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. Explain different data types.
2. Explain DIKW pyramid.
3. Compare vector & raster model.
4. What are the components of GIS?
5. Explain network analysis.
6. What is the importance of terrain modeling?
7. Define BIM.
8. What is COBie standard?
9. List the IoT protocols.
10. Explain the concept of smart buildings.

PART B

(Answer one full question from each module, each question carries 14 marks)

11. (a) Discuss data analysis techniques for spatial data. (5 Marks)

    (b) Explain the steps in processing data into information. (9 Marks)

OR

12. (a) Briefly describe the history of informatics (5 Marks)

    (b) Explain various data mining techniques. (9 Marks)

13. (a) Discuss various data inputting methods for GIS (5 Marks)

    (b) Explain various vector analysis techniques. (9 Marks)

OR

14. (a) Explain buffering analysis. What is its application? (5 Marks)

    (b) Explain various raster data analysis techniques. (9 Marks)

15. (a) How the site suitability analysis is carried out for a solid waste management facility? (7 Marks)

(b) Explain how geomatics is useful for mapping hazard zones. (7 Marks)

OR

16. (a) Explain the methodology for road network analysis. (7 Marks)

(b) Explain the process of converting data to information for a reservoir site selection. (7 Marks)

17. (a) What are the applications of BIM? (5 Marks)

(b) Discuss the steps in developing a BIM for an infrastructure project.(9 marks)

OR

18. (a) Explain the elements of BIM. (5 Marks)

(b) How BIM helps in reducing the cost of construction? (9 Marks)

19. (a) What sensors & devices would help in monitoring water distribution network. (5 Marks)

(b) Infrastructuremanagement could leverage from IoT technologies! Discuss. (9 Marks)

OR

20. (a) What are the selection criteria for sensors & devices used in IoT technologies. (7 Marks)

(b) Discuss how IoT technologies could help in pollution control. (7 Marks)

CET 286	Climate Change and Hazard Mitigation	Category	L	T	P	Credit	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: The course is designed to build climate literacy among students, encourages them to adapt to climate change related issues. It helps learners to understand the fundamentals of climate, climate change and climate models, evaluate the impacts of climate change on ecosystems, and empower learners to take appropriate actions to adopt various hazard mitigation measures.

Pre-requisite: Nil

Course outcome

After the course, the student will able to:

CO1	Explain the basic physical principles of the global climate system.
CO2	Describe the large-scale climatic changes which has influenced the ecosystem.
CO3	List actions in key sectors to mitigate hazards due to climate change.
CO4	Identify international initiatives which support countries to address the climate change challenges.
CO5	Analyse the impact of climate change on ecosystem.

CET 256 Climate Change and Hazard Mitigation		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CO1	3					2	1							1	
	CO2	3					2	1								
	CO3	3					2	1								
	CO4	3					2									
	CO5	3					2	1								

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Test (2 numbers)	:	25 marks
Assignment/Quiz/Course project	:	15 marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A		
1	Define climate system.	3	CO1
2	How does Albedo affect climate of a place?	3	CO1
3	Briefly explain El Nino and its effects.	3	CO2

4	What is carbon cycling?	3	CO2
5	Describe about General Circulation Models.	3	CO5
6	Comment on Ocean Acidification.	3	CO5
7	Discuss the mission of Intergovernmental Panel on Climate Change.	3	CO4
8	What is Montreal Protocol?	3	CO4
9	Briefly explain Carbon dioxide Capture and Storage.	3	CO3
10	Discuss the importance of bio energy crops.	3	CO3
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11(a)	What is the general circulation of the atmosphere?	7	CO1
11(b)	How does the general circulation affect the earth's climate?	7	CO1
12(a)	What is the composition and structure of the atmosphere?	7	CO1
12(b)	Explain the significance of water in the atmosphere on climate of earth.	7	CO1
	Module II		
13(a)	State and explain Global Warming Potential.	7	CO2
13(b)	Briefly explain Gandhian ideas on Global warming.	7	CO2
14(a)	Describe the importance of Greenhouse effect on global climate system.	7	CO2

14(b)	Discuss the role of carbon dioxide in Greenhouse effect	7	CO2
	Module III		
15	Briefly explain the impact of climate change on surface temperature and precipitation.	14	CO5
16	Describe the different uncertainties inherent in the projection of climate. .	14	CO5
	Module IV		
17	Enumerate the international initiatives to address climate change challenges and explain any two.	14	CO4
18(a)	Outline the structure of the Intergovernmental Panel on Climate Change.	4	CO4
18(b)	Explain the comprehensive Assessment Reports of IPCC.	10	CO4
	Module V		
19 (a)	Explain hazards due to climate change and describe the possible mitigation measures to it.	14	CO3
20 (a)	Discuss the concept of energy efficiency in buildings in response to climate change.	5	CO3
20 (b)	Discuss the impact of climate change on Ecosystem and its adaptation measures.	9	CO3

Model Question Paper

Reg No.:…….. **QP CODE:……..**

Name:……

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRD SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 286

Climate Change and Hazard Mitigation

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. Define climate system.
2. How does Albedo affect climate?
3. Briefly explain El Nino and its effects.
4. What is carbon cycling?
5. Describe about General Circulation Models.
6. Comment on Ocean Acidification.
7. Discuss the mission of Intergovernmental Panel on Climate Change.
8. What is Montreal Protocol?
9. Briefly explain Carbon dioxide Capture and Storage.
10. Discuss the importance of bio energy crops.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. a) What is the general circulation of the atmosphere? (7 Marks)

    b) How does the general circulation affect the earths climate? (7 Marks)

OR

12. a) What is the composition and structure of the atmosphere? (7 Marks)

    b) Explain the significance of water in the atmosphere on climate of earth. (7 Marks)

Module II

13. (a) State and explain Global Warming Potential. (7 Marks)

    (b) Briefly explain Gandhian ideas on Global warming. (7 Marks)

OR

14. (a) Describe the importance of Greenhouse effect on global climate system. (7 Marks)

    (b) Discuss the role of carbon dioxide in Greenhouse effect. (7 Marks)

Module III

15. Explain the impact of climate change on surface temperature and precipitation. (14 Marks)

OR

16. Describe the different uncertainties inherent in the projection of climate. (14 Marks)

Module IV

17. Enumerate the international initiatives to address climate change challenges and explain any two. (14 Marks)

OR

18. a) Outline the structure of the Intergovernmental Panel on Climate Change. (4 Marks)

    b) Explain the comprehensive Assessment Reports of IPCC. (10 Marks)

Module V

19. Explain hazards due to climate change and describe the possible mitigation measures to it. (14 Marks)

OR

20. (a) Discuss the concept of energy efficiency in buildings in response to climate change. (5 Marks)

    (b) Discuss the impact of climate change on Ecosystem and its adaptation measures. (9 Marks)

Course Code: CET 286
Climate Change and Hazard Mitigation

Module I

Introduction to Earth's Climate System: Basic concepts- Radiation, Albedo, Emissivity, scales of motion, large-scale motion, general circulation, troposphere-stratosphere transport. Atmospheric structure and thermodynamics: pressure, density, composition, temperature structure, water in the atmosphere. Atmospheric photochemistry and chemical kinetics

Module II

Hurricanes and Global warming: Global Ocean Circulation - El Nino and its effects - Paleo- indicators of climate -The Nature of Storms—cyclones, tornadoes and hurricanes. Greenhouse effect-greenhouse gases-sources of emission - The Role of Carbon Dioxide, The Earth's Carbon Reservoirs, Carbon Cycling-Climate and Weather Global warming potential - Effects of Global warming- Gandhian ideas on global warming.

Module III

Climate data and Models: Equations of atmospheric fluid mechanics, energy equation, turbulence, mixing length models, Atmospheric chemical transport and general circulation models. Analyses of climate data. Climate projections and their uncertainties. Impacts of climate change on Surface temperature, Precipitation, Ocean pH, Sea-level and Arctic sea-ice extent.

Module IV

International initiatives to address the climate change challenges: History of Earth's climate – 1970s (IIASA, DOE), 1980s, Startup of the U.N IPCC, Mission of the IPCC, The Framework Convention on Climate Change, The Kyoto Protocol to the Framework Convention, Earth Summit, Montreal Protocol. Policy Analyses, Internationally Adopted Emissions Restrictions.

Module V

Climate Change Adaptation & Mitigation Measures: Adaptation to climate change in the fields of Ecosystems and biodiversity - Agriculture and food security, land use, forestry, human health, water supply, sanitation and infrastructure. Hazards due to climate change

and Mitigation Measures: Extreme weather events. Mitigation measures in sectors vital to humanity (food, water, health): Brief explanation of - Carbon dioxide capture and storage (CCS), Bio-energy crops, Energy efficiency in buildings.

Text Books

- Mark Masli, Climate Change: A Very Short Introduction, Oxford University Press, 2014.
- Jan C van Dam, Impacts of Climate Change and Climate Variability on Hydrological Regimes, Cambridge University Press, UK, 2003.
- Trenberth, K.E. (Editor), 1992: *Climate System Modeling*, Cambridge University Press, Cambridge, U.K.

References

- IPCC second assessment report - Working Group I Report, The Science of climate change, 1995.
- IPCC fourth assessment report - The AR4 synthesis report, 2007
- IPCC fourth assessment report - Working Group I Report, The physical Science Basis, 2007.
- IPCC fourth assessment report - Working Group II Report, Impacts, Adaptation and Vulnerability, 2007.
- IPCC fourth assessment report - Working Group III Report Mitigation of Climate change, 2007
- IPCC fifth assessment report - The AR5 synthesis report, 2014

Course Code: CET 286
Climate Change and Hazard Mitigation
Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to Earth's Climate System: Basic concepts	CO1	1
1.2	Radiation, Albedo, Emissivity,	CO1	1
1.3	Scales of motion, large-scale motion	CO1	1
1.4	General circulation, troposphere-stratosphere transport	CO1	1
1.5	Atmospheric structure and thermodynamics	CO1	1
1.6	Pressure, density, composition	CO1	1

1.7	Temperature structure, water in the atmosphere	CO1	1
1.8	Atmospheric photochemistry	CO1	1
1.9	Chemical kinetics	CO1	1
Module II (9 Hours)			
2.1	Hurricanes and Global warming: Global Ocean Circulation	CO2	1
2.2	El Nino and its effects - Paleo- indicators of climate	CO2	1
2.3	The Nature of Storms—cyclones, tornadoes and hurricanes	CO2	1
2.4	Greenhouse effect-greenhouse gases-sources of emission	CO2	1
2.5	The Role of Carbon Dioxide, The Earth's Carbon Reservoirs	CO2	1
2.6	Carbon Cycling-Climate and Weather Global warming potential	CO2	1
2.7	Effects of Global warming	CO2	1
2.8	Effects of Global warming	CO2	1
2.9	Gandhian ideas on global warming.	CO2	1

Module III (9 Hours)			
3.1	Climate data and Models; Equations of atmospheric fluid mechanics, energy equation, turbulence	CO5	1
3.2	Mixing length models	CO5	1
3.3	Atmospheric chemical transport	CO5	1
3.4	General circulation models	CO5	1
3.5	Analyses of climate data	CO5	1
3.6	Climate projections and their uncertainties	CO5	1
3.7	Impacts of climate change on Surface temperature, Precipitation	CO5	1
3.8	Impacts of climate change on Ocean pH, Sea-level and Arctic sea-ice extent	CO5	1

3.9	Impacts of climate change on Ocean pH, Sea-level and Arctic sea-ice extent	CO5	1
Module IV (9 Hours)			
4.1	International initiatives to address the climate change challenges	CO4	1
4.2	History of Earth's climate – 1970s (IIASA, DOE), 1980s	CO4	1
4.3	Startup of the U.N IPCC, Mission of the IPCC	CO4	1
4.4	The Framework Convention on Climate Change	CO4	1
4.5	The Kyoto Protocol to the Framework Convention	CO4	1
4.6	Earth Summit	CO4	1
4.7	Montreal Protocol	CO4	1
4.8	Policy Analyses	CO4	1
4.9	Internationally Adopted Emissions Restrictions	CO4	1

Module V (9 Hours)			
5.1	Climate Change Adaptation & Mitigation Measures	CO3	1
5.2	Adaptation to climate change in the fields of Ecosystems and biodiversity	CO3	1
5.3	Agriculture and food security, land use, forestry, human health	CO3	1
5.4	Water supply, sanitation and infrastructure	CO3	1
5.5	Hazards due to climate change and Mitigation Measures: Extreme weather events	CO3	1
5.6	Mitigation measures in sectors vital to humanity (food, water, health)	CO3	1
5.7	Carbon dioxide capture and storage (CCS)	CO3	1
5.8	Bio-energy crops, Energy efficiency in buildings.	CO3	1
5.9	Energy efficiency in buildings.	CO3	1

CET381	STRUCTURAL MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: Structural Mechanics is a basic course in the analysis of structural systems. The course helps students to develop their analytical and problem-solving skills. The course introduces students to the various internal effects induced in structural members as well as their deformations due to different types of loading. After this course students will be able to analyse simple structural systems.

