CET301	STRUCTURAL ANALYSIS - I	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: The course enables the students to analyse various types of simple structures using appropriate methods and tools. It introduces the applications of principles of mechanics of solids to determine stress resultants in statically determinate and indeterminate structures. Specific cases of cables, suspension bridges and arches are also discussed at length. The course trains the students to develop mathematical models and helps to sharpen their analytical skills. After this course students will be able to analyse structures subjected to moving loads as well.

Prerequisite: CET201Mechanics of Solids

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Apply the principles of solid mechanics to analyse trusses.	Applying
CO2	Apply various methods to determine deflections in statically determinate structures.	Applying
CO3	Identify the problemswith static indeterminacy and tackling such problems by means of the method of consistent deformations and energy principles.	Understanding, Analysing, Applying
CO4	Apply specific methods such as slope deflection and moment distribution methods of structural analysis for typical structures with different characteristics.	Understanding, Applying
CO5	Apply suitable methods of analysis for various types of structures including cables, suspension bridges and arches.	Understanding, Applying
CO6	Analyse the effects of moving loads on structures using influence lines.	Understanding, Analysing, Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	05	10
Understand	20	10	20
Apply	30	25	50
Analyse	10	10	20
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

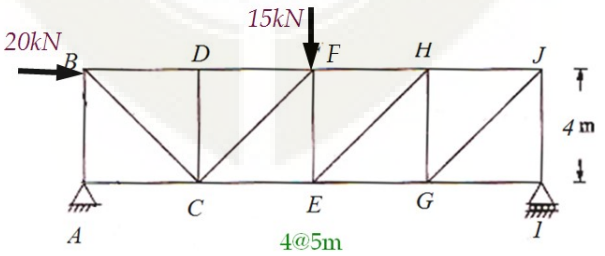
Continuous Internal Evaluation Pattern:

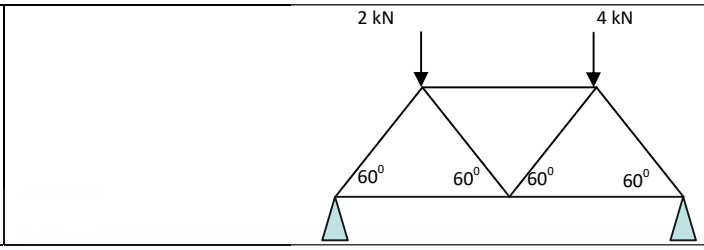
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

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.

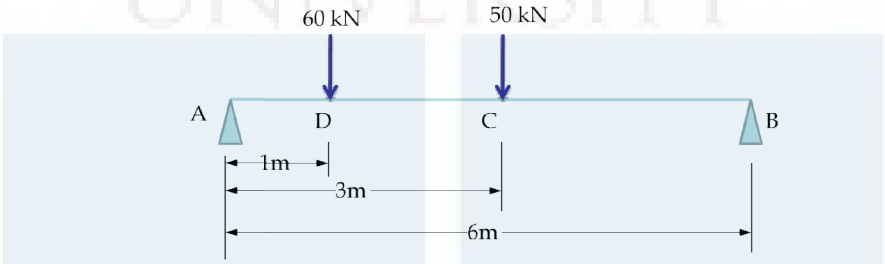
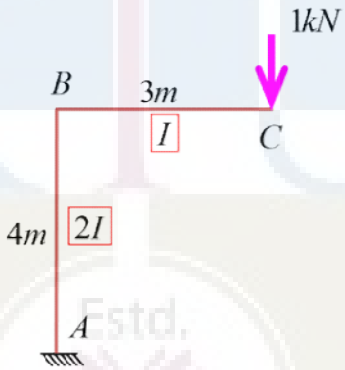
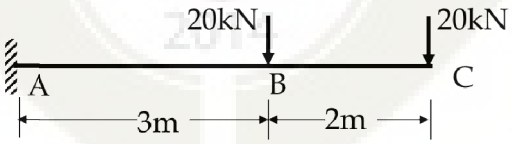
Course Level Assessment Questions

CO1: Apply the principles of solid mechanics to analyse trusses.

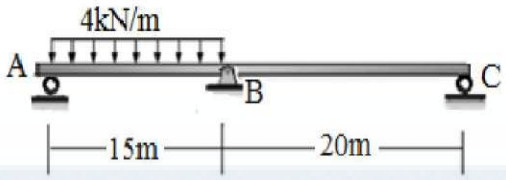
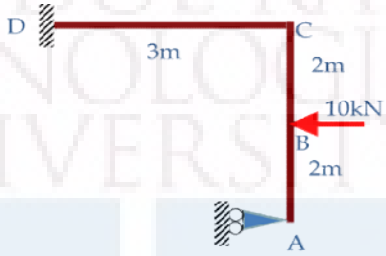
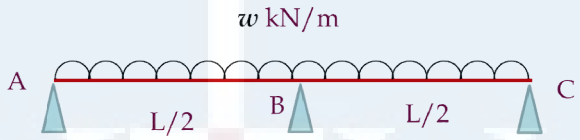
1.	Explain the method of joints to analyse trusses.
2.	Find the member forces in FH, EH and EG using method of sections. 
3.	Analyse the truss in figure using method of joints

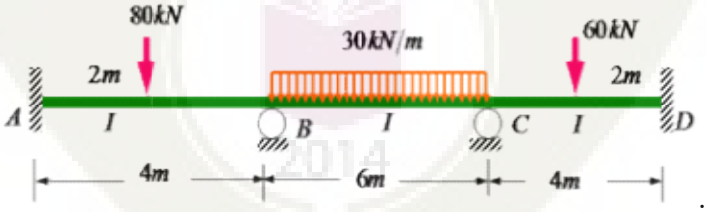
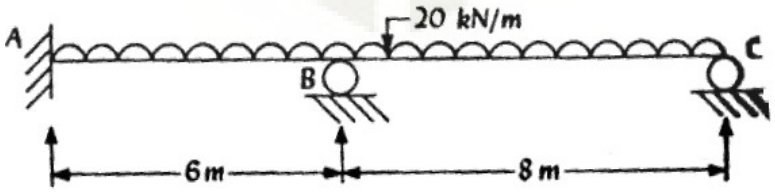
CO2: Apply various methods to determine deflections in statically determinate structures.

1.	Find the slopes at A & B, and deflections at C& D of the simple beam. E= $2x10^5$ N/mm^2. I = 8500 cm^4 
2.	Find the vertical deflection at C for the frame in figure using strain energy method. 
3.	State and prove Betti's Theorem
4.	Find the deflection and slope at C for the cantilever, using unit load method. Take *EI* as unity. 

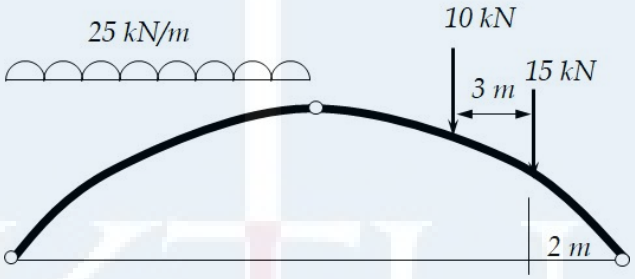
CO3:	**Identify the problems with static indeterminacy and tackling such problems by means of the method of consistent deformations and energy principles.**
1.	Explain static and kinematic indeterminacies with examples.
2.	Differentiate between force and displacement methods for analysing indeterminate structures

3.	Find the reaction at B for the beam shown in figure, using consistent deformation method. 
4.	Analyse the 2D frame using consistent deformation method (EI is constant). 
5.	Using minimum strain energy method, analyse the continuous beam shown in figure. 

CO4: Apply specific methods such as slope deflection and moment distribution methods of structural analysis for typical structures with different characteristics.

1.	Explain briefly on the analysis of frames with sidesway, using slope deflection method
2.	Derive expressions for stiffness at the near-end for a beam with hinged far-end
3.	Analyse the continuous beam using slope deflection method (EI is constant). 
4.	Analyse the continuous beam in figure using moment distribution method (EI is constant) 

CO5: Apply suitable methods of analysis for various types of structures including cables, suspension bridges and arches.

1.	Write a note on three-hinged and two-hinged stiffening girders.
2.	State and explain Eddy's theorem
3.	For a cable AB, the level difference between the supports A and B is 6m, and the lowest point is at a vertical distance of 4.5m from A. If the horizontal span AB is 24m and is loaded with 7.5kN/m throughout the span, find the length of the cable, and the minimum and maximum tension in the cable
4.	A suspension bridge with 25m span and central dip 2.5m transfers 4kN per horizontal metre to each cable. Find max and min pull in each cable, and the length of cable
5.	The span of the 3-hinged parabolic arch shown in figure is 30m and the rise is 6m. Find BM, normal thrust, and radial shear at a section 7.5 m from the left hinge. Find maximum BM on the arch. 

CO6: Analyse the effects of moving loads on structures using influence lines.

1.	State and explain the condition for absolute maximum bending moment in a simple beam when a series of concentrated loads is moving across it
2.	What are influence lines? Draw ILD for SF and BM at any intermediate section of a simply supported beam.What are the uses of influence lines?
3.	Four point loads 30kN, 40kN, 20kN and 15kN, distance between them being 2m, are moving across a simple beam (of span 15m) from left to right with 30kN load leading. Find position of the loads for maximum -ve SF and BM at a section 7m from left end. Also find maximum -ve SF and BM at the section.

SYLLABUS

Module – 1

Statically determinate trusses: Method of joints and method of sections (simple illustrative numerical problems only) – 4 hrs.