Prerequisite: EST 100 Engineering Mechanics

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Recall the fundamental terms/theorems associated with mechanics of linear elastic deformable bodies and explain the behavior/response of various structural elements under various loading conditions.	Remembering/ Understanding
CO2	Calculate the stresses/strains in structural elements subjected to axial load and bending/twisting moments.	Applying
CO3	Analyse statically determinate beams and trusses to determine the internal forces.	Applying
CO4	Determine the deflection of statically determinate beams.	Applying
CO5	Analyse statically indeterminate beams and frames.	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember/ Understand	20	20	30
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

Course Level Assessment (Sample) Questions

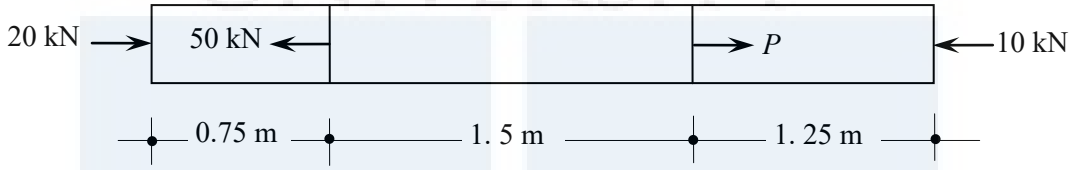
CO1: Recall the fundamental terms/theorems associated with mechanics of linear elastic deformable bodies and explain the behavior/response of various structural elements under various loading conditions.

1. Explain Hooke's law.
2. Sketch the stress-strain curve of mild steel and mark the salient points
3. Explain the concept of BM and SF in beams, with the help of a cantilever beam subjected to uniformly distributed load over the whole span.
4. What is pure bending? Give an example.
5. What is point of contraflexure?
6. Explain (i) Section modulus and (ii) Moment of resistance

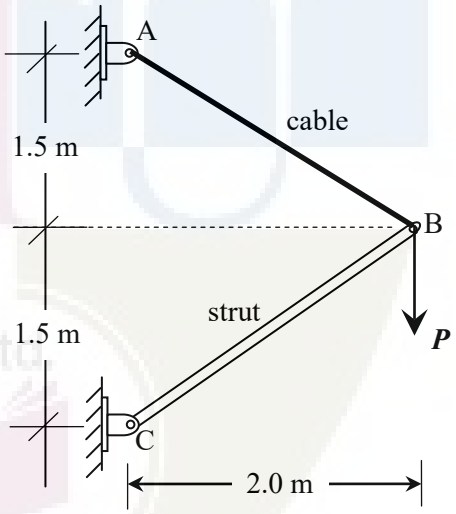
7. Distinguish between statically determinate and statically indeterminate structures.
8. What is degree of static indeterminacy? Explain with an example.
9. Explain (i) distribution factor and (ii) carry over moment.
10. Compare slope-deflection and moment distribution methods.

CO2: Calculate the stresses/strains in structural elements subjected to axial load and bending/twisting moments.

1. A 32 mm diameter steel bar is subjected to forces as shown in figure. Find the value of P necessary for equilibrium and stresses in different segments. Also calculate the final length of the bar. Take E = 200 GPa.



2. A strut and cable assembly ABC, shown in figure supports a vertical load P = 10 kN. The cable has an effective cross sectional area of 120 mm^2 and the strut has an area of 200 mm^2. Calculate the normal stresses induced in the cable and the strut and indicate whether they are tension or compression. If the cable elongates 1.15 mm and the strut shortens 0.58 mm find the strains also.

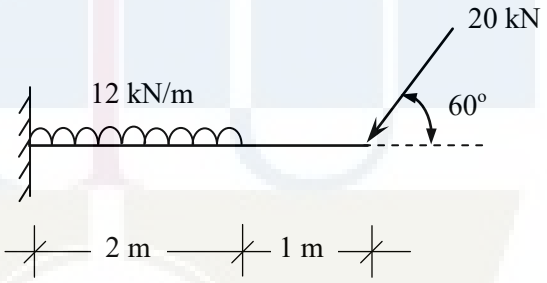


3. A tension test is carried out on a mild steel bar of 10 mm diameter. The bar yields under a load of 20 kN, it reaches a maximum load of 40 kN and breaks at 25 kN. The diameter of the bar at breaking was found to be 7 mm. The increase in length of the bar over a gauge length of 50 mm was found to be 0.029 mm under a load of 10 kN. Estimate (a) Young's modulus, (b) yield strength, (c) ultimate strength and (d) actual breaking strength.
4. A steel flat 25 mm wide and 6 mm thick is required to be bend into a circular arc of radius 10 m. Find the bending moment required to bend the flat. Also find the maximum stress induced. Take E = 200 GPa.

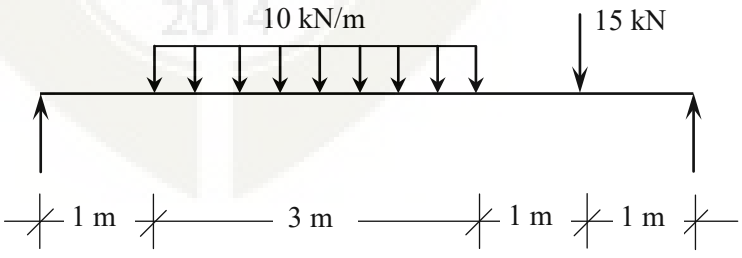
5. A steel box section 100 mm × 150 mm with thickness 5 mm is used as a cantilever beam of span 2 m. If the beam carries a load of 1 kN at the free end, find the maximum bending stress at the mid span and the support. Neglect weight of the beam.
6. A timber beam 150 mm × 200 mm is used as a simply supported beam of span 3 m. Find the maximum load that can be applied at 1 m from one of the supports, if the maximum bending stress in the beam is not to exceed 8 N/mm^2. Neglect self weight of beam.
7. A beam of I section 400 mm deep has flanges 200 mm wide and 20 mm thick and web 15 mm thick. Compare its moment of resistance with that of a beam of rectangular section of the same weight, the depth being twice its breadth.
8. A solid circular shaft of diameter 50 mm is subjected to a torque. If the maximum shear stress induced in the shaft is 70 MPa, find the torque applied. If the modulus of rigidity of the material of the shaft is 80 GPa, find the angle of twist per meter length of the shaft.

CO3: Analyse statically determinate beams and trusses to determine the internal forces.

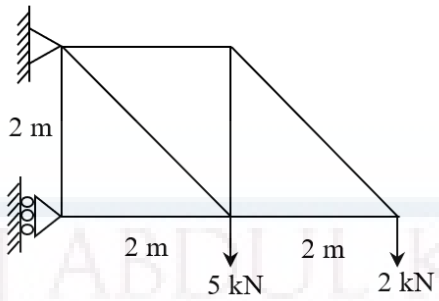
1. Draw the SFD and BMD of the beam shown.



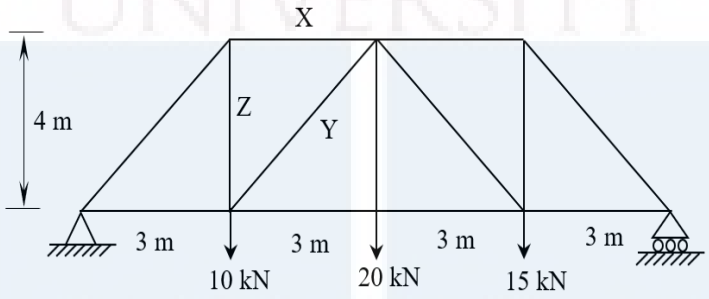
2. Draw SFD and BMD. Find the maximum BM also.



3. Analyse the truss by method of joints and determine the forces in all members.

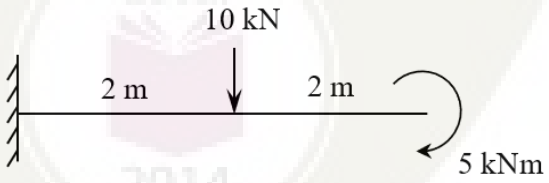


4. Analyse the truss by method of sections and determine the forces in members X, Y and Z.



CO4: Determine the deflection of statically determinate beams.

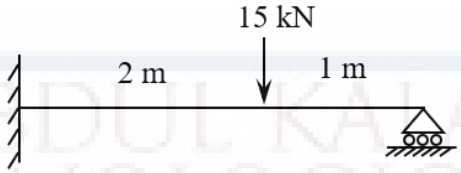
1. A cantilever beam of span 3 m carries a point load of 10 kN at the free end along with a udl of 5 kN/m covering a distance of 2 m starting from the support. Find the maximum deflection of the beam. Take $EI = 3500$ kNm^2.
2. Find the slope and deflection at the free end of the cantilever beam loaded as shown. Flexural rigidity (EI) of the beam may be assumed to be constant.



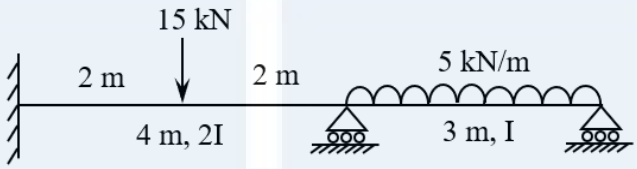
3. A simply supported beam of span 5 m carries a concentrated load of 20 kN at a distance of 2 m from the left support. Find the slope at supports and deflection under the load. Also find the maximum deflection and its location. Flexural rigidity of the beam is 2200 kNm^2.
4. A simply supported beam of span 4 m carries a udl of 10 kN/m covering half the span starting from the left support. Find the slope at supports and maximum deflection. Locate the point of maximum deflection also. Flexural rigidity of the beam is 1500 kNm^2.

CO5: Analyse statically indeterminate beams and frames.

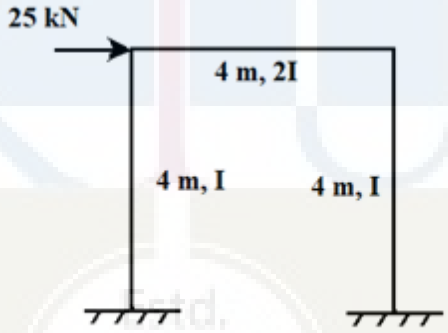
1. Analyse the propped cantilever beam shown by consistent deformation method and draw BMD and SFD.



2. Analyse the continuous beam by slope deflection method and draw BMD.

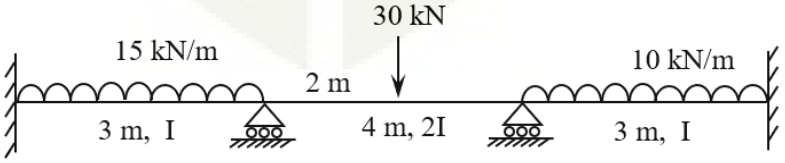


3. Analyse the frame by slope deflection method and draw BMD.



4. Analyse the frame shown in Question 2 using moment distribution method and draw BMD.

5. Analyse the continuous beam shown using moment distribution method and draw BMD.



SYLLABUS

Module – 1

Review of statics, Concept of stress and strain – types, Stress – strain relation - Hooke's law, Young's modulus of elasticity.
Axially loaded bars with uniform cross section–stress, strain and deformation.
Deformation of axially loaded bars with varying cross section and bars with varying axial loads.
Torsion of circular shafts – stress and deformation, Power transmitted by circular shafts.

Module – 2

Analysis of truss – method of joints and method of sections.
Beams – different types. Types of loading on beams. Concept of bending moment and shear force.
Shear force and bending moment diagrams of cantilever beams and simply supported beams for different type of loads.

Module – 3

Theory of simple bending, assumptions and limitations.
Calculation of normal stress in beams, moment of resistance
Shear stress in beams (concept only).
Moment-curvature relation. Deflection of beams by successive integration.
Macaulay's method - Deflection of cantilever beams and simply supported beams.

Module – 4

Statically indeterminate structures, degree of static and kinematic indeterminacy.
Fixed beam – fixed end moments for simple cases of loading (No analysis required).
Method of consistent deformation - Analysis of propped cantilever beam and continuous beams with maximum two redundants.

Module – 5

Slope deflection method – Analysis of continuous beams with maximum two unknowns, effect of support settlement. Analysis of frames with sway.
Moment distribution method – analysis of continuous beams and frames without sway.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall International Series.
2. James M Gere, S.P. Timoshenko, Mechanics of Materials, CBS Publishers and Distributors, New Delhi.

3. R. K. Bansal, A Text book of Strength of Materials, Laxmi Publications (P) Ltd, New Delhi.

References:

1. R.C. Hibbeler, Structural Analysis, Pearson.
2. Devdas Menon, Structural Analysis, Narosa Publications.
3. H. J. Shah and S. B. Junnarkar, Mechanics of Structures Vol - I, Charotar Publishing House.
4. S. Ramamrutham and R. Narayanan, Strength of Materials, Dhanpat Rai Publishing Co (P) Ltd.
5. B. C. Punmia, Ashok K. Jain, Arun Kumar Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, New Delhi.

Lecture Plan – Structural Mechanics

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I: Total lecture hours: 9**		
1.1	Review of statics – equilibrium conditions, free body diagrams, centroid, moment of inertia.	-	1
1.2	Concept of stress, types of stresses. Concept of strain, types of strains. Stress – strain relation - Hooke's law, Young's modulus of elasticity. Stress-strain ($\sigma - \varepsilon$) diagram of mild steel.	CO1	1
1.3	Axially loaded bars with uniform cross section– calculation of stress, strain and deformation.	CO1, CO2	1
1.4	Deformation of axially loaded bars with varying cross section. Stepped bars, deformation of axially loaded bars with varying axial loads	CO1, CO2	3
1.5	Torsion of circular shafts, assumptions, derivation of torsion equation. Variation of stress across the cross section. Polar modulus.	CO1	1
1.6	Calculation stress and deformation of circular shafts subjected to torsion. Power transmitted by circular shafts.	CO1, CO2	2
2	**Module II: Total lecture hours:10**		
2.1	Analysis of truss – Method of joints	CO1, CO3	2

2.2	Analysis of Truss – Method of sections	CO1, CO3	2
2.3	Beams – different types. Types of loading on beams. Concept of bending moment and shear force. Shear force and bending moment diagrams.	CO1, CO3	2
2.4	Shear force and bending moment diagrams of cantilever beams subjected to point load, uniformly distributed load, uniformly varying load and concentrated moment.	CO3	2
2.5	Shear force and bending moment diagrams of simply supported beams subjected to point load and uniformly distributedload.	CO3	2
3	**Module III : Total lecture hours : 9**		
3.1	Theory of simple bending – derivation of equation, assumptions and limitations.	CO1, CO2	1
3.2	Calculation of normal stress in beams, moment of resistance. Problems involving bending stress. Shear stress in beams (concept only)- variation of shear stress across the cross section.	CO1, CO2	2
3.3	Moment-curvature relation. Basic differential equation for calculating the deflection of beams. Calculation of deflection by successive integration. Principle of superposition.	CO1, CO4	2
3.4	Macaulay's method - Deflection of cantilever beam subjected to point load and uniformly distributed loads.	CO1, CO4	2
3.5	Macaulay's method - Deflection of simply supported beams subjected to point load and uniformly distributed loads. Clerk Maxwell's theorem of reciprocal deflection	CO1, CO4	2
4	**Module IV: Total lecture hours:8**		
4.1	Statically indeterminate structures, degree of static and kinematic indeterminacy - examples Force and displacement method of analysis (concept only)	CO1	1
4.2	Fixed beam – fixed end moments for simple cases of loading (No analysis required). BMD of fixed beam, point of contraflexure.	CO1, CO3	2
4.3	Method of consistent deformation - Analysis of propped cantilever beam.	CO1, CO5	2

4.4	Method of consistent deformation – analysis of beams with maximum two redundants.	CO1, CO5	3
5	**Module V: Total lecture hours:9**		
5.1	Slope deflection method – equation (no derivation required). Analysis of continuous beams with maximum two unknowns.	CO1, CO5	2
5.2	Slope deflection method – analysis of continuous beam with support settlement.	CO1, CO5	1
5.3	Slope deflection method – analysis of frames with sway.	CO1, CO5	2
5.4	Moment distribution method – concept. Distribution factor and carry over moment.	CO1, CO5	1
5.5	Moment distribution method – analysis of continuous beams.	CO1, CO5	1
5.6	Moment distribution method – analysis of frames without sway.	CO1, CO5	2

MODEL QUESTION PAPER

Reg. No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER BTECH DEGREE EXAMINATION

Course Code: CET381

Course Name: STRUCTURAL MECHANICS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Sketch the stress-strain graph of mild steel and mark the salient points.
   b) A steel bar of length 1 m and diameter 12 mm was found to elongate by 0.64 mm under an axial load of 15 kN. Find the stress induced and modulus of elasticity of the material.
   c) What is the advantage of method of sections over method of joints in the analysis of trusses?
   d) What is the relationship between SF and BM? Illustrate with a simple example.
   e) What is pure bending? Give an example.
   f) Using successive integration method, find the deflection at the free end of a cantilever beam carrying a point load at the free end.
   g) Explain 'static indeterminacy' and 'kinematic indeterminacy' with a suitable example.
   h) Write down the consistent deformation equations for a beam with degree of static indeterminacy =2. Explain the basic terms in the equation.
   i) What are the reasons for side sway in frames?
   j) Write notes on (i) distribution factor and (ii) carry over moment.

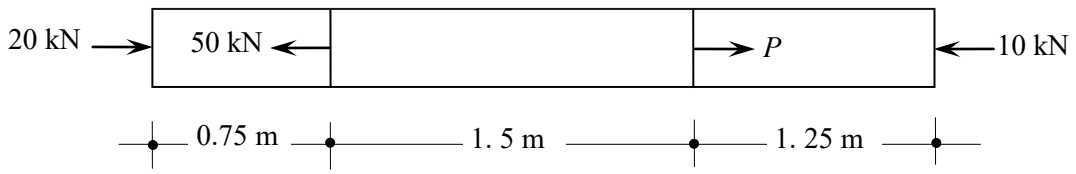
(10×3 marks = 30 marks)

PART B

Answer one full question from each module; each full question carries 14 marks.

Module I

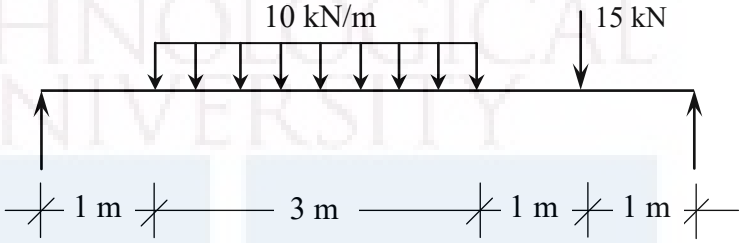
2. A 32 mm diameter steel bar is subjected to forces as shown in figure. Find the value of P necessary for equilibrium and stresses in different segments. Also calculate the final length of the bar. Take E = 200 GPa.



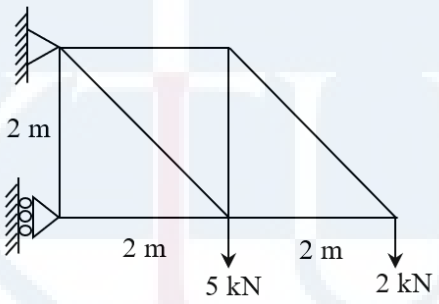
3. A tension test is carried out on a mild steel bar of 10 mm diameter. The bar yields under a load of 20 kN, it reaches a maximum load of 40 kN and breaks at 25 kN. The diameter of the bar at breaking was found to be 7 mm. The increase in length of the bar over a gauge length of 50 mm was found to be 0.029 mm under a load of 10 kN. Estimate (a) Young's modulus, (b) yield strength, (c) ultimate strength and (d) actual breaking strength.

Module II

4. Draw the SFD and BMD of the beam loaded as shown in figure. Find the maximum BM and locate the point of maximum BM also.



5. Analyse the truss by method of joints and determine the forces in all members.



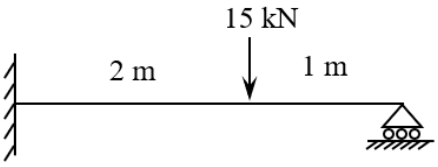
Module III

6. A beam of I section 400 mm deep has flanges 200 mm wide and 20 mm thick and web 15 mm thick. Compare its moment of resistance with that of a beam of rectangular section of the same weight, the depth being twice its breadth.
7. A simply supported beam of span 4 m carries a udl of 10 kN/m covering half the span starting from the left support. Find the slope at supports and maximum deflection. Locate the point of maximum deflection also. Flexural rigidity of the beam is 1500 kNm^2.

Module IV

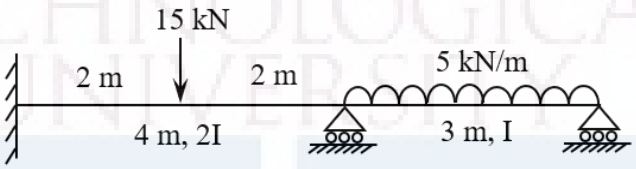
8. a) Draw the BMD of a fixed beam carrying udl through out its span. (4 marks)

   b) Analyse the propped cantilever beam shown by consistent deformation method and draw BMD and SFD.