Deflection of statically determinate structures: Introduction and simple illustrative examples of simple beams and cantilever beams only on: a) Method of successive integrations,b) Moment area method and c) Castigliano's theorem Part I– 5hrs.

Module – 2

Principle of virtual work, Betti's theorem, Maxwell's law of reciprocal deflections; Unit load method for determination of deflection of statically determinate beams and trusses (simple illustrative numerical problems only) – 4hrs.

Analysis of Statically Indeterminate Structures:

Degree of static and kinematic indeterminacies; Introduction to force and displacement methods.

Method of consistent deformations: Analysis of beams (simple problems with one redundant, illustration only for two-redundant problems). Concepts of effect of pre-strain, lack of fit, temperature changes and support settlement. (No numerical problems) – 4 hrs.

Castigliano's theorem Part II, theorem of least work. Minimum strain energy method for analysing statically indeterminate structures (Illustrative simple examples only) – 2 hrs.

Module – 3

Slope Deflection Method: Analysis of continuous beams and portal frames without sway; Frames with sway (illustration only); Settlement effects (illustration only) – 5 hrs.

Moment Distribution Method: Analysis of continuous beams and portal frames without sway; Frames with sway (illustration only)– 4 hrs.

Module – 4

Cables: Analysis of forces in cables under concentrated and uniformly distributed loads; Anchor Cable supports – 4 hrs.

Suspension Bridges: Un-stiffened suspension bridges, maximum tension in the suspension cable and backstays, pressure on towers – 5 hrs.

Module – 5

Arches: Theory of arches – Eddy's theorem;Analysis of three-hinged arches; Normal thrust and radial shear due to simple cases of loading. – 4 hrs.

Moving loads and influence lines: Introduction to moving loads - concept of influence lines - influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams – analysis for single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span – conditions for maximum bending moment and shear force – 5 hrs.

Text Books:

1. Gere and Timoshenko, Mechanics of materials, CBS Publishers
2. Kenneth Leet, Chia M Uang & Anne M Gilbert, Fundamentals of Structural Analysis, McGraw Hill
3. R.Vaidyanathan and P.Perumal, Comprehensive Structural Analysis Volume I & II, Laxmi Publications (P) Ltd

References:

1. Wang C.K., Intermediate Structural Analysis, McGraw Hill
2. Aslam Kassimali., Structural Analysis, Cenage Learning
3. Chandramouli P N, Structural Analysis I –Analysis of Statically Determinate Structures, Yes Dee Publishing Pvt Ltd.,Chennai,Tamil Nadu.
4. Devdas Menon, Structural Analysis, Narosa Publications
5. Hibbeler., Structural Analysis, Pearson Education
6. Kinney S., Indeterminate Structural Analysis, Oxford & IBH
7. M.L. Gambhir, Fundamentals of structural Mechanics and analysis, Printice Hall India
8. Reddy C.S., Indeterminate Structural Analysis, Tata McGraw Hill
9. Timoshenko S.P.& Young D.H., Theory of Structures, McGraw Hill
10.Daniel L Schodak, Structures, Pearson Education, 7e, 2014
11.Negi L. S. and Jangid R. S, Structural Analysis, Tata McGraw Hill, 1997
12.Rajasekaran S. and Sankarasubramanian G., Computational Structural Mechanics, PHI, 2008
13.S.S. Bhavikatti, Structural Analysis II, Vikas Publication Houses (P) Ltd, 2016
14.Utku S, Norris C. H & Wilbur J. B, Elementary Structural Analysis, McGraw Hill, 1990

Lecture Plan –Structural Analysis I

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I: Total lecture hours: 9**		
1.1	Trusses: Method of joints	CO1	2
1.2	Trusses: Method of sections	CO1	2
1.3	Method of successive integrations	CO2	2
1.4	Moment area method	CO2	2
1.5	Castigliano's theorem Part I	CO2	1
2	**Module II: Total lecture hours: 9**		
2.1	Principle of virtual work, Betti's theorem, Maxwell's law of reciprocal deflections	CO2	2
2.2	Unit load method for determination of deflection of statically determinate beams and trusses (simple illustrative numerical problems only)	CO2	2
2.3	Degree of static and kinematic indeterminacies; Introduction to force and displacement methods	CO3	1
2.4	Method of consistent deformations: Analysis of beams (simple problems with one redundant, illustration only for two-redundant problems).	CO3	2
2.5	Concepts of effect of pre-strain, lack of fit, temperature changes and support settlement. (No numerical problems)	CO3	1
2.6	Castigliano's theorem Part II, theorem of least work. Minimum strain energy method for analyzing statically indeterminate structures (Illustrative simple examples only)	CO3	1
3	**Module III: Total lecture hours: 9**		
3.1	Slope Deflection Method: Concept and derivation of basic equations	CO4	1
3.2	Slope Deflection Method: Analysis of continuous beams and portal frames without sway.	CO4	2
3.3	Slope Deflection Method: Frames with sway (illustration only). Settlement effects (derivation only)	CO4	1
3.4	Moment Distribution Method: Concept and derivation of basic equations	CO4	1

3.5	Moment Distribution Method: Analysis of beams and frames – non sway analysis.	CO4	3
3.6	Moment Distribution Method: Sway analysis (illustration only)	CO4	1
4	**Module IV: Total lecture hours: 9**		
4.1	Cables: Analysis of forces in cables under concentrated and uniformly distributed loads	CO5	3
4.2	Anchor Cable supports	CO5	1
4.3	Suspension Bridges: Un-stiffened suspension bridges, maximum tension in the suspension cable and backstays, pressure on towers.	CO5	5
5	**Module V: Total lecture hours: 9**		
5.1	Arches: Theory of arches – Eddy's theorem	CO5	1
5.2	Analysis of three hinged arches-Support reactions-normal thrust and radial shear at any section of a parabolic arch due to simple cases of loading	CO5	3
5.3	Moving loads and influence lines: Introduction to moving loads - concept of influence lines	CO6	1
5.4	Influence lines for reaction, shear force and bending moment in simply supported beams and over hanging beams	CO6	1
5.5	Analysis single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span. Conditions for maximum shear and bending moment.	CO6	3

MODEL QUESTION PAPER

Reg. No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET301

Course Name: STRUCTURAL ANALYSIS I

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Explain the method of sections to analyse trusses.
   b) State and prove Moment Area Theorem I
   c) Explain the method of consistent deformations, with an example.
   d) State and prove Betti's Theorem.
   e) Explain briefly on the analysis of frames with sidesway, using slope deflection method.
   f) Derive expressions for stiffness at the near-end for a beam with hinged far-end.
   g) Write a note on anchor cable supports.
   h) Write a note on three-hinged and two-hinged stiffening girders.
   i) State and explain Eddy's theorem.
   j) State and explain the condition for absolute maximum bending moment in a simple beam when a series of concentrated loads is moving across it.

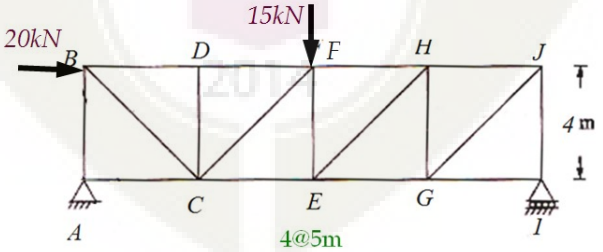
(10×3 marks = 30 marks)

PART B

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

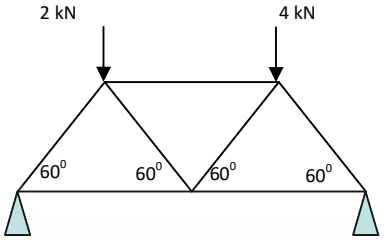
Module I

2. a. Find the member forces in FH and EH and EG using method of sections.



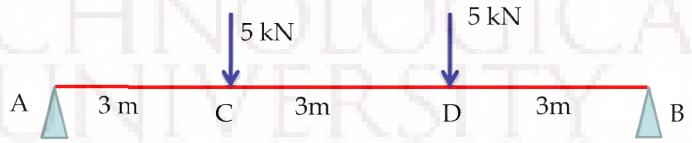
(6 marks)

b. Analyse the truss in figure using method of joints.



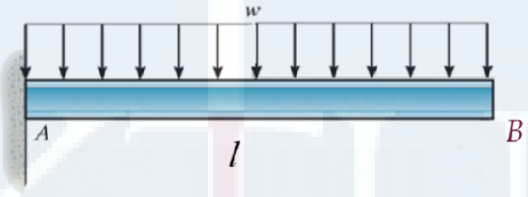
(8 marks)

3. a. Find the slope at A and deflection at C of the simple beamusing the method of successive integrations. E= $2x10^5$ N/mm^2. I = 8500 cm^4.



(7 marks)

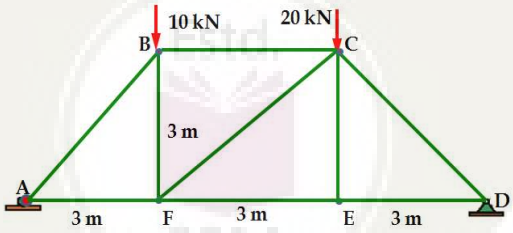
b.Find the slope and deflection at B of the cantilever using moment area method. w =10 kN/m, l = 3m, E= $2x10^5$ N/mm^2, I = 8500 cm^4



(7 marks)

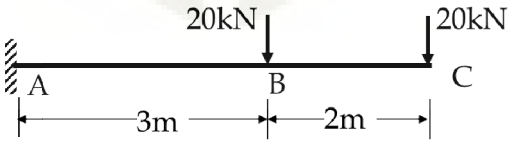
Module II

4. a. Find the deflection at E of the truss in figure, using unit load method. Cross-sectional areas of members are 1200mm2. E= 200 kN/mm^2.