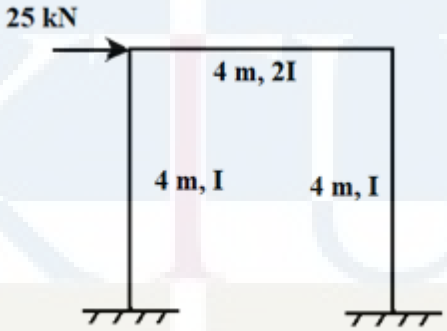
(10 marks)

9. Analyse the beam shown by consistent deformation method and draw BMD.

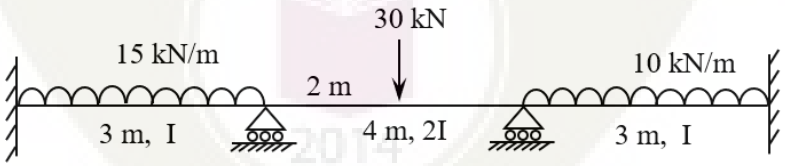


Module V

10. Analyse the frame by slope deflection method and draw BMD.



11. Analyse the continuous beam shown using moment distribution method and draw BMD.



****

CET382	ESTIMATION, COSTING AND VALUATION	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	3	1	0	4	2019

Preamble: The course introduces the various types of estimation, specification writing, analysis of rate and various methods to determine the valuation of building. It enables the students to prepare the detailed estimate of various items of work related to civil engineering construction. This course trains the student to find out the valuation of building by various methods.

Prerequisite: Building drawing

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Explain the specifications for various items of work associated with building construction	Understanding
CO2	Analyse the unit rates of different items of work associated with building construction	Applying
CO3	Prepare the approximate estimate of building	Applying
CO4	Prepare detailed estimates of buildings and the bar bending schedules for R.C.C works	Applying
CO5	Describe various principles and methods of valuation	Understanding
CO6	Determine the valuation of buildings by different methods	Analyse

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		-	-	-	-	-	-	-	-	2	-
CO2	3		-	-	-	-	-	-	-	-	3	-
CO3	3	2	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	20	10	35
Apply	30	10	40
Analyse		30	25
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10marks
Continuous Assessment Test(2numbers) : 25 marksAssignment/Quiz/Courseproject : 15marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from modules 1 to 3 and 4 questions from module 4, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each full question carries 16 marks from module 1, 2 and 4 and 22 marks from module 3 and can have maximum 2 sub- divisions.

Note: For analysis of rate and cost estimation, unit rate and labour requirement should be given along with the questions in the question paper. No other charts, tables, codes are permitted in the Examination Hall. If necessary, relevant data shall be given along with the question paper.

Course Level Assessment Questions

CO1: Explain the specifications for various items of work associated with building construction

1.	Write the detailed specification of earth work in excavation
2.	Differentiate general specification and detailed specification with suitable example

CO2: Analyse the unit rates of different items of work associated with building construction

1.	Explain DAR and DSR.
2.	Develop rate analysis for DSR item No.5.3, Reinforced cement concrete work with 1:1.5:3 (3 graded stone aggregate 20 mm nominal size) in beams, suspended floors, roofs having slope up to 15° landings, above plinth level up to floor five level, excluding the cost of centering, shuttering, finishing and reinforcement. **Material**: 20mm Aggregate 0.57m^3@₹1300/m^3, 10mm 0.28m^3@ ₹1300/m^3, coarse sand (Zone III) 0.425m^3@₹1200/m^3, Portland cement 400kg@₹5700/tonne. **Labour :** Mason 0.24@₹467/day, Beldar 2.75@₹368/day, Bhisti 0.90@₹407/day, Coolie 1.88@₹368/day **Carriage provisions**: Stone aggregate below 40mm 0.85m^3@₹103.77, Portland cement 0.40tonne@₹5700/tonne. **Hire Charges** for concrete mixer 0.08@₹800/day, Vibrator needle type ₹0.08@350/day **Sundries** (LS) 14.30@₹1.73. Adopt water charges, contractor profit and overheads as per the CPWD DSR2018 provisions.

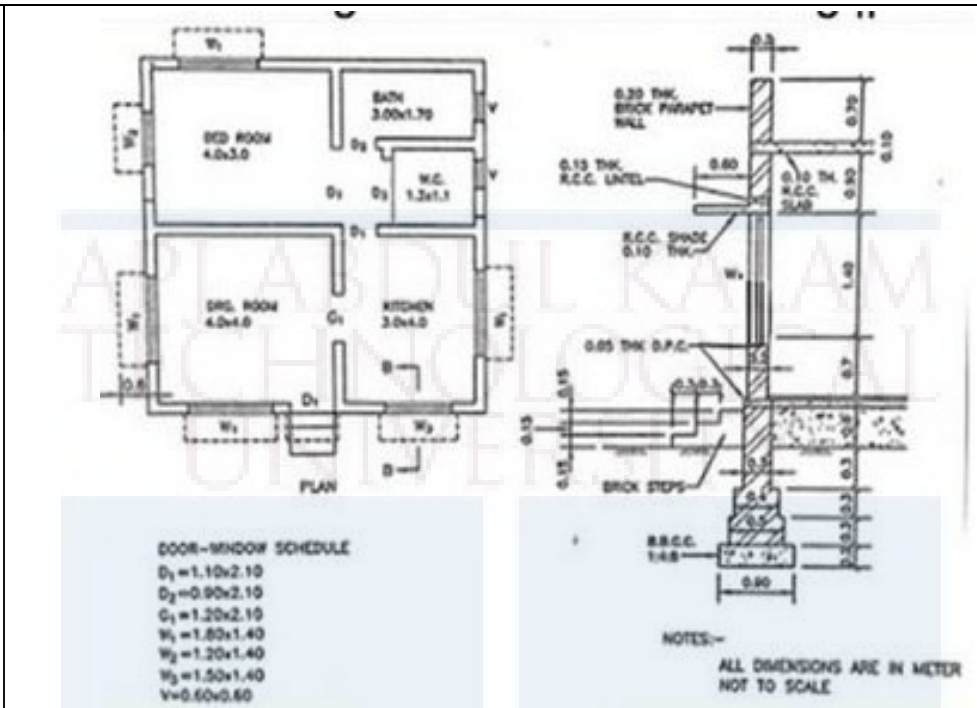
CO3: Prepare the approximate estimate of building

1.	Differentiate plinth area estimate and cubic content estimate
2.	Prepare the approximate estimate of building project with total plinth area of all building is 800sqm from the following data a) Plinth area rate₹. 45000 per sqm b) Cost of water supply @7.5% of cost of building c) Cost of sanitary and electrical installations each @ 7.5% of cost of building d) Cost of architectural features @ 1% of cost of building

	e) Cost of roads and lawns @5% of cost of building f) Cost of PS and contingencies @4% of cost of building Determine the total cost of building project

CO4: Prepare detailed estimates of buildings and the bar bending schedules for R.C.C works

1.	Explain bar bending schedule. State its uses
2.	Write the unit of measurement of (i) Carpentry fittings (ii) Pointing of Brick wall
3.	Calculate the quantity of RCC and Prepare a bar bending schedule of the slab of size 330cm x 550cm (internal dimensions) shown in the figure. (All dimensions are in centimeters) 
4.	Prepare detailed estimate for the following items of work for the construction of residential building shown below a) RRM for foundation and basement b) RCC works c) Inside and outside plastering

CO5: Describe various principles and methods of valuation

1.	Explain how depreciation in building is worked out.
2.	Discuss about the different types of values and the term obsolescence
3	Discuss the importance of valuation in civil engineering.

CO6: Calculate the value of buildings by different methods

1.	A building is situated by the side of a main road of Mumbai city on a land of 500sqm.The built up portion is 20m x 15 m. The building is first class type and provided with water supply, sanitary and electrical fittings, and the age of the building is 30 years. Workout the valuation of the property.
2.	A three storied building is standing on a plot of land measuring 800sqm. The plinth area of each storey is 400sqm.There is an RCC framed structure and thefuture life may take as 70 years. The building fetches a gross rent of ₹.18000per month, Work out the capitalized value of the property on the basis of 6% netyield. For sinking fund 3% compound interest may be assumed. Cost of the land may be taken as ₹. 10000 per sqm. The other data may assume suitably

3.	Workout the valuation of a commercial building with the following data: Cost of land for life-time period of building is ₹.5,20,000/-. Gross income per year is ₹.8,50,000/-Expenses required per year: (a) staff salary, electric charges, municipal taxes including licenses fees, stationery and printing etc. is 20% of the gross income. (b) For repair and maintenance of lift, furniture etc. @ 5% of their capital cost of ₹.10,50,000/- (c) sinking fund for the items considered in capital cost, whose life is 25years @4% after allowing 10% scrap value. (d) Insurance premium is ₹.25, 000/- per year. Take year's purchase @8% and annual repair of the building @2% on gross income.

SYLLABUS

MODULE 1. General introduction- Quantity surveying- Basic principles, Types of Estimates-purposes, Specifications-General &detailed specification for building materials and execution of major item of work (Earth work excavation, masonry, concrete, finishing) of building work with reference to CPWD specifications-Method of measurement with reference to IS1200.

MODULE 2. Analysis of rates, Introduction to the use of CPWD schedule of rates as per latest DSR and Analysis of rate as per latest DAR, Overhead charges. Analysis of rates for Earth work in excavation for foundation, mortars, reinforced cement concrete Works, finishing work, masonry work, stone works, flooringwith reference to latest DSR and latest DAR .Types of tender, contracts, General and important conditions of contract, contract document(concept only). Duties and roles of client, architect/engineer, contractor and local bodies.

MODULE 3. Detailed Estimate- Preparation of detailed measurement and abstract of estimate using Centreline method &Long wall short wall(separate wall) method for RCC single storey building, (students may answer the question by using any of the two methods)Septic tank and Soak Pit, preparation of Bar Bending Schedule– lintel, beams, slabs, RCC column footings.

MODULE 4. Valuation – explanation of different technical terms, purpose. Depreciation – methods of calculating depreciation – straight line method, constant percentage method, sinking fund method and quantity survey method, obsolescence.

Principles of valuation of open land- comparative method, abstractive method, belting method, valuation based on hypothetical building schemes. Methods of valuation of land with building – rental method, direct comparison of capital cost, valuation based on profit, depreciation method. Free hold and leasehold properties, Forms of rent, Rent fixation- Methods.