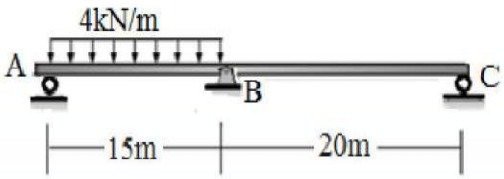
(7 marks)

bFind the deflection and slope at C for the cantilever, using unit load method. Take *EI* as unity.



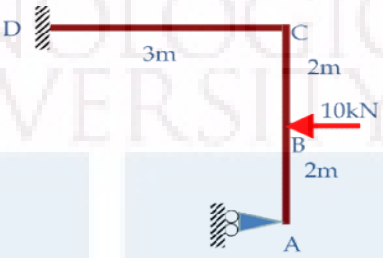
(7 marks)

5. a.Find the reaction at B for the beam shown in figure, using consistent deformation method.



(7 marks)

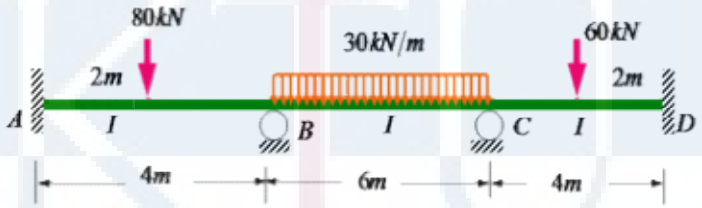
b. Analyse the 2D frame using consistent deformation method (EI is constant).



(7 marks)

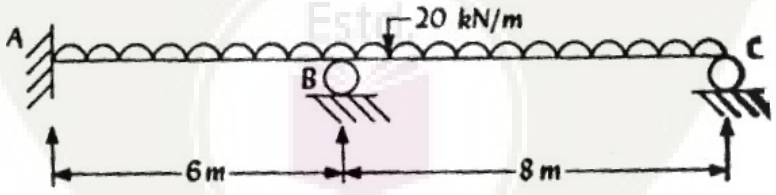
Module III

6. Analyse the continuous beam using slope deflection method (EI is constant).



(14 marks)

7. Analyse the continuous beam in figure using moment distribution method (EI is constant).



(14 marks)

Module IV

8. For a cable AB, the level difference between the supports A and B is 6m, and the lowest point is at a vertical distance of 4.5m from A. If the horizontal span AB is 24m and is loaded with 7.5kN/m throughout the span, find the length of the cable, and the minimum and maximum tension in the cable.

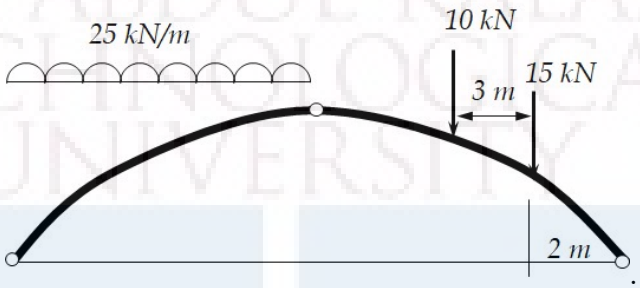
(14 marks)

9. A suspension bridge with 25m span and central dip 2.5m transfers 4kN per horizontal metre to each cable. Find max and min pull in each cable, and the length of cable. (14

marks)

Module V

10. The span of the 3-hinged parabolic arch shown in figure is 30m and the rise is 6m. Find BM, normal thrust, and radial shear at a section 7.5 m from the left hinge. Find maximum BM on the arch.



(14 marks)

11. a) What are influence lines? Draw ILD for SF and BM at any intermediate section of a simply supported beam.(5 marks)

b) Four point loads 30kN, 40kN, 20kN and 15kN, distance between them being 2m, are moving across a simple beam (of span 15m) from left to right with 30kN load leading. Find position of the loads for maximum -ve SF and BM at a section 7m from left end. Also find maximum -ve SF and BM at the section. (9 marks)

CET 305	GEOTECHNICAL ENGINEERING - II	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	4	0	0	4	2019

Preamble: Goal of this course is to impart to the students, in-depth knowledge about the basic concepts and theories of foundation engineering. After this course, students will be able to recognize practical problems of foundations in real-world situations and respond accordingly.

Prerequisite : Geotechnical Engineering - I

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

CO 1	Understand soil exploration methods
CO 2	Explain the basic concepts, theories and methods of analysis in foundation engineering
CO 3	Calculate bearing capacity, pile capacity, foundation settlement and earth pressure
CO 4	Analyze shallow and deep foundations
CO 5	Solve the field problems related to geotechnical engineering

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	-	-	3	-	-	-	-	-	-	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	3	-	-	-	-	-	-	-	-	-	-
CO 4	2	2	3	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	10
Understand	10	10	20
Apply	25	25	50
Analyse	10	10	20
Evaluate			
Create			

Mark Distribution

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

Continuous Internal Evaluation (CIE)Pattern :

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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 the bearing capacity theory of shallow foundations
2. Explain the basic concepts and theory of settlement calculations of shallow foundations
3. Explain the concepts and theory of pile capacity
4. Explain the earth pressure theories for cohesionless and cohesive soils

Course Outcome 3 (CO3):

1. Calculate the bearing capacity of shallow foundations
2. Calculate pile capacity
3. Calculate the settlement of footings
4. Calculate the earth pressure acting on retaining walls

Course Outcome 4 (CO4):

1. Analyze and design shallow foundations
2. Analyze deep foundations

Course Outcome 5 (CO5):

1. Solve the field problems related to different types of shallow and deep foundations, retaining walls, etc.

SYLLABUS

Module 1

Earth pressure : Earth pressure - At rest, active and passive earth pressures - Practical examples Rankine's theory – Earth pressure and point of application for cohesionless and cohesive soils - Influence of surcharge and water table on earth pressure - Numerical problems - Earth pressure with layered backfill - Numerical problems - Coulomb's theory [no derivation required] – Comparison of Rankine's and Coulomb's theory

Foundation – General Considerations : Functions of foundations - definition of shallow and deep foundation - Selection of type of foundation - Different types of shallow foundations - advantages and limitations of various types of shallow foundations

Module 2

Bearing capacity of shallow foundations: Gross and Net bearing pressure - Ultimate and Safe bearing capacity - Failure mechanism - Allowable soil pressure - Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions – Bearing capacity factors - Numerical problems - Terzaghi's formulae for circular and square footings - Numerical problems - Factors affecting bearing capacity - Effect of water table on bearing capacity - Numerical problems - General, local and punching shear failure - Skempton's formula – Numerical problems

Module 3

Settlement analysis: Introduction- causes of settlement – estimation of immediate settlement – Numerical problems - Allowable settlement-Maximum and differential settlements as per Indian standard - Field test - Plate load test – Procedure, uses and limitations

Footings :Principles of design of footings – strip/continuous and individual footings - Numerical Problems - Combined footings- Rectangular and Trapezoidal combined footings - Numerical problems - Footings subjected to eccentric loading

Raft foundations: Types – Principles of design of raft foundation- Bearing capacity equations for raft on sand (Teng's equation based on SPT value) and for raft on clay (Skempton's formula) - Floating foundations - conventional design procedure for rigid mat.

Module 4

Pile foundations: uses of piles - classification of piles - determination of type and length of piles - Bearing capacity of single pile in clay and sand [I.S. Static formulae] - Numerical problems - Dynamic formulae (Modified Hiley formulae only) – Numerical Problems - I.S. Pile load test [conventional] - Negative skin friction - Group action - Group efficiency - Capacity of Pile groups - Numerical problems

Well foundation : Elements of a well foundation – construction details of well foundations - Problems encountered in well sinking – Methods to rectify tilts and shifts

Module 5

Site investigation and soil exploration: objectives - planning - reconnaissance - Guidelines for choosing spacing and depth of borings [I.S. guidelines only]- Methods of subsurface exploration - test pits - Auger borings – Wash Boring - Rotary drilling - Standard Penetration Test – procedure and correlations - Corrections for SPT value – Numerical Problems - Sampling - disturbed samples, undisturbed samples and chunk samples - types of samplers - Sampler parameters - Boring log - Soil

profile- Location of Water table - Geophysical methods : Seismic Refraction method and Electrical Resistivity method (in brief).

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	**Earth pressure** : Earth pressure - At rest, active and passive earth pressures - Practical examples	CO 2 & CO 5	1
1.2	Rankine's theory – Earth pressure and point of application for cohesionless and cohesive soils	CO 2	1
1.3	Influence of surcharge and water table on earth pressure - Numerical problems	CO 2 & CO 3	2
1.4	Earth pressure with layered backfill - Numerical problems	CO 2 & CO 3	2
1.5	Coulomb's theory [no derivation required] – Comparison of Rankine's and Coulomb's theory	CO 2	1
1.6	**Foundation – General Considerations**: Functions of foundations - definition of shallow and deep foundation - Selection of type of foundation	CO 4 & CO 5	1
1.7	Different types of shallow foundations- advantages and limitations of various types of shallow foundations	CO 4 & CO 5	1
2	**Module 2**		**9**
2.1	**Bearing capacity of shallow foundations**: Gross and Net bearing pressure - Ultimate and Safe bearing capacity	CO 2	1
2.2	Failure mechanism - Allowable soil pressure	CO 2	1

2.3	Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions – Bearing capacity factors	CO 2	1
2.4	Numerical problems	CO 3	1
2.5	Terzaghi's formulae for circular and square footings - Numerical problems	CO 2 & CO 3	1
2.6	Factors affecting bearing capacity - Effect of water table on bearing capacity	CO 2	1
2.7	Numerical problems	CO 3	1
2.8	General, local and punching shear failure	CO 2 & CO 3	1
2.9	Skempton's formula – Numerical problems	CO 2 & CO 3	1
3	**Module 3**		**9**
3.1	**Settlement analysis**: Introduction- causes of settlement – estimation of immediate settlement – Numerical problems	CO 2 & CO 3	1
3.2	Allowable settlement-Maximum and differential settlements as per Indian standard	CO 2 & CO 5	1
3.3	Field test - Plate load test – Procedure, uses and limitations	CO 3 & CO 5	1
3.4	**Footings** :Principles of design of footings – strip/continuous and individual footings - Numerical Problems	CO 4	1
3.5	Combined footings- Rectangular and Trapezoidal combined footings	CO 4	1
3.6	Numerical problems	CO 4	1
3.7	Footings subjected to eccentric loading	CO 4	1
3.8	**Raft foundations**: Types – Principles of design of raft foundation- Bearing capacity equations for raft on sand (Teng's equation based on SPT value) and for raft on clay (Skempton's formula)	CO 3 & CO 4	1
3.9	Floating foundations - conventional design procedure for rigid mat.	CO 2 & CO 4	1
4	**Module 4**		**9**
4.1	**Pile foundations**: Uses of piles - classification of piles - determination of type and length of piles	CO 2 & CO 5	1
4.2	Bearing capacity of single pile in clay and sand [I.S. Static formulae]	CO 2	1
4.3	Numerical problems	CO 3	1
4.4	Dynamic formulae (Modified Hiley formulae only) – Numerical Problems	CO 2 & CO 3	1
4.5	I.S. Pile load test [conventional]	CO 5	1
4.6	Negative skin friction - Group action - Group efficiency	CO 2	1
4.7	Capacity of Pile groups - Numerical problems	CO 3 & CO 4	1
4.8	**Well foundation** : Elements of a well foundation – construction details of well foundations	CO 2 & CO 5	1

4.9	Problems encountered in well sinking – Methods to rectify tilts and shifts	CO 2 & CO 5	1
5	**Module 5**		**9**
5.1	**Site investigation and soil exploration**: objectives - planning - reconnaissance	CO 1	1
5.2	Guidelines for choosing spacing and depth of borings [I.S. guidelines only]	CO 1	1
5.3	methods of subsurface exploration - test pits - Auger borings – Wash Boring - Rotary drilling	CO 1	1
5.4	Standard Penetration Test – procedure and correlations	CO 1	1
5.5	Corrections for SPT value – Numerical Problems	CO 1	1
5.6	Sampling - disturbed samples, undisturbed samples and chunk samples	CO 1	1
5.7	types of samplers - Sampler parameters	CO 1	1
5.8	Boring log - soil profile- Location of Water table	CO 1	
5.9	Geophysical methods: Seismic Refraction method and Electrical Resistivity method (in brief).	CO 1	1

Model Question Paper
QP CODE:

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

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

Course Code: CET305
Course Name :GEOTECHNICAL ENGINEERING - II

Max. Marks: 100 Duration: 3 hours

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

1. List the assumptions of Rankine's theory of earth pressure.
2. Explain the situations in which combined footings are provided.
3. Write the assumptions of Terzaghi's method for bearing capacity.
4. Explain the factors affecting bearing capacity.
5. Explain Allowable settlement.
6. Explain floating foundation.
7. Explain negative skin friction.
8. List the elements of a well foundation.
9. List Objectives of soil exploration.
10. Define (i) Inside clearance, (ii) Outside clearance and (iii) Area ratio as applied to sampler.

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

Module – 1

17. (a) Explain different types of earth pressures with practical examples. (6 Marks)

    (b) A wall of 8m height retains a non-cohesive layered backfill. Top 3 m soil is having γ = 18kN/m^3 and ϕ =30°. Bottom 5 m soil is having γ = 17.5 kN/m^3 and ϕ =28°. Using Rankine's theory, find the total active thrust on the wall and the point of application. (8 Marks)

18. (a) A 6m high retaining wall with vertical back supports soil which is in level with the top of retaining wallcarries a uniform surcharge load of 20kPa. Backfill properties are c = 5 kN/m^2, γ = 18.5 kN/m^3, ϕ = 30°. Determine Rankine's passive earth pressure on the retaining wall. (6 Marks)

    (b) A 6m high retaining wall with vertical back supports soil which is in level with the top of retaining wall. Backfill properties are c = 5 kN/m^2,γ = 18 kN/m^3,ϕ = 30°. Find the maximum depth up to which excavation can safely be done without the sides caving in? Also determine Rankine's active earth pressure on the retaining wall before the formation of tension crack. (8 Marks)

Module – 2

11. (a) Differentiate between General shear failure and local shear failure. (6 Marks)

(b) A strip footing of 2.0 m wide is to be founded at a depth of 1.6 m in a soil with following data:

□= 19 kN/m^3; c = 10 kN/m^2 ; □= 40^0

N_c = 95.7 ; N_q = 81.3 ; $N_{□}$= 100.4

Determine the safe bearing capacity with a FS of 3, when

i) Water table is at great depth

ii) Water table is at a depth of 1.0 m from ground level.

iii) Water table is at a depth of 3.0 m from ground level. (8 Marks)

12. (a) A Circular footing rests in pure clay with unconfined compressive strength q_u = 200 kN/m^2 at a depth of 1.5 m. Using Skempton's method, determine the diameter of footing if it has to transmit a net load of 1000 kN. Take FS = 3. (6 Marks)

(b) A square footing 2m x 2m is at a depth of 1.5 m in a soil with c = 30 kN/m^2, ϕ = 35°, (Nc = 57.8, N_q = 41.4 and N_γ = 42.4). Takeγ = 18 kN/m^3. Calculate the net safe load that can be carried by footing. (8 Marks)

Module – 3

13. (a) A rectangular surface footing 2m x 3m carries a column load of 600 kN. The footing rests on a c-ϕ soil strata 6 m thick having μ = 0.25 and E as 5000 kN/m^2. Calculate the immediate settlement of footing assuming the influence factor I_f= 1.36. (6 Marks)

(b) Explain Plate Load Test with neat sketch. List the limitations of plate load test. (8 Marks)

16. (a) What are the different types of raft foundations? Under what circumstances raft foundations are preferred? (6 Marks)

(b) Design a rectangular combined footing for uniform pressure for the column loads of 1000 kN and 1500 kN at column A and B respectively. Projection of footing beyond centre line of column A is restricted to 0.5 m. Distance of c/c of columns is 5 m. Net Allowable pressure = 150 kN/m^2.

Design a suitable combined footing if projection beyond centre line of both columns restricted to 0.5 m. (8 Marks)

Module – 4

19. (a) Explain the classification of pile foundations based on installation. (6 Marks)

(b) A RCC pile weighs 25 kN is driven by drop hammer weighing 35 kN, having effective fall of 0.85 m. Average set/blow is 1.3 cm. Take elastic compression as 1.6 cm. Assuming coefficient of restitution as 0.25. Find ultimate and safe load on pile by assuming factor of safety of 2.5. (8 Marks)

20. (a) Explain any three methods (with neat sketches) for rectification of tilts in a well foundation. (6 Marks)

(b) A bored pile in a clayey soil is 50 cm diameter and 10 m long, determine the capacity of a 3X3

pile group spaced 1 m centre to centre both ways. Take C_u = 70 kN/m^2 and α = 0.6.

(8 Marks)

Module – 5

14. (a) Explain Augur boring and wash boring methods used in soil exploration. (6 Marks)

    (b) Explain Standard Penetration Test? How this is correlated with shear strength parameters? What are the corrections to the observed SPT (N) value? (8 Marks)

15. (a) A SPT is conducted in a sand deposit at a depth of 16 m. Water table is at 7 m below ground level. Unit weight of sand is 18 kN/m^3 above water table and 19 kN/m^3 below water table. If N value is 36, find the corrected N value. (6 Marks)

    (b) Explain Geophysical Exploration using Seismic Refraction Method. What are its limitations? (8 Marks)

CET303	DESIGN OF CONCRETE STRUCTURES	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	1	0	4	2019

Preamble: Reinforced concrete members are designed according to the existing codes of practice [IS 456 (2000)]. The course provides all the fundamental topics in reinforced concrete design and enable students to design and detail reinforced concrete structural members such as beam, slab, column and footing. The course also provides an introduction to earthquake resistant design and detailing.

Prerequisite: CET201 Mechanics of Solids

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 concepts of limit state design and code provisions for design of concrete members under bending, shear, compression and torsion.	Remembering/ Understanding
CO2	Analyse reinforced concrete sections to determine the ultimate capacity in bending, shear and compression.	Applying
CO3	Design and detailbeams, slab, stairs and footings using IS code provisions.	Applying
CO4	Design and detail columns using IS code and SP 16 design charts.	Applying
CO5	Explain the criteria for earthquake resistant design of structures andductile detailing of concrete structures subjected to seismic forces.	Understanding

Mapping of course outcomes with program outcomes (Minimum requirement)

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember			
Understand	10	10	30
Apply	30	30	60
Analyse	10	10	10
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 concepts of limit state design and code provisions for design of concrete members under bending, shear, compression and torsion.