Text Books:

1. B. N. Dutta, Estimation and Costing in Civil Engineering, UBS publishers
2. Rangwala, Estimation Costing and Valuation,Charotar publishing house pvt. ltd
3. Dr. S. Seetha Raman, M.Chinna Swami, Estimation and Quantity Surveying, Anuradha publications Chennai.
4. M Chakraborthy,Estimating, Costing, Specification and valuation, published by the author, 21 B, Babanda Road, Calcutta 26

References:

1. B S Patil, Civil Engineering Contracts and Estimates, university press
2. V N Vazirani& S P Chandola, Civil Engineering Estimation and Costing, Khanna Publishers
3. IS 1200-1968; Methods of Measurement of Building &Civil Engineering Works
4. CPWD DAR 2018 and DSR 2018 orlatest

Lecture Plan

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I: Total lecture hours: 7**		
1.1	Introduction, estimation, purpose of estimation	CO3	1
1.2	Types of estimates, simple problems of approximate estimate	CO3	2
1.3	Specification, objectives, principles of specification writing, design of ideal specification	CO1	1
1.4	Types of specifications	CO1	1
1.5	Detailed specification of excavation, PCC& RCC, mortars, brick works.	CO2	2
2	**Module II: Total lecture hours: 6**		
2.1	Analysis of rate, need, factors affecting, Introduction to the use of CPWD DSR and DAR,overhead charges	CO2	1
2.2	Analysis of rates for earth works, PCC, RCC Works, finishes, masonry works, stone works,flooring, with reference to latest DSR and DAR.(Required data for rate analysis will be provided in the question paper.)	CO2	3

2.3	Tender, types, Contract,types,factors affecting, contract document, General and important conditions of contact.Duties and roles of client, architect/engineer, contractor and local bodies	CO2	2
3	**Module III: Total lecture hours: 16**		
3.1	Different methods of detailed estimation- center line method and long wall short wall method.	CO4	2
3.2	Preparation of detailed measurement and abstract of estimatefor RCC single storey buildings- Excavation for foundation, Foundation and basement, DPC, Masonry in superstructure, RCC, Plastering, Painting, Flooring, Woodwork.	CO4	8
3.3	Estimation of Septic tank and soak pit	CO4	2
3.4	BBS of lintel, beam, slab and column footing	CO4	4
4	**Module IV: Total lecture hours:16**		
4.1	Valuation-purpose, different forms of values	CO5	1
4.2	Capitalized value, years purchase, sinking fund, Gross income, net income, outgoings –simple problems	CO5	3
4.3	Depreciation – methods of calculating depreciation – straight line method, constant percentage method, sinking fund method, and quantity survey method-problems,obsolescence	CO5	3
4.4	Methods of valuation of open land – comparative method, abstractive method, belting method, valuation based on hypothetical building schemes-Problems based on this	CO5,CO6	3
4.5	Methods of valuation of land with buildings – rental method, direct comparison with capital cost, valuation based on profit, depreciation method-Problems based on this	CO5,CO6	4
4.6	Free hold and leasehold properties, Forms of rent, Rent fixation- Methods. Simple problems based on this	CO6	2

MODEL QUESTION PAPER

Reg.No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH. DEGREE EXAMINATION

Course Code: CET382

Course Name: ESTIMATION, COSTING AND VALUATION

Max.Marks:100 Duration: 3Hours

PART A

Answer all questions; each question carries 3 marks. (10×3 marks = 30 marks)

1. a) Differentiate revised estimate and supplementary estimate

   b) What are the principles of specification writing?

   c) Explain the use of data book and schedule of rates

   d) What are the important points to be noted while preparing contract document?

   e) In a simply supported beam of depth 450mm is provided with a 3, 20mm diameter bar at bottom, in this one bar is provided as bendup bar near both the supports. 10mm stirrups are provided with top and bottom cover 25mm. Calculate the additional length provided for bend up in both end. If the (i) bendup angle is 45^o and (ii) bendup angle is 30^o.

   f) Write the unit of measurement of (i) DPC using waterproofing compound (ii) Iron work for window (iii) Water proof Painting above roof slab

   g) Differentiate book value and market value

   h) Differentiate depreciation and obsolescence

   i) Explain how will you find out the valuation of land by hypothetical building scheme

   j) Explain the depreciation method of valuation

PART B

Answer one full question from each module (Assume any missing data suitably)

Module I

2. a) Prepare approximate estimate of a public building having plinth area equal to1800 sq.m.

i. Plinth area rate as ₹. 35,000 / sq. m.
ii. Special architectural treatment = 3% of cost of building.
iii. Water supply and sanitary installation = 5% of cost of building.
iv. Electric installation =14% of cost of building.
v. Other services = 5% of cost of building.
vi. Contingencies = 3% of overall cost of building.
vii. Supervision charges = 8% of overall cost of building. (10marks)

b) Differentiate detailed estimate and preliminary estimate. What are the documents to be accompanied with detailed estimate? (6marks)

OR

3. Differentiate general specification and detailed specification with suitable example(16marks)

Module II

4. a) What are the factors affecting the rate of a particular item of work. (6 marks)

b) Develop unit rate analysis for Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level 1:1½:3 (1 Cement: 1½ coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size)

Details of cost for 1 cum.

MATERIAL: Stone Aggregate (Single size) 20 mm nominal size 0.57 m^3@₹1350/m^3, Stone Aggregate (Single size): 10 mm nominal size 0.28 m^3@₹1350/m^3, Coarse sand (zone III)0.425 m^3@₹1350/m^3, Portland Cement (0.2833 cum) 0.40 tonne@₹4940/tone

LABOUR: Mason (average) 0.1/day @ ₹709/day, Beldar 1.63/day @ ₹558/day,Bhisti 0.70/day @ ₹617/day

HIRE CHARGES: Concrete Mixer 0.25 to 0.40 cum with hooper 0.07/day @ ₹800/day Vibrator (Needle type 40mm) 0.07/day @ ₹370/day

CARRIAGE CHARGES: Stone aggregate below 40 mm nominal size 0.85 m^3@₹103.77/m^3, Coarse sand 0.425 m^3@₹103.77/m^3, Portland cement 0.40 tonne@₹92.24/tone

Sundries: 14.3LS @₹2.00/LS (10marks)

OR

5. a. Explain the different types of contracts (8 marks)

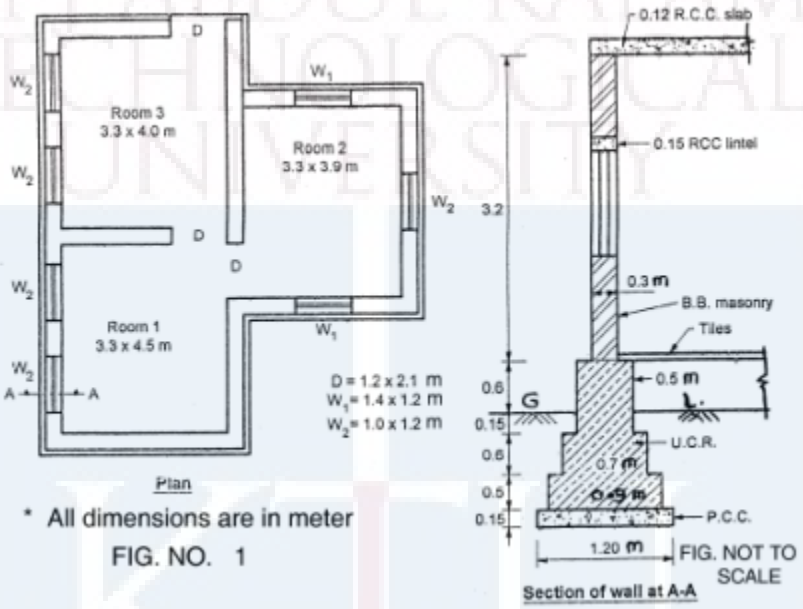
b.What are the general and important conditions of contract? (8 marks)

Module III

6. Prepare the detailed estimate of the following items of the building. Refer Fig. No. 1

(22 marks)

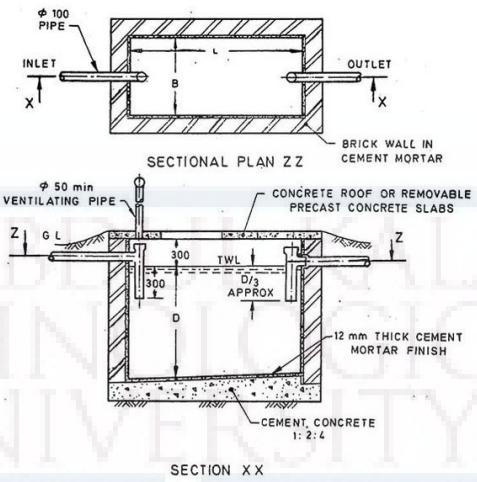
i. Excavation for foundation.
ii. RR masonry in foundation and plinth (1:6)
iii. Brick Masonry in superstructure (1:6).
iv. Mosaic tile flooring.



OR

7. Prepare the detailed estimate of following items of septic tank shown below (22 marks)

a) Earth work in excavation
b) Cement concrete 1:2:4
c) R.C.C work 1:1 ½:3
d) Plastering in C.M 1:3
e) Brick masonry



Module IV

8. a) A concrete mixer was purchased at ₹.8000/-. Assuming salvage value to be ₹.1000, after5years, calculate depreciation for each year adopting (a) Straight line method (b) Constant percentage method and (c) Sinking fund method considering 6% interest. (8 marks)

b) A lease-hold property is to produce a net income of ₹.1,20,000/- per annum for the next 60years. What is the value of the property? Assume that the land lord desires a return of 6% on his capital and the sinking fund to replace the capital is also to accumulate at 6%. What will be the value of the property if the rate of interest for redemption of capital is 3%? (8 marks)

OR

9. a) A property consists of a south facing plot of land, having south-east and north sides in due directions, which measures 60m, 180m and 80m respectively. It consists of an old two storied building, having a total cubical content of 2840 cubic metres. Assuming prime cost of construction of the building as ₹.20000/- per cubic metre and allowing 10% old materials value only for the building, what would you recommend as the fair value of the property, if the front belt land (depth of front belt being 25m) be estimated at ₹.9000/- per sqm? (8 marks)

b) The owner of a building gets a net annual rent of ₹.85,500. The future life of building is estimated to be 12 years. But if recommended repairs are carried out immediately at an estimated cost of ₹.3, 00,000, it is expected to last for at least 30years. Assuming rate of interest as 8%, determine whether it is economical to carry out the recommended repairs to the building or leave it as it is. (8 marks)

CET383	ECO-FRIENDLY TRANSPORTATION SYSTEMS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		VAC	3	1	0	4	2019

Preamble : Objective of the course is to introduce the principles and practice of sustainability on transportation systems and development of an eco-friendly transport system.

Prerequisite: Nil

Course Outcomes:

	Description
CO No.	At the end of the course, students will be able to:
CO 1	Apply the basic principles of sustainability to infrastructure related problems
CO 2	Analyse Transportation network for eco-friendliness and quantify the levels.
CO 3	Design eco-friendly transportation systems
CO 4	Apply concepts of sustainability in developing green fuels and vehicles.
CO 5	Design for sustainability in public transport, Applications of tools like GIS, GPS.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	2	1		1	3	1		2		1	2	3
CO 2	2	2	1	2	1	1	1	1	1	1		1	2	2
CO 3	2	1	3	1	2	1	1	1	2	2	1	2	2	3
CO 4	2	2	2	1	1	2	2	1	1	1	1	2	2	3
CO 5	1	3	3	3	3	3	2	2	3	3	2	2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**7.5**	**7.5**	**30**
Understand	**7.5**	**7.5**	**30**
Apply	**-**	**-**	**-**
Analyse	**5**	**5**	**20**
Evaluate	**5**	**5**	**20**
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

The question consists of two parts- Part A and Part B. Part A consists of 10 questions with 3 marks for each (two questions from each module). Part B consists of two questions from each module, out of which one has to be answered. Each question carries 14 marks and can have maximum 2 subdivisions.

Sample Course Level Assessment Questions:

1 **Course Outcome 1 (CO1):**Define sustainability in transportation context. How can the principles be applied here?

2 Course Outcome 2 (CO2): Describe the procedure of evaluating the performance of a transportation network, citing any example.

3 Course Outcome 3 (CO3): What are the characteristics of eco-friendly transportation system? What changes are to be incorporated in designing the same?

4 Course Outcome 4 (CO4): Discuss the concept of green vehicles describing the aspects that make them green.

5 Course Outcome 5 (CO5): Giving KSRTC as an example explain how sustainability can be achieved in public transport.

Syllabus

Module	Contents	Hours
1	Introduction to the concept of sustainability, basic principles.	10
2	Transport networks basics, Performance measures, Advanced transport systems	10
3	Design for eco-friendly Transportation, Professional praxis in sustainability, concept and applications	9
4	Emerging concepts in sustainable transportation: green vehicles and green roads	9
5	Sustainable public transport: Promoting public transport, Transit oriented development, integrated multi-modal transport.	7

Text Books

1. Chisty, J, Lall, K. Introduction to Transportation Engineering. PHI
2. O' Flaherty, C.A (Ed.)., Transport Planning and Traffic Engineering, Elsevier.
3. Jeffrey Tumlin: Sustainable Transportation Planning: Tools for Creating Vibrant, Healthy, and Resilient Communities, John Wiley & Sons

References

1. Green Transportation Logistics: The Quest for Win-Win Solutions Editors: Psaraftis, Harilaos N. (Ed.), Springer
2. Thomas Abdallah: Sustainable Mass Transit: Challenges and Opportunities in Urban Public Transportation.
3. Chester Patton, Public Transit Operations: The Strategic Professional
4. Sustainable and Efficient Transport: Incentives for Promoting a Green Transport Market-Edited by Ellen Eftestøl-Wilhelmsson, et al, Edward Elgar
5. Rani Iyer:Green Transport: Exploring Eco-Friendly Travel for a Better Tomorrow:
6. Smart City project reports.
7. Environmental Impact Assessment Reports on Infrastructure projects.

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 10
1.1	Sustainability: Definition, concepts	CO1	2
1.2	Environmental impacts of infrastructure projects, depletion of natural resources and pollution.	CO1	2
1.3	Problems of present transportation systems, performance analysis. Introduction to eco-friendly systems.	CO1	6
2	**Module 2**		Total: 10
2.1	Transportation network basics: network planning, design, operation and management (elementary ideas only)	CO2	3
2.2	Measures of network performance, factors and parameters.	CO2	4
2.3	Introduction to advanced transport systems: metro, monorail, maglev, hyperloop.	CO2	3
3	**Module 3**		Total: 7
3.1	Eco-friendly transport: Necessity, Basics: reducing natural fuels	CO3	2
3.2	Eco-friendly transport network. Parameters, design, implementation.	CO3	3
3.3	Professional praxis in sustainability: concepts, practical applications. Paradigm shift: Mobility and accessibility.		2
4	**Module 4**		Total: 9
4.1	Emerging concepts in sustainable transportation: green vehicles and green roads: basics and necessity.	CO4	2
4.2	Green vehicles: minimizing fuel consumption, alternate fuels. Green pathways: sustainable design, construction,	CO4	4
4.3	Forgiving designs for safety, ITS applications.	CO4	3
5	**Module 5**		Total: 9
5.1	Sustainable public transport: Promoting public transport, Fleet management and scheduling: Concepts and tools only.	CO5	3
5.2	Transit oriented development (smart cities), integrated multi-modal transport, GIS applications.	CO5	6

5.3	Micro projects: i) Compilation of studies on green fuels and transport, with comparison. ii) A study on literature available on a typical smart city project, in the transport context, and propose designs. (may be given as assignments)		

Model Question Paper

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIFTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET383

Course Name: **Eco-friendly Transportation Systems (Minor)**

Marks:100 Duration: 3 hrs

PART A
(Answer all questions. Each question carry three marks)

1. Define sustainability with emphasis on transport.
2. List the principles of sustainability.
3. What are the fundamental elements of a transport network? How do they contribute to performance?
4. Compare metro and maglev technologies.
5. Why is an eco-friendly transport necessary? Cite a typical example.
6. Why is a paradigm shift necessary in sustainability?
7. Explain the terms: Green roads, Green fuels.
8. With a typical example, explain forgiving designs.
9. List a few methods of promoting public transport.
10. What do you understand from Transit Oriented Development?

PART B
(Answer one full question from each module)

11. a) Describe how an infrastructure project affects environment. (10)
    b) What are the issues with present transport systems? (4)

OR

12 a)When is a system deemed eco-friendly? Explain in transport context. (6)

b). What are the parameters of performance analysis of transportation systems? Explain (8)

13 a) With a typical example, illustrate the performance evaluation of a transport network(6)

b) What is hyperloop? Is it eco-friendly? How? (8)

OR

14a) Describe the process of network planning, design, operations and management (10)

b) What are the challenges faced by metro rail systems? (4)

15a) Explain the principles of an eco-friendly transport network (8)

b)Discuss the term professional praxis in a sustainability scenario. (6)

OR

16 a) How is the eco-friendliness of a transport network evaluated? Discuss the steps involved(8)

b)Explain the factors involved in designing an eco-friendly network (6)

17 a) List the alternate fuels for transport and discuss any two (6)

b) Define ITS. What are its application in eco-friendly transport. Expalin any two. (8)

OR

18 a) Discuss any two eco-friendly construction methods for roads (8)

b) What are the methods of reducing fuel consumption in vehicles (6)

19a)Write a note on public transport fleet management. (6)

b) /what is meant by integrated multi-modal transport? Discuss it's possibilities in a city in Kerala. (8)

OR

20 Discuss the applications of GIS and GPS in transport, explaining how eco-friendliness can be achieved. (14)

CET 384	GEOTECHNICAL INVESTIGATION & GROUND IMPROVEMENT TECHNIQUES	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: Goal of this course is to expose the students to various methods of soil exploration, to recognize weak soils based on the soil investigation reports and to analyze suitable remedial measures to improve the properties of weak soils. After this course, students will be able to recognize practical problems in real-world situations and respond accordingly.

Prerequisite : CET283 Introduction to Geotechnical Engineering

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

CO 1	Understand soil exploration methods
CO 2	Explain different methods of ground improvement techniques with and without addition of other materials
CO 3	List various types, functions and practical applications of Geosynthetics
CO 4	Describe the application of reinforcement function of geosynthetics in retaining structures like Reinforced Earth Retaining Walls, Gabions and Soil nailing
CO 5	Solve the field problems related to geotechnical engineering by applying ground improvement techniques

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	3	-	-	-	-	-	-	-	-	-	-
CO 3	3		-	-	-	-	-	-	-	-	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			

Create			CIVIL ENGINEERING

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation (CIE) Pattern :

Attendance : 10 Marks

Continuous Assessment Test (2 numbers) : 25 Marks

Assignment/Quiz/Course project : 15 Marks

End Semester Examination (ESE) Pattern : There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

(*Questions may be framed based on the outline given under each course outcome*)

Course Outcome 1 (CO1):

1. Understand Soil Investigation and Soil Exploration methods

Course Outcome 2 (CO2):

1. Explain different methods of ground improvement techniques without addition of any materials viz. surface compaction & deep compaction
2. Explain different methods of ground improvement techniques with addition of other materials viz. grouting and lime stabilization

Course Outcome 3 (CO3):

1. List various types of Geosynthetics
2. List functions of Geosynthetics
3. List practical applications of Geosynthetics

Course Outcome 4 (CO4):

1. Explain reinforced earth retaining walls
2. Explain Gabions
3. Explain Soil Nailing

Course Outcome 5 (CO5):

1. Explain solutions of suitable ground improvement techniques for various practical situations

SYLLABUS

Module 1
Site investigation and soil exploration: Introduction and practical importance – objectivesPlanning of a sub-surface exploration program – Reconnaissance – Preliminary investigation - Detailed investigation - methods of subsurface exploration – direct methods - Open pits and trenches - Semi direct methods – Borings - Auger boring – Shell and Auger Boring - Wash boring, percussion drilling and rotary drilling – advantages and disadvantages -Guidelines for choosing spacing and depth of borings [I.S. guidelines only] - Sampling - disturbed samples, undisturbed samples and chunk samples - Types of samplers – Split spoon sampler – Thin-walled sampler – Piston sampler - Rotary sampler – Core Recovery and Rock Quality Designation
Module 2
Sounding and Penetration Tests - Standard Penetration Test – Procedure - Corrections to be applied to observed N values – Numerical examples - Factors influencing the SPT results and precautions to obtain reliable results – Merits and drawbacks of the test - Correlations of N value with various engineering and index properties of soils - Static Cone Penetration Test (SCPT) and Dynamic Cone Penetration Test (DCPT) – Brief Procedure - Merits/drawbacks - Boring log - soil profile- Location of Water table - Geophysical methods : Seismic Refraction method and Electrical Resistivity method – Brief Procedure - Merits/drawbacks
Module 3
Ground Improvement Techniques : Introduction – Objectives - Soil improvement without the addition of any material : Shallow and Deep Compaction - Shallow compaction – Rollers - Deep Compaction - Dynamic compaction - Compaction piles - Blasting technique - Vibro compaction– Vibroflotation - Terra probe method - Vibro replacement - sand piles and stone columns - Preloading techniques – sand drains
Module 4
Soil improvement by adding materials : Grouting – materials - Grouting systems : One shot and two shot systems - Modes of grouting - Main types of grouting : Permeation Grouting, Compaction Grouting and Jet Grouting – Practical Applications - Grouting Plant and equipment - Grouted columns – Curtain and blanket grouting – Practical applications - Lime stabilization –Mechanism-optimum lime content-lime fixation point
Module 5
Soil improvement using Geosynthetics : Materials of Geosynthetics - Types of Geosynthetics - Types of Geotextiles and Geogrids - Functions of Geosynthetics - Practical applications - Introduction to reinforced earth – principles – reinforcing materials - Reinforced earth retaining walls – components – construction sequence – practical applications - Gabions – Introduction - practical applications - Soil Nailing – Introduction – practical applications

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Purushotham S. Raju, Ground Improvement Technique, Laxmi Publications

References:

1. Shashi K. Gulhati and Manoj Dutta, Geotechnical Engineering, Tata McGraw-Hill Publishing CompayLimited,New Delhi, 2008
2. Venkatramaiah, Geotechnical Engg, Universities Press, 2000.
3. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.
4. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall, 2004
5. Boweven R., Grouting in Engineering Practice, Applied Science Publishers Ltd
6. Sivakumar Babu, G. L., An introduction to Soil Reinforcement and Geosynthetics, Universities Press (India) Private Limited, 2006
7. Jewell R.A., Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
8. Donald .H. Gray & Robbin B. Sotir, Bio Technical & Soil Engineering Slope Stabilization, John Wiley
9. Rao G.V. & Rao G.V.S., Engineering with Geotextiles, Tata McGraw Hill
10. Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill

Course Contents and Lecture Schedule:

Module	Contents	Outcomes Addressed	Hours
1	**Module 1**		**9**
1.1	**Site investigation and soil exploration**: Introduction and practical importance - objectives	CO 1	1
1.2	Planning of a sub-surface exploration program – Reconnaissance – Preliminary investigation	CO 1	1
1.3	Detailed investigation - methods of subsurface exploration – direct methods - Open pits and trenches	CO 1	1
1.4	Semi direct methods – Borings - Auger boring – Shell and Auger Boring - Wash boring, percussion drilling and rotary drilling – advantages and disadvantages	CO 1	2
1.5	Guidelines for choosing spacing and depth of borings [I.S. guidelines only]	CO 1	1
1.6	Sampling - disturbed samples, undisturbed samples and chunk samples	CO 1	1
1.7	Types of samplers – Split spoon sampler – Thin-walled sampler – Piston sampler - Rotary sampler – Core Recovery and Rock Quality Designation	CO 1	2
2	**Module 2**		**9**
2.1	Sounding and Penetration Tests - Standard Penetration Test – Procedure	CO 1	1
2.2	Corrections to be applied to observed N values – Numerical examples	CO 1	1
2.3	Factors influencing the SPT results and precautions to obtain reliable results – Merits and drawbacks of the test	CO 1	1
2.4	Correlations of N value with various engineering and index properties of soils	CO 1	1
2.5	Static Cone Penetration Test (SCPT) and Dynamic Cone Penetration Test (DCPT) – Brief Procedure - Merits/drawbacks	CO 1	2
2.6	Boring log - soil profile- Location of Water table	CO 1	1
2.7	Geophysical methods : Seismic Refraction method and Electrical Resistivity method – Brief Procedure - Merits/drawbacks	CO 1	2
3	**Module 3**		**9**
3.1	Ground Improvement Techniques : Introduction - Objectives	CO 2	1
3.2	Soil improvement without the addition of any material : Shallow and Deep Compaction	CO 2	1