1. Explain the term limit state design.
2. Enumerate the five limit states commonly used in limit state design and state briefly how they are provided for in design.
3. Define the term partial safety factor as used in limit state design. Identify the various factors and state the values recommended in IS 456
4. Explain the term 'factored load' and 'characteristic loads. Why IS 456 specifies the same partial safety factor for dead and live loads? Is it technically correct?
5. How are the following factors incorporated in design formulae for limit design
   (a) partial safety factor for load,
   (b) partial safety factor for material strength,

(c) difference between cube strength and strength of concrete in structure.

6. Explain the basis for the selection of partial load and safety factors by the Code for serviceability limit states
7. Why is the partial safety factor for concrete (γ_c) greater than that for reinforcing steel (γ_s) in the consideration of ultimate limit states?
8. Explain the necessity for specifying maximum and minimum tension steel in reinforced beams. What are their values?
9. What is equivalent shear as applied to torsion and shear in IS 456?
10. Explain the terms balanced', 'over reinforced' and 'under reinforced' section Explain which of these should be recommended in design. How is this ensured in design of beams according to IS 456?
11. Why is it necessary to put a limit on the x/d allowed in singly reinforced beams as stipulated in IS 456? Can this condition be relaxed for beams with compression steel? Give reasons for your answer
12. What are the types of reinforcements used to resist shear? Explain the action of difference types of shear steel in resisting shear.
13. What is meant by equivalent length of a column? Explain how column behaviour is affected by the effective length.
14. Why is it necessary to have lateral ties in a column?
15. How does helically reinforced columns differ from tied columns in their behaviour? In what situations would one recommend the use of helically reinforced column?

CO2: Analyse reinforced concrete sections to determine the ultimate capacity in bending, shear and compression.

1.	A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. Find the moment of resistance of the section if M20 concrete and Fe 415 grade steel are used. As per IS 456:2000 find the limiting moment of resistance also.
2.	A rectangular RC beam 230 mm wide and 420 mm effective depth is reinforced with 2-16mm diameter bars at top and 4 – 16 mm bars at bottom. Estimate the ultimate moment carrying capacity of the section assuming M20 concrete and Fe415 steel.
3.	A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. 8mm diameter two legged vertical stirrups are provided at 200 mm c/c. Determine the ultimate SF the section can resist. Assume M20 concrete and Fe415 steel.
4.	A square column 300 mm x 300 mm is reinforced with 8 bars of 16 mm diameter. Assuming M25 concrete and Fe415 steel, determine the safe axial load carrying capacity of the column

CO3: Design and detail beams, slab, stairs and footings using IS code provisions.

1. Design a simply supported beam of span 6m subjected to a live load of 4 kN/m. Use M20 concrete and Fe415 steel.
2. Design a simply supported rectangular beam to carry a superimposed load of 30kN/m over a span of 5.5m. Assume support width as 300mm. Maximum overall depth is restricted to 550mm. Use M20 concrete and Fe 415 grade steel.
3. Design a slab for a room of size 3mx5.5m carrying a live load of 7 kN/m^2. Use M20 concrete and Fe 415 grade steel. Assume that the corners are held down. The slab is having all the four edges discontinuous
4. Design a square isolated footing for a column of size 400mm x 400mm carrying a load of 1500 kN under service conditions. Safe bearing capacity of soil is 200 kN/m^2.Use M20 concrete and Fe 415 grade steel.
5. Design and detail an isolated rectangular footing for a column 400 mm x 600 mm to carry a load of 2000 kN. The SBC of the soil is 180 kN/m^2.Use M20 concrete and Fe 415 grade steel
6. A dog-legged staircase for a residential flat consists of 18 steps, each of 300 mm tread 180 mm rise, with an intermediate landing 1.2 m in width at the middle. The width of staircase is also 1.2 m. If the flights are of equal number of steps, design the staircase detail the steel. f_{ck} = 20 N/mm² and f_y = 415 N/mm^2.
7. Explain the design detail of a combined rectangular footing with reinforcement details.

CO4: Design and detail columns using IS code and SP 16 design charts.

1. Design a RCC rectangular column to carry an axial load of 1200 kN and a moment of 70 kNm, The length of the column is 3.5m. The one end is fixed and the other end is hinged. The width of the column is restricted to the wall thickness of 24 cm.
2. Design a reinforced concrete column to carry an axial load of 1600 kN. Use M20 concrete and Fe415 steel. The column has unsupported length of 3m and is effectively held in position at both the ends, but not restrained against rotation.
3. Design and detail a column under biaxial bending with the following data:
   Size of column = 40 x 60cm
   The column is effectively held in position at both ends but not restrained against rotation. The unsupported length of column is 3.5m
   Concrete grade = M20
   Grade of Steel = Fe 415
   Factored load Pu = 1900 kN
   Factored Moment Mux = 150 kNm and Muy = 110kNm
4. A short column 300 mm x 600 mm is carrying an axial working load of 750 kN and a moment of 160 kNm at an axis bisecting the depth. Design the reinforcement required if f_y = 250 N/mm^2 and f_{ck} 20 N/mm^2, Also sketch the reinforcement.

CO5: Explain the criteria for earthquake resistant design of structures and ductile detailing of concrete structures subjected to seismic forces.

1. What are the objectives of earthquake-resistant design of reinforced concrete structures?
2. What are the objectives behind the special detailing provisions in IS 13920?
3. Distinguish between ordinary moment resisting frame (OMRF) and special moment resisting frame (SMRF)
4. How do you fix the minimum width of columns of moment resisting frames in Zone III?
5. What are the design requirements of beam-column joints?
6. What is meant by special confining reinforcement in columns of ductile frames?
7. What are the design requirements of beam-column joints in earthquake resistant design?

SYLLABUS

Module I

Introduction – Limit states – Limit state of collapse in flexure – Analysis and design of singly reinforced beams.

Module II

Analysis & design of doubly reinforced beams. Analysis of T-beams . Limit state of collapse in shear. Bond and development length.

Module III

Design of slabs – one way and two way slabs. Design of stair case.

Module IV

Limit state of collapse – compression, Design of axially loaded short column.

Design of short columns subjected to compression and uniaxial/biaxial bending- design using SP16 charts.

Module V

Design of isolated and combined footings.

Limit state of serviceability.

Introduction to earthquake resistant design. Codal provisions – IS 1893, IS 13920

Text Book:

1. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015

References:

1. Pillai S.U & Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009
2.Varghese P.C, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt Ltd, 2008
4. Relevant IS codes (IS 456, IS 875, IS 1893,IS 13920, SP 16, SP 34)

Lecture Plan –Design of Concrete Structures

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I : Total lecture hours : 9**		
1.1	Introduction – Principles of Limit state method of design, Introduction to BIS code- Types of limit states-characteristic and design values-partial safety factors-types of loads and their factors.	CO1	2
1.2	Limit State of Collapse by flexure -assumptions-stress-strain relationship of steel and concrete-	CO1	2

1.3	Analysis of singly reinforced rectangular beams- balanced-under reinforced-over reinforced sections- moment of resistance codal provisions	CO2	2
1.4	Design of singly reinforced rectangular beams- basic rules for design-.	CO3	1
1.5	Design example of simply supported beam- design of cantilever beam-detailing	CO3	2
2	**Module II : Total lecture hours : 9**		
2.1	Analysis of doubly reinforced beams	CO2	1
2.2	Design of doubly reinforced beams –detailing,	CO3	1
2.3	T-beams- terminology- Formulae for analysis of T beams- examples –	CO1,CO2	2
2.4	Limit state of collapse in shear and bond- shear stresses in beams-types of reinforcement-shear strength of RC beam- IS code recommendations for shear design-	CO1	2
2.5	Design of shear reinforcement-examples	CO3	1
2.6	Bond and development length - anchorage for reinforcement bars - code recommendations regarding curtailment of reinforcement	CO1, CO3	1
2.7	Design for torsion-IS code approach- examples	CO3	1
3	**Module III : Total lecture hours : 10**		
3.1	Design of slabs- introduction- one-way and two-way action of slabs - load distribution in a slab-	CO1,CO3	1
3.2	IS recommendations for design of slabs- design of one-way slab- numerical problems – concepts of detailing of continuous slab –code coefficients.	CO1,CO3	2
3.3	Two- way slabs- simply supported design using IS Code coefficients Reinforcement detailing	CO1,CO3	2
3.4	Two- way slabs- restrained slabs – design using IS Code coefficients Reinforcement detailing	CO1,CO3	2
3.5	Stair cases- Types-proportioning-loads- distribution of loads – codal provisions –Concepts of tread-riser type stairs (detailing only)	CO1,CO3	1
3.6	Design and detailing of dog legged stair-	CO1,CO3	2
4	**Module IV : Total lecture hours : 9**		
4.4	Columns- introduction –classification- effective length- short column - long column - reinforcement-IS specifications regarding columns- limit state of collapse: compression -	CO1,CO4	1
4.5	Design of axially loaded short columns-design examples	CO4	2

	with rectangular ties		
4.6	Design of axially loaded short columns-design examples with helical reinforcement	CO4	2
5.1	Analysis and design of short columns subjected to compression and uniaxial bending- design using SP16 charts for limit state	CO4	2
5.2	Analysis and design of short columns subjected to combined axial load and biaxial bending moments-code procedure for design- design using SP16 charts for limit state	CO2,CO4	2
5	**Module V : Total lecture hours : 11**		
5.3	Foundations- classification-IS code provisions for design of isolated footings-	CO1, CO3	2
5.4	Design principles of rectangular footings- detailing.	CO1, CO3	2
5.5	Combined footings (design principles only)- analysis of combined footings-rectangular and trapezoidal.	CO1, CO3	2
4.1	Limit state of serviceability - limit state of deflection-short term and long term deflection-	CO1	1
4.2	Limit state of serviceability - IS code recommendations-limit state of cracking- estimation of crack width- simple numerical examples	CO1	2
4.3	Introduction to earthquake resistant design, Importance of Ductility in Seismic Design, Major Design Considerations, Codal provisions – IS 1893, IS 13920	CO5	2