3.3	Shallow compaction - Rollers	CO 2	1
3.4	Deep Compaction - Dynamic compaction	CO 2	1
3.5	Compaction piles	CO 2	1
3.6	Blasting technique	CO 2	1
3.7	Vibro compaction– Vibroflotation - Terra probe method	CO 2	1
3.8	Vibro replacement - sand piles and stone columns - Preloading techniques – sand drains	CO 2	2
4	**Module 4**		**9**
4.1	Soil improvement by adding materials : Grouting - materials	CO 2	1
4.2	Grouting systems : One shot and two shot systems - Modes of grouting	CO 2	1
4.3	Main types of grouting : Permeation Grouting, Compaction Grouting and Jet Grouting – Practical Applications	CO 2 & CO 5	3
4.4	Grouting Plant and equipment	CO 2	1
4.5	Grouted columns – Curtain and blanket grouting – Practical applications	CO 2 & CO 5	1
4.6	Lime stabilization –Mechanism-optimum lime content-lime fixation point	CO 2	1
5	**Module 5**		**9**
5.1	Soil improvement using Geosynthetics : Materials of Geosynthetics	CO 3	1
5.2	Types of Geosynthetics - Types of Geotextiles and Geogrids	CO 3	1
5.3	Functions of Geosynthetics - Practical applications	CO 3 & CO5	1
5.4	Introduction to reinforced earth – principles – reinforcing materials	CO 4	1
5.5	Reinforced earth retaining walls – components – construction sequence – practical applications	CO 4 & CO5	2
5.6	Gabions – Introduction - practical applications	CO 4 & CO5	1
5.7	Soil Nailing – Introduction – practical applications	CO 4 & CO5	1

Model Question Paper

QP CODE:

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 384

Course Name : GEOTECHNICAL INVESTIGATION & GROUND IMPROVEMENT TECHNIQUES

Max. Marks: 100 Duration: 3 hours

Part A

(***Answer all questions; each question carries 3 marks***)

1. Explain Objectives of soil exploration
2. List out the factors, which affect the spacing between the bore holes
3. Discuss the merits and demerits of SPT in the sub-surface investigation
4. Discuss any one method of determining the ground water table.
5. Explain Compaction piles in sand
6. Explain Significant depth of influence in Deep compaction.
7. Explain One Shot system and two shot system in grouting
8. Explain optimum lime content and lime fixation point
9. Differentiate between Woven and Non-woven geotextiles.
10. Explain the principle of reinforced earth.

PART B

(Answer one full question from each module, each question carries 14 marks)

Module – 1

11. (a) Give guidelines, which enable the determination of the depth of exploration (5 Marks)

    (b) Explain Wash boring methods of site exploration with neat sketch. What are the advantages and disadvantages of this method. (9 Marks)

12. (a) Distinguish between thin-wall and thick-wall samplers (5 Marks)

    (b) Explain Auger boring and Shell & Auger boring methods of site exploration with neat sketches. What are the advantages of these methods. (9 Marks)

Module – 2

13. (a) Explain Static Cone Penetration Test. (5 Marks)

    (b) What is Standard Penetration Test? Explain the test setup and the procedure of conducting the test. What are the corrections to the observed SPT (N) value? (9 Marks)

14. (a) Explain Dynamic Cone Penetration Test. (5 Marks)

    (b) Explain Seismic Refraction Method of exploration. What are its limitations? (9 Marks)

Module – 3

15. (a) Explain the dynamic compaction process for granular soils. (7 Marks)

    (b) Explain Vibroflotation with neat sketch. What are the practical applications? (7 Marks)

16. (a) Explain Sand Piles and Stone Columns. (7 Marks)

    (b) Explain Preloading Techniques with neat sketch. What are the advantages and disadvantages? (7 Marks)

Module – 4

17. (a) Explain Grouting Plant and Equipment (5 Marks)

    (b) Explain Compaction Grouting. What are its practical applications? (9 Marks)

18. (a) Explain Lime stabilization method. (5 Marks)

    (b) Explain jet grouting method. What are its practical applications? (9 Marks)

Module – 5

19. (a) What are the functions of geosynthetics? (5 Marks)

    (b) Explain Gabions and Soil Nailing. What are its practical applications? (9 Marks)

20. (a) List different types of geosynthetics. (5 Marks)

    (b) Explain the components of Reinforced Earth Retaining Walls with neat sketch. What are the practical applications of reinforced earth? (9 Marks)

CET 385	SUSTAINABILITY ANALYSIS AND DESIGN	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	4	0	0	4	2019

Preamble: Goal of this course is to introduce various tools and techniques of sustainability analysis and its significance in design and engineering decision making.

Prerequisite: Nil

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

Course outcome identifier	Description of course outcome	Prescribed learning level
CO 1	Identify the impacts of various materials and processes on the biosphere	Remembering
CO2	Identify the parameters used in the calculation of sustainability	Understanding
CO 3	Estimate sustainability metrics for application-material combinations.	Applying
CO 4	Apply the design approaches by integrating sustainability concepts	Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	-	-	-	-	-	-	-	-
CO 2	1	2	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	2	-	2	-	-	-	-	-	-	-
CO 4	2	3	2	-	2	-	-	-	-	-	-	-
CO5												

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	7.5	7.5	30
Understand	7.5	7.5	30
Apply	10	10	40
Analyse			

Evaluate			
Create			

Mark Distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course Project : 15 marks

End Semester Examination Pattern:

There will be two parts: Part A and Part B.

Part A contains 10 questions with 2 questions from each module and each question shall carry 3 marks. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions

Course level Assessment Questions

Course Outcome 1 -Identify the impacts of various materials and processes on the biosphere.

1. How are materials classified as renewable and non-renewable?
2. Compare infinitely available and regenerative renewable resources.
3. Prepare a short description on zero waste production system.

Course Outcome 2 -Identify the parameters used in the calculation of sustainability

1. Compare “output pulled” and “input pushed” systems
2. Prepare short note on “dematerialization” and “remanufacturing”.
3. Explain ecological footprint

Course Outcome 3 -Estimate sustainability metrics for application-material combinations

1. Illustrate the significance of biomimicry taxonomy in sustainable design.
2. How is global warning potential assessed?
3. Illustrate water foot print of a process.

Course Outcome 4 - Apply the design approaches by integrating sustainability concepts

1. Illustrate the role of biomimicry in the design for sustainability approaches.
2. Explain the significance of “cradle to cradle” design concept.

3. List any five commonly used life cycle impact categories

Syllabus

Module 1

Introduction to sustainability - Sustainable use of materials: Energy, ecology and natural resources

Engineering design process-Role of materials in design: important material characteristics, construction ecology and metabolism - specifications and market.

Module 2

Material flow analysis - efficiencies in mass flow — Constructing a material flowsystem—embodied energy—engineering models based on waste and materials management

Module 3

Sustainability metrics — mass balance and footprint concept Sustainable design - Specifications for sustainable material use — waste management and material life cycles - Environmentally sensitive design — Green engineering

Module 4

Life-cycle assessment—Life cycle assessment framework-Inventory analysis —impact assessment – interpretation

Module 5

Sustainable designs approaches - Sustainable urbanization – sustainable cities –sustainable transport - energy efficiency.

Text Books:

I. Allen,D.TandShornard,DR,SustainabilityEngineering,Concepts,DesignandCase Studies, Prentice Ha1.

2. BradleyA.S.,Adebryo,A.0.,MariaP,EngineeringApplicationsinSustainableDesignand Development, Cengige Learning

References:

1. UNDP (1987), Our Common Future, Report of the World Commission on Environment and Development

2. Riley,D.R.,Thatche,C.E.,andWorkman,E.A.(2006),Developingandapplyinggreen building technology in an indigenous community: An engaged approach to sustainability education,InternationalJournalofSustainabilityinHigherEducation,7(2),142-157.

3. LSF-LST (2007). Understanding Sustainability, Learning for a Sustainable Future, http://www.lsfIst.cz/en/teachers/understanding.php,YorkUniversity,Ontario,Canada.

4. ASCE (2004), Sustainable Engineering Practice: An Introduction, Jorge A. Vanegas(Editor).

5. USGBC (2008), LEEE Rating Systems, US Green Building Council, http://www.usgbc.trg/DisplayPage.aspx?CMSPagelD=222(2008),Thematic Strategy on the prevention and recycling of waste, The EuropeanCommission, http://ec.euroaa.eu/environment/waste/index.htm

Course Contents and Lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total: 9
1.1	Introduction to sustainability - Sustainable use of materials	CO1, CO2	2
1.2	Energy, ecology and natural resources	CO1, CO2	3
1.3	Engineering design process-Role of materials in design	CO1, CO2	2
1.4	Construction ecology and metabolism - specifications and market	CO1, CO2	2
2	**Module 2**		Total: 9
2.1	Material flow analysis - efficiencies in mass flow	CO1. CO2 CO3	3
2.2	Constructing a material lflowsystem—embodied energy	CO1, CO2 CO3	3
2.3	Embodied energy	CO2, CO3	1
2.4	Engineering *models* based on waste and materials management	CO2, CO3	2
3	**Module 3**		Total: 9
3.1	Sustainability metrics — mass balance and footprint concept Sustainable design	CO1, CO2 CO3,CO4	2
3.2	Specifications for sustainable material use	CO1,CO2 CO3,CO4	3
3.3	Waste management and material life cycles	CO3,CO4	2
3.4	Environmentally sensitive design — Green engineering	**CO3,CO4**	2
4	**Module 4**		Total: 9
4.1	Life-cycle assessment—Life cycle assessment framework	CO1,CO2 CO3,CO4	3
4.2	Inventory analysis	CO1,CO2 CO3,CO4	3
4.3	impact assessment – interpretation	CO1,CO2 CO3,CO4	3
5	**Module 5**		Total: 9
5.1	Sustainable designs approaches	CO1,CO2 CO3,CO4	3
5.2	Sustainable urbanization – sustainable cities	CO1,CO2 CO3,CO4	3
5.3	Sustainable transport - energy efficiency.	CO3, CO4	3

Model Question Paper

QP CODE:

Reg No.:_____ Name:_____

ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 385

Course Name:SUSTAINABILITY ANALYSIS AND DESIGN

Max. Marks: 100 Duration: 3 hours

Answer All Questions- 10 ×3 =30marks

Each question carries 3marks

1. Narrate any one material characteristic that is needed to ensure sustainability.
2. Highlight any one approach that could enable products in the market to be preferred on environmental performance.
3. State any one of the observation from material flow analysis that would supplement sustainability evaluation.
4. What is embodied energy of a material?
5. Define footprint based sustainability indicators.
6. Illustrate the term “Reuse factor”
7. Additive operations in LCA
8. LCA helps to arrive at lower entropy form of a material. Substantiate the statement giving any one reason.
9. Prepare a short account on sustainable urbanization
10. How is energy efficiency linked with sustainable design process.

PART B

Each question carries 14marks

11. Identify any three engineering materials that are used as environmental substitutes for the conventional systems. Also narrate the factors considered in their selection based on engineering design requirement.

or

12. Explore the possibility of creating ecosystem based approach for construction process and highlight its significance to ensure sustainability.