MODEL QUESTION PAPER

Reg. No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET303

Course Name: Design of Concrete Structures

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1. a) Derive the limiting values of depth of neutral axis for different grades of steel
   b) Define characteristic strength & partial safety factor for materials. Why is partial safety factor for material high for concrete than steel?
   c) Explain the term development length and explain its significance in RC design. obtain the expression for it
   d) Explain why and how shear reinforcement is provided in beams
   e) Explain the difference in the behaviour of one-way and two-way slabs. Why it is essential to provide corner reinforcement in two way rectangular slabs whose corners are prevented from lifting up?
   f) What is meant by stair supported on landings? Explain the codal provision for the effective span of the stair slab in such cases?
   g) What are the objectives behind the special detailing provisions in IS 13920?
   h) Compare the behaviour of tied columns with spiral column subject to axial loading.
   i) Explain how interaction curves are used in the design of column
   j) Explain at what situations a combined footing is recommended.

(10×3 marks = 30 marks)

PART B

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

Module I

2. (a) Explain balanced, under reinforced and over reinforced sections in the context of Limit State Design of Reinforced Concrete structures.**(4 marks)**

   (b) A rectangular beam 250mm wide and effective depth 450 mm has 4 bars of 20mm diameter. Find the moment of resistance of the section if M20 concrete and Fe 415 grade steel are used. As per IS 456:2000 find the limiting moment of resistance also. **(10 marks)**

3. (a) Explain the term Limit State. Enumerate the different limit states to be considered in reinforced concrete design. **(4 marks)**

   (b).Design and detail an RC rectangular section subjected to a udl of 15 kN/m over the entire span. Clear span is 5m. The beam is supported on masonry walls, 230 mm thick on

both sides. Assume moderate exposure conditions. Use M 25 grade concrete and Fe 415 grade steel.**(10 marks)**

Module II

4. (a) Enumerate the situations in which a doubly reinforced section become necessary. Derive expression for the ultimate moment of resistance of doubly reinforced section Explain. **(4 marks)**

   (b) Determine the ultimate moment of resistance of a doubly reinforced rectangular section of width 300 mm and overall depth 700 mm reinforced with 4 – 25mm diameter bars on tension side and 2 – 25mm diameter bars on compression side. Assume effective cover of 45 mm on both sides. Use M 20 concrete and Fe 415 steel.**(10 marks)**

5. (a) The provision of minimum stirrup reinforcement is mandatory in all reinforced concrete beams. Why?**(2 marks)**

   (b) Determine the ultimate moment of resistance of an isolated beam of T-shaped cross-section having a span of 6m and cross sectional dimensions are flange width of 1000mm, flange thickness of 100mm, web width of 250mm and an effective depth of 520mm, having tension reinforcement of 6 x 28mm diameter bars. The materials used are concrete mix of grade M20 and mild steel of grade Fe 415. **(12 marks)**

Module III

6. (a) Distinguish between one way slab and two way slab**. (2 marks)**

   (b) Design and detail a simply supported slab for a room of interior dimension 5m x 4m subjected to an imposed load of 8 kN/m^2. Thickness of supporting wall is 230 mm. Use M 20 concrete and Fe 415 grade steel.**(12 marks)**

7. (a) Explain the behavior of two way slabs and also the need of corner reinforcement in two way rectangular slabs whose corners are prevented from lifting.**(3 marks)**

   (b) Design a staircase to be provided in a residential building in two straight opposite flights of 1.0m width connected by a landing for a floor height of 3.3m. The landing which is 1m wide spans in the same direction as the stair slab. The rise and tread shall be 150mm and 270mm respectively. The weight of finishes 1kN/m^2, live load =3kN/m^2. M20 concrete & Fe415 steel are to be used.**(11 marks)**

Module IV

8. (a)Classify the columns separately based on loadings and slenderness ratios.**(4 marks)**

   b)Design a reinforced concrete column to carry an axial load of 1600 kN. Use M20 concrete and Fe415 steel. The column has unsupported length of 3m and is effectively held in position at both the ends, but not restrained against rotation.**(10 marks)**

9. a)Draw four typical strain profiles of a short, rectangular and symmetrically reinforced concrete column causing collapse subjected to different pairs of Pu and Mu when the depths of the neutral axis are (i) less than the depth of column D, (ii) equal to the depth of column D, (iii) D <xu< ∞ and (iv) xu = ∞. Explain the behaviour of column for each of the four strain profiles. **(4 marks)**

(b) Design a RCC rectangular column to carry an axial load of 1200 kN and a moment of 70 kNm, The length of the column is 3.5m. The one end is fixed and the other end is hinged. The width of the column is restricted to the wall thickness of 24 cm.**(10 marks)**

Module V

10. (a) Design a footing for a 400 mm x 400 mm column to carry a load of 100 kN with foundation resting on a soil of SBC 120 kN/m^2.Assume M20 concrete and Fe415 steel. **(8 marks)**

    (b) What are the objectives of earthquake-resistant design of reinforced concrete structures? What are the design requirements of beam-column joints in earthquake resistant design? **(6 marks)**

11. (a) Explain the different types of shallow footings.**(2 marks)**

    (b) Design an isolated rectangular footing for a column 450 mm x 600 mm to carry a load of 2400 kN. The SBC of the soil is 180 kN/m^2.Use M20 concrete and Fe 415 grade steel. **(10 marks)**

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CET309	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	3	0	0	3	2019

Preamble:

Construction Technology and Management introduces the basic concepts of civil engineering construction and its management. The course provides a detailed insight into the materials used in construction, various building elements and construction technology. Management is essential for successful completion of construction projects and the course introduces the students to the basic concepts of construction project management and planning. After the course, students will be familiar with the fundamental concepts of building construction and management.

Prerequisite: Basics of Civil and Mechanical Engineering

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Describe the properties of materials used in construction	Understand
CO2	Explain the properties of concrete and its determination	Understand
CO3	Describe the various elements of building construction	Understand
CO4	Explain the technologies for construction	Understand
CO5	Describe the procedure for planning and executing public works	Understand
CO6	Apply scheduling techniques in project planning and control	Application

Mapping of course outcomes with program outcomes(Minimum requirement)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	1	1		1		1
CO2	3					1		1		1		1
CO3	3					1				1		1
CO4	3					2	1			1		1
CO5	3	2				1				1	3	1
CO6	3	3	3		1				2	1	3	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	40	30	76
Apply		10	14
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 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: Describe the properties of materials used in construction

1. Write a short note on manufacturing process of cement.
2. Explain any three laboratory tests on cement and its IS specifications.
3. Write a note on quality of water used for concrete.
4. Explain the various types of admixtures and their uses.

CO2: Explain the properties of concrete and its determination

1. Explain briefly the manufacturing process of concrete.
2. Explain a method to assess the workability of concrete. Also highlight the merits and demerits of the test.
3. Explain the factors affecting bleeding and segregation of concrete.
4. Explain the various factors affecting strength of concrete.

CO3: Describe the various elements of building construction

1. Discuss the purpose of providing damp proof course.
2. Distinguish between plastering and pointing.
3. Explain the various types of pointing with neat sketches.
4. State the advantages and disadvantages of framed structures.

CO4: Explain the technologies for construction

1. Explain voided slab construction.
2. Describe the classification of scaffolding.
3. Explain slipform construction.
4. Discuss the general reasons of building failure.

CO5: Describe the procedure for planning and executing public works

1. Differentiate between earnest money deposit and security deposit.
2. Discuss the advantages of a lump sum contract over an item-rate contract.
3. Explain the life cycle of a construction project.
4. Explain the process of tendering for a construction project.

CO6: Apply scheduling techniques in project planning and control

1. The following details regarding a project are given.

Activity	A	B	C	D	E	F	G	H	I	J
Immediate Predecessor	-	A	A	B	B	C	C	D	E, F	G
Duration (Days)	5	2	6	4	4	2	3	8	7	2

(a) Prepare an Activity on Node Diagram.

(b) Find the expected duration of the project.

(c) Determine the critical activities.

(d) Compute the total and free float of all the activities.

2. For the project details given below:
   (a) Draw the network.
   (b) Prepare the schedule of activities
   (c) What is the project completion time?
   (d) Which is the critical path?
   (e) Determine the probability of completing the project in 55 days?

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	A	A	B	B	C	E	D,F	G,H
a	4	5	4	15	10	8	4	1	6
m	6	7	8	20	18	9	8	2	7
b	8	15	12	25	26	16	12	3	8

SYLLABUS

Module 1

Construction Materials

Timber products –properties and uses of veneer, plywood, fibre board, particle board, multi wood

Cement: Manufacturing, chemical composition,Tests on cement – specific gravity, standard consistency, initial and final setting time, fineness, soundness, compressive strength, IS specifications

Aggregates – types, Gradation, importance of gradation, bulking of fine aggregate

Quality of water for construction (Brief discussion only, Permissible limits of chemical constituents not required)

Admixtures, uses – mineral admixtures – fly ash and ground granulated blast furnace slag and chemical admixtures – plasticizers, super plasticizers, accelerators, retarders (brief discussion only)

Module 2

Concrete and Building Construction

Process of manufacturing concrete – batching, mixing, transportation, placing, compacting, finishing, curing

Properties of fresh concrete: Workability, factors affecting workability, test on workability (slump test), segregation and bleeding (brief discussion)

Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure

Lintels and arches: Types and construction details

Damp proof course (brief discussion only)

Finishing works: Plastering, pointing, painting – objectives and types

Structural systems – load bearing and framed construction, RCC and steel framed structures

Module 3

Construction Technology

Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology(brief discussion only)

Scaffolding – uses and classification (brief discussion only)

Formwork – requirements of good formwork, classification, slipform(brief discussion only)

Prefabricated construction – advantages and disadvantages, prefabricated building components.

Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned construction

Construction 3D printing (brief discussion only)

Building failures – general reasons

Causes of failures in RCC, steel and masonry structures

Module 4

Construction Project Management

Construction projects, categories, life cycle of a project –pre-project phase, project phase, post-project phase, Detailed Project Report – contents

Tendering: types of tenders, stages in tendering

Contracts: types of contracts – item rate contract, lumpsum contract, percentage rate contract, turnkey contracts, concession contracts – BOT

Module 5

Construction Planning

Work break down structure

Types of Schedules – Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule

Bar chart,Mile Stone Charts

Networks, Network representation – Activity on Node (AoN) Diagram

Network analysis – Critical Path Method (CPM), Programme Evaluation and Review Technique(PERT) – concepts and problems

Text books:

1. Shetty M.S. and A. K. Jain (2019), Concrete Technology: Theory and Practice, S. Chand &Company Pvt. Ltd.
2. Varghese P. C. (2007), Building Construction, Prentice Hall India.
3. Punmia B. C., Ashok Kumar Jain and Arun Kumar Jain (2016), Building Construction, Laxmi Publications (P) Ltd.
4. Sharma S.C. and S.V. Deodhar (2019), Construction Engineering & Management, Khanna Book Publishing Co. (P) Ltd.
5. Kumar Neeraj Jha (2015), Construction Project Management: Theory and Practice, Pearson India Education Services Pvt.Ltd.

Reference books:

1. SahuG. C.andJoygopal Jena (2015), Building Materials and Construction, McGraw Hill Education (India) Private Limited.
2. Gambhir M. L. (2004), Concrete Technology, Tata McGraw-Hill Publishing Company Limited.

3. Sharma S.K. (2019),Civil Engineering Construction Materials, Khanna Book Publishing Co. (P) Ltd.
4. Neville A.M. and BrooksJ.J. (2010), Concrete Technology, Pearson Education Ltd.
5. Mehta P. K. and Paulo J. M. Monteiro (2014),Concrete-Microstructure, Properties and Materials, McGraw Hill Education.
6. SanthakumarR. (2006), Concrete Technology, Oxford Universities Press India.
7. Tony Bryan (2010), Construction Technology – Analysis and Choice, Wiley-Blackwell.
8. Joseph J. Moder, Cecil R. Philips and Edward W. Davis (1983), Project Management with CPM, PERT and Precedence Diagramming, Van Nostrand Reinhold Company Inc.
9. Charles Patrick (2012), Construction Project Planning and Scheduling, Dorling Kindersley India Pvt. Ltd.
10. Daniel W. Halpin and Bolivar A. Senior (2011), Construction Management, John Wiley and Sons Inc.

Lecture Plan

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I (6 hours)**		
1.1	Timber products –properties and uses of veneer, plywood, fibre board, particle board, multi wood	CO1	1
1.2	Cement – Manufacturing, chemical composition	CO1	1
1.3	Tests on cement – specific gravity, standard consistency, initial and final setting time, fineness, soundness, compressive strength, IS specifications	CO1	1
1.4	Aggregates – types, Gradation, importance of gradation, bulking of fine aggregate	CO1	1
1.5	Quality of water for construction (Brief discussion only, Permissible limits of chemical constituents not required) Admixtures, uses – mineral admixtures – fly ash and	CO1	2

	ground granulated blast furnace slag and chemical admixtures – plasticizers, superplasticizers, accelerators, retarders (brief discussion only)		
2	**Module II (8 hours)**		
2.1	Concrete manufacturing – batching, mixing, transportation, placing, compacting, finishing, curing	CO2	2
2.2	Properties of fresh concrete: Workability, factors affecting workability, test on workability (slump test), segregation and bleeding (brief discussion)	CO2	1
2.3	Properties of hardened concrete: Strength, factors affecting strength, tests for strength of concrete in compression, tension and flexure	CO2	1
2.4	Lintels and arches: Types	CO3	1
2.5	Damp proof course (brief discussion only),Finishing works: Plastering, pointing (objectives and types)	CO3	1
2.6	Painting (objectives and types)	CO3	1
2.7	Structural systems – load bearing and framed construction, RCC and steel framed structures	CO3	1
3	**Module III (6 hours)**		
3.1	Cost-effective construction – rapid wall construction, soil-cement block masonry, voided slab technology, filler slab technology (brief discussion only)	CO4	1
3.2	Scaffolding – uses and classification (brief discussion only)	CO4	1
3.3	Formwork – requirements of good formwork, classification, slipform (brief discussion only)	CO4	1
3.4	Prefabricated construction – advantages and disadvantages, prefabricated building components. Basic concept of prestressing – fundamental understanding of pre-tensioned and post-tensioned	CO4	1

	construction Construction 3D printing (brief discussion only)		
3.5	Building failures – general reasons Causes of failures in RCC, steel and masonry structures	CO4	2
4	**Module IV (7 hours)**		
4.1	Introduction to construction project management, construction projects, categories	CO5	1
4.2	Life cycle of construction project – pre-project phase, project phase, post-project phase,Detailed Project Report – contents	CO5	2
4.3	Tendering, types of tenders, stages in tendering	CO5	2
4.4	Contracts – types of contracts – item rate contract, lumpsum contract, percentage rate contract, turnkey contracts, concession contracts – BOT	CO5	2
5	**Module V (8 hours)**		
5.1	Introduction to construction planning and scheduling, Work break down structure	CO6	1
5.2	Types of Schedules: Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule	CO6	1
5.3	Bar chart,Mile Stone Charts	CO6	1
5.4	Introduction of networks, Network representation – Activity on Node (AoN) Diagram, Critical Path Method (CPM) – concepts and problems on determination of critical path, floats	CO6	3
5.5	Programme Evaluation and Review Technique (PERT) – concepts and problems	CO6	2

MODEL QUESTION PAPER

Reg.No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET309

Course Name: **CONSTRUCTION TECHNOLOGY AND MANAGEMENT**

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain bulking of fine aggregate.
2. State the IS specification for initial and final setting time of OPC.
3. Discuss the various objectives of plastering.
4. List the various requirements of an ideal paint.
5. Briefly describe rapid wall construction technology.
6. Explain 3D printing in construction.
7. Discuss the advantages and disadvantages of an item-rate contract.
8. Explain selective tendering.
9. Explain the three time estimates in PERT.
10. Illustrate the use of a material schedule in organizing construction activities at a site.

(10×3 marks = 30 marks)

PART B

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

Module I

11. a) Discuss the role of plasticizers in concrete. (6 marks)

    b) Differentiate between fibre board and particle board. (8 marks)

OR

12. a) Discuss the chemical composition of cement. (5 marks)

    b) Explain gradation of aggregates. Discuss the significance of gradation of aggregates. (9 marks)

Module II

13. a)Define workability of concrete. Explain the factors affecting workability.(5 marks)

b) Explain any three laboratory tests on hardened concrete. (9 marks)

OR

14. a) Explain various types of arches with neat sketches. (8 marks)

b) Distinguish between RCC framed and steel framed structures. (6 marks)

Module III

15. Explain the causes of failure in RCC structures. (14 marks)

OR

16. a) Discuss the advantages and disadvantages of prefabricated construction. (6 marks)

b) Explain filler slab technology. (8 marks)

Module IV

17. Discuss the details included in the DPR of an infrastructure project. (14 marks)

OR

18. Explain the project formulation stage of a construction project. (14 marks)

Module V

19. For the given data, draw an AON network and determine the critical path. Also find the total float, free float and independent float of each activity.

Activity	A	B	C	D	E	F	G	H	I
Predecessor	-	A	A	C	B	B, D	C	F, G	E, H
Duration (days)	4	6	4	2	4	5	3	4	2

(14 marks)

OR

20. The table shows the details of various activities of a small project.

Activity	A	B	C	D	E	F	G	H	I	J
Predecessor	-	-	A	A	B	E	C	D, F	H	G
Optimistic	4	3	7	5	6	2	3		2	6

time (days)										
Most likely time (days)	6	5	8	7	7	3	4	9	4	8
Pessimistic time (days)	8	7	9	9	8	4	5	11	6	10

a) Draw an AON network and calculate the project completion time with 50% probability.

b) Find the probability of completing the project in (i) 30 days; (ii) 26 days.

c) What project completion date has 80% chance of being met? (14 marks)

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CET 307	HYDROLOGY & WATER RESOURCES ENGINEERING	Category	L	T	P	Credit	Year of Introduction
		PCC	4	0	0	4	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of surface and groundwater components of hydrology and basics of water resources engineering. The course aim to impart the knowledge on the availability of water on hydrosphere, its distribution and quantification, scientific methods for computing irrigation water requirements, reservoir engineering and river engineering

Pre-requisite: NIL

Course outcome

After the course, the student will be able to:

CO1	Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data
CO2	Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering
CO3	Perform the estimation of streamflow and/or describe the river behavior and control structures
CO4	Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life
CO5	Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells

CO - PO Mapping

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CET307 Hydrology and Water Resources	CO1	3	3		1			1					
	CO2	3	3					1					
	CO3	3	2					1					
	CO4	3	3					1					
	CO5	3	3					1					

Assessment pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	5	5	15
Understand	10	10	15
Apply	20	20	40
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 Code: CET 307
Hydrology and Water Resources Engineering
(Course Level Assessment Questions)

CO1	**Describe and estimate the different components of hydrologic cycle by processing hydro-meteorological data**
1	Differentiate rainfall mass curve and hyetograph
2	Explain the use of double ring infiltration for infiltration measurement
3	Explain any three methods for baseflow separation
4	Explain the limitations of unit hydrograph theory
5	A storm with 10 cm of precipitation produced a direct runoff of 5.8 cm. The duration of the rainfall was 16 hrs and its time distribution is given below : (10 Marks)

		Time from start (h)	0	2	4	6	8	10	12	14	16
		Cumulative rainfall (cm)	0	0.4	1.3	2.8	5.1	6.9	8.5	9.5	10

Determine the ϕ-index of the storm.

6 The ordinates of a 4-hour unit hydrograph for a particular basin are given below. Determine the ordinates of the 6-hour unit hydrograph.

Time (hrs)	0	2	4	6	8	10	12	14	16	18	20	22	24
Discharge (Cumecs)	0	25	100	160	190	170	110	70	30	20	16	1.5	0

CO2	**Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering**
1	Explain the factors affecting duty. Explain how can you improve the duty
2	Define duty and delta. Obtain the relation between the two
3	Define the different types of irrigation efficiencies
4	The following data pertaining to healthy growth of a crop: Root zone depth = 75 cm Field capacity = 27 %, Wilting point=14 % Dry density of soil=1500 kg/$m^{3.}$ Daily consumptive use =11 mm. Assuming 80 % depletion of available moisture as an indicator for application of water, determine how long the crop survive without irrigation
5	The CCA for a distributary is 15000 ha. The intensity of irrigation for Rabi is 40 % and for Kharif is 15 %. If the total water requirement of the two crops is 37.5 cm and 120 cm and their periods of growth are 160 days and 140 days respectively, determine the design discharge at the outlet.

<table>
<tr><td>CO3</td><td>Perform the estimation of streamflow and/or describe the river behavior and control structures</td></tr>
<tr><td>1</td><td>Explain Meandering. What are the causes of meandering ?</td></tr>
<tr><td>2</td><td>Explain the objectives of providing river training works</td></tr>
<tr><td>3</td><td>Enlist the factors affecting the selection of site for stream gauging station</td></tr>
<tr><td>4</td><td>The data pertaining to a stream gauging operation at a gauging station are given below. The rating equation of the current meter is $v = 0.32N_s + 0.032$ m/sec where N_s is the number of revolutions per second. Compute the discharge in the stream by area velocity method
<table>
<tr><td>Distance from left water edge (m)</td><td>0</td><td>2</td><td>4</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td><td>20</td><td>22</td><td>23</td><td>24</td></tr>
<tr><td>Depth (m)</td><td>0</td><td>0.5</td><td>1.1</td><td>1.95</td><td>2.25</td><td>1.85</td><td>1.75</td><td>1.65</td><td>1.5</td><td>1.25</td><td>0.75</td><td>0</td></tr>
<tr><td>Revolutions of current meter kept at 0.6 depth</td><td>0</td><td>80</td><td>83</td><td>131</td><td>139</td><td>121</td><td>114</td><td>109</td><td>92</td><td>85</td><td>70</td><td>0</td></tr>
<tr><td>Duration of observation (s)</td><td>0</td><td>180</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td><td>120</td></tr>
</table></td></tr>
<tr><td>5</td><td>Describe with sketches different type of groynes</td></tr>
</table>

<table>
<tr><td>CO4</td><td>Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life</td></tr>
<tr><td>1</td><td>Define safe yield, secondary yield and design yield of reservoirs</td></tr>
<tr><td>2</td><td>Explain mass inflow curve and mass demand curve</td></tr>
<tr><td>3</td><td>Explain with a neat sketch the zones of a storage reservoir</td></tr>
<tr><td>4</td><td>Explain the procedure for estimating the life of storage reservoir</td></tr>
</table>

<table>
<tr><td>5</td><td>The average annual discharge of a river for 11 years is given below
<table>
<tr><td>Year</td><td>1960</td><td>61</td><td>62</td><td>63</td><td>64</td><td>65</td><td>66</td><td>67</td><td>68</td><td>69</td><td>70</td></tr>
<tr><td>Discharge (m^3/sec)</td><td>1750</td><td>2650</td><td>3010</td><td>2240</td><td>2630</td><td>3200</td><td>1000</td><td>950</td><td>1200</td><td>4150</td><td>3500</td></tr>
</table>
Determine the storage capacity of a reservoir required to meet a demand of 2000 cumec throughout the year by mass curve method.</td></tr>
</table>

CO5	**Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells**
1	State Darcy's law and its limitations
2	Enlist the assumptions in the derivation of Dupuit's equation
3	Differentiate perched aquifer and leaky aquifer
4	Describe the working of strainer type tube well with a sketch
5	Pumping at the rate of 1500 litres per minute from a 30cm diameter well of depth 60m in an unconfined aquifer gives a drawdown of 2m and 1.1m in observation wells located at distances 120m and 160m respectively from it. Calculate the drawdown of the pumping well and the coefficient of permeability of the aquifer.
6	During a recuperation test conducted on an open well in a region, the water level in the well was depressed by 3 m and it was observed to rise by 1.75 m in 75 minutes. (a) What is the specific yield of open wells in that region (b) What will be the yield from a well of 5 m diameter under a depression head of 2.5 m ? (c) What diameter should be the diameter of the well to give a yield of 12 l/sec under a depression head of 2 m ?

Course Code: CET 307
Hydrology and Water Resources Engineering
Syllabus

Module I

Hydrologic cycle-precipitation-mechanism, types, forms and measurement using rain gauges ; Optimum number of rain gauges, representation of rainfall data-mass curve and hyetograph, computation of mean precipitation over a catchment, Design rainfall - probable maximum rainfall; IDF curves (conceptual idea only). Infiltration-measurement by double ring infiltrometer, Horton's model, infiltration indices. Evaporation –measurement and control

Module II

Runoff-components of runoff- Hydrograph analysis-Hydrograph from isolated storm-Base flow separation. Unit hydrograph – uses, assumptions and limitations of unit hydrograph theory. Computation of storm/flood hydrograph of different duration by method of superposition and by development of S– Hydrograph; Floods-methods of design flood estimation –Empirical methods; SPF and PMF, Return period (conceptual ideas only)

Module III

Irrigation– Necessity, Benefits and ill effects. Types: flow and lift irrigation - perennial and inundation irrigation. Soil-water –plant relationships. Irrigation efficiencies, Computation of crop water requirement: depth and frequency of Irrigation. Duty and delta, duty-factors affecting and method of improving duty, Computation of crop water requirement by using the concept of duty and delta

Module IV

Streamflow measurement-area velocity method of stream gauging, selection of site for stream gauging station, Stage-discharge curve, flow duration curve-uses and characteristics. River training works-types; Meandering and meander parameters; Reservoirs- types, zones, yield of reservoir; determination of storage capacity and yield by mass curve method; Reservoir sedimentation and control- trap efficiency- computation of life of reservoir

Module V

Vertical distribution of ground water- classification of saturated formation (review) Aquifer properties, Darcy's law, Well hydraulics-Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers; Types of wells, Types of tube wells; well losses; Yield of open wells-pumping test and recuperation test

Text Books:

1. Modi P. N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors New Delhi 2009.
2. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power
Engineering, Laxmi Publications (P) Ltd. 2009

References:

3. VenTe Chow. Hand book of Applied Hydrology, Tata McGraw Hill, 1988
4. Todd D. K. Ground Water Hydrology, Wiley, 2005.
5. H.M Raghunath. Groundwater. New Age International New Delhi 2007
6. G.L.Asawa. Irrigation and Water Resources Engineering New Age International New Delhi 2008
7. Garg S. K. Hydrology and Water Resources Engineering, Khanna Publishers New Delhi 2005.
8. Garg SK, Irrigation Engineering and Hydraulic Structures Khanna Publishers New Delhi 2006.
9. Subramanya K. Engineering Hydrology, Tata McGraw Hill, 2013.
10. Raghunath H.M. Hydrology: Principles, Analysis and Design. New Age International New Delhi 2006.

Course Code: CET 307
Hydrology and Water Resources Engineering
(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (11 Hours)			
1.1	Hydrology-Hydrologic cycle	CO1	1
1.2	Precipitation- mechanism, types, forms	CO1	1
1.3	Measurements of rainfall- Use of rain gauges	CO1	1
1.4	Representation of rainfall data-Rainfall Mass curve, hyetograph; Optimum number of rain gauges	CO1	1
1.5	Estimation of missing precipitation	CO1	1
1.6	Computation of mean precipitation	CO1	1
1.7, 1.8	Problems	CO1	2
1.9	Design rainfall - probable maximum rainfall