13. “Buildings embody large quantity of material energy”. Prepare a short description narrating how this resource could be used to create energy efficient material use road map for Kerala.

or

14. Establish the industrial ecological model as an outcome of engineering models proposed for waste and material management.

15. Explore the possibility of creating ecosystem based approach for construction process and highlight its significance to ensure sustainability. Case based justification is expected.

or

16. Explain a few interventions incorporated as part of design for environment concept for improving the material handing process.

17. Explain the four major steps involved in the LCA programme.

or

18. (i) List any two challenges faced while implementing the LCA for an impact assessment programme.

(ii) Justify ,giving two reasons, how LCA enables to take environmentally informed decisions

CET 386	ENVIRONMENTAL HEALTH AND SAFETY	CATEGORY	L	T	P	CREDIT	Year of Introduction
		VAC	3	1	0	3	2019

Preamble: The course is designed to build environmental health literacy among students and encourages them to take safety measures against various environmental hazards. It motivates the students in maintaining and improving the quality of the environment and empower learners to take appropriate actions to reduce the environment pollution.

Pre-requisite: Nil

Course outcome : After the course, the student will able to:

CO1	Understand the Toxicology and Occupational Health associated with industries.
CO2	Identify chemical and microbial agents that originate in the environment and can impact human health.
CO3	Describe various measures to ensure safety in Construction industry.
CO4	Explain the effect of air and water pollution on environment.
CO5	Describe the safety measures against various environmental hazards.

CET 386 Environmental Health And Safety		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	CO1	3					2	2							1	
	CO2	3					2	1								
	CO3	3					2	2								
	CO4	3					2	2								
	CO5	3					2	2								

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	20	20	40
Apply			
Analyze	15	15	30
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance	:	10marks
Continuous Assessment Test(2numbers)	:	25 marks
Assignment/Quiz/Course project	:	15marks
Total	**:**	**50 marks**

End semester examination pattern – There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment

Qn. No	Question	Marks	Course outcome (CO) Assessed
	Part A		
1	What are the socio- economic reasons in safety?	3	CO1
2	Define industrial hygiene.	3	CO1
3	Define noise. What are the compensation aspects of noise?	3	CO2
4	Explain about the biohazard control program.	3	CO2
5	Discuss the possible electrical injuries in a construction industry.	3	CO3
6	What are the hazards due to radiation?	3	CO3
7	What are the criteria air pollutants?	3	CO4
8	Describe the Depletion of Ozone Layer.	3	CO4
9	What are the benefits of safety inspection?	3	CO5
10	Discuss the role of an individual in conservation of natural resources.	3	CO5

	Part B (Answer ANY ONE FULL question from each module)		
Module I			
11	Briefly explain about occupational related diseases found in the industries.	14	CO1
12	Write the short notes on : (i) Silicosis (ii) Asbestosis (iii) Anthracosis (iv) Anthrax.	14	CO1
Module II			
13(a)	Write briefly about the classification of biohazardous agents.	7	CO2
13(b)	What are the precautionary measures for chemical hazards?	7	CO2
14	Write short notes on : (i)Vapour (ii) Fog (iii) Dust (iv) Fumes.	14	CO2
Module III			
15	Explain effects of radiation on human body and the methods of radioactive waste disposal.	14	CO3
16(a)	What are the requirements for safe work platform?	7	CO3
16(b)	Discuss about the scaffolding inspections.	7	CO3
Module IV			
17	Describe the effect of air pollution on environment.	14	CO4
18	Describe the effect of water pollution on environment.	14	CO4
Module V			
19 (a)	What is First aid? Explain CPR.	7	CO5
19 (b)	What are the important points to be considered in carrying out workplace inspection?	7	CO5
20 (a)	Explain the first aid measure to be taken during i)gas poisoning, ii)heart attack, iii)chemical splash and iv)electric shock.	10	CO5
20 (b)	Briefly explain the elementary first aid	4	CO5

Model Question Paper

Reg.No.:…….. **QP CODE:……..**

Name:……

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 386

Environment Health and Safety

Max. Marks: 100 **Duration: 3 hours**

Part A

(Answer all questions; each question carries 3 marks)

1. What are the socio- economic reasons in safety?
2. Define industrial hygiene.
3. Define noise. What are the compensation aspects of noise?
4. Explain about the biohazard control program.
5. Discuss the possible electrical injuries in a construction industry.
6. What are the hazards due to radiation?
7. What are the criteria air pollutants?
8. Describe the Depletion of Ozone Layer.
9. What are the benefits of safety inspection?
10. Discuss the role of an individual in conservation of natural resources.

Part B

(Answer one full question from each module; each question carries 14 marks)

Module I

11. Briefly explain about occupational related diseases found in the industries. (14 Marks)

OR

12. Write the short notes on : (14 Marks)

    (i) Silicosis

    (ii) Asbestosis

    (iii) Anthracosis

    (iv) Anthrax.

Module II

13. (a) Write briefly about the classification of biohazardous agents.(7 Marks)

(b) What are the precautionary measures for chemical hazards? (7 Marks)

OR

14. Write short notes on :(14 Marks)
(i)Vapour(ii) Fog (iii) Dust (iv) Fumes.

Module III

15. Explaineffects of radiation on human body and the methods of radioactive waste disposal. (14 Marks)

OR

16. (a) What are the requirements for safe work platform? (7 Marks)

(b) Discuss about the scaffolding inspections.(7 Marks)

Module IV

17. Describe the effect of air pollution on environment. (14 Marks)

OR

18. Describe the effect of water pollution on environment.(14 Marks)

Module V

19. (a) What are the important points in carrying outworkplace inspection?(7 Marks)

(b) What is First aid? Explain CPR. (7 Marks)

OR

20. (a)Explain the first aid measure to be taken during gas poisoning,(10 Marks)
heart attack, chemical splash and electric shock.

(b) Briefly explain the elementary first aid (4 Marks)

Course Code: CET 386
Environmental Health And Safety

Module I

Introduction to Occupational Health And Toxicology : Safety at work – Socio – Economic reasons. Introduction to health and safety at various industries. occupational related diseases-Musculoskeletal disorders, hearing impairment, carcinogens, silicosis, asbestosis, pneumoconiosis – Toxic materials and substances used in work, exposure limits, toxicological investigation, Industrial Hygiene, Arrangements by organisations to protect the workers.

Module II

Chemical hazards-dust, fumes, vapour, fog, gases, Methods of Control. **Biological hazards**-Classification of Biohazardous agents– bacterial agents, viral agents, fungal, parasitic agents, infectious diseases, control of biological agents at workplaces. Noise, noise exposure regulation and control.

Module III

Safety in Construction industry - Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting, control measures to reduce the risk. Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste.

Module IV

Air Pollution - air pollutants from industries, effect on human health, animals, Plants and Materials - depletion of ozone layer-concept of clean coal combustion technology.
Water Pollution - water pollutants-health hazards - effluent quality standards. Waste Management -waste identification, characterization and classification, recycling and reuse.

Module V

Safe working environment - The basic purpose and benefits of safety inspection, First-aid appliances, Shelters, rest rooms and lunch rooms, use of personal protective equipment, Role of an individual in conservation of natural resources, Methods for controlling water pollution, role of individual in prevention of pollution.

Text Books:

1. Environmental and Health and Safety Management by By Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995.
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005.

3. The Facility Managers Guide to Environmental Health And Safety by Brian Gallant, Government Inst Publ., 2007.
4. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006).
5. Mackenzie L Davis, Introduction to Environmental Engineering, McGrawhill Education (India).

References:

1. Slote. L, Handbook of Occupational Safety and Health, JohnWilleyand Sons, NewYork.
2. Heinrich H.W, Industrial Accident Prevention, McGrawHillCompany,NewYork,1980.
3. S.P.Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing Company, New Delhi, 1993.

Course Code: CET 386

Environmental Health And Safety

Course content and Schedule of Lecture (sample)

Module	Topic	Course outcome addressed	No of Hours
Module I (9 Hours)			
1.1	Introduction to Occupational Health And Toxicology.	CO1	1
1.2	Safety at work – Socio – Economic reasons.	CO1	1
1.3	Introduction to health and safety at various industries.	CO1	1
1.4	Occupational related diseases-Musculoskeletal disorders, hearing impairment	CO1	1
1.5	Occupational related diseases - carcinogens, silicosis, asbestosis, pneumoconiosis.	CO1	1
1.6	Toxic materials and substances used in work.	CO1	1
1.7	Exposure limits, toxicological investigation.	CO1	1
1.8	Industrial Hygiene.	CO1	1
1.9	Arrangements by organisations to protect the workers.	CO1	1
Module II (9 Hours)			
2.1	Chemical hazards.	CO2	1
2.2	Dust, fumes, vapour, fog, gases.	CO2	1
2.3	Methods of Control.	CO2	1
2.4	Biological hazards.	CO2	1
2.5	Classification of Biohazardous agents.	CO2	1
2.6	Bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.	CO2	1
2.7	Control of biological agents at workplaces.	CO2	1
2.8	Noise.	CO2	1
2.9	Noise exposure regulation and control.	CO2	1

Module III (8 Hours)			
3.1	Safety in Construction industry- Scaffolding and Working platform.	CO3	1
3.2	Welding and Cutting, Excavation Work, Concreting.	CO3	1
3.3	Control measures to reduce the risk.	CO3	1
3.4	Electrical Hazards.	CO3	1
3.5	Protection against voltage fluctuations.	CO3	1
3.6	Effects of shock on human body, Radiation Hazards	CO3	1
3.7	Types and effects of radiation on human body.	CO3	1
3.8	Disposal of radioactive waste.	CO3	1
Module IV (9 Hours)			
4.1	Air Pollution - air pollutants from industries.	CO4	1
4.2	Effect on human health, animals.	CO4	1
4.3	Plants and Materials - depletion of ozone layer.	CO4	1
4.4	Concept of clean coal combustion technology.	CO4	1
4.5	Water Pollution - water pollutants.	CO4	1
4.6	Health hazards - effluent quality standards.	CO4	1
4.7	Waste Management-waste identification.	CO4	1
4.8	Characterization and classification.	CO4	1
4.9	Recycling and reuse.	CO4	1
Module V (8 Hours)			
5.1	Safe working environment.	CO5	1
5.2	The basic purpose and benefits of safety inspection.	CO5	1
5.3	First-aid appliances.	CO5	1
5.4	Shelters, rest rooms and lunch rooms.	CO5	1
5.5	Use of personal protective equipment.	CO5	1

5.6	Role of an individual in conservation of natural resources.	CO5	1
5.7	Methods for controlling water pollution.	CO5	1
5.8	Role of individual in prevention of pollution.	CO5	1

CED481	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Chemical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Continuous Internal Evaluation Pattern:

Sl. No.	Level of Evaluation	Marks
1	Interim evaluation by the committee	**20**
2	Project Guide	**30**
3	Final Seminar evaluation by the committee	**30**
4	The report evaluated by the evaluation committee	**20**
	Total	**100**
	Minimum required to pass	**50**

The evaluation committee comprises a panel of HoD or a senior faculty member, Project coordinator and project supervisor.

CED482	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Chemical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Continuous Internal Evaluation Pattern:

Sl. No.	Level of Evaluation	Marks
1	Interim evaluation by the committee	**20**
2	Project Guide	**30**
3	Final Seminar evaluation by the committee	**30**
4	The report evaluated by the evaluation committee	**20**
	Total	**100**
	Minimum required to pass	**50**

The evaluation committee comprises a panel of HoD or a senior faculty member, Project coordinator and project supervisor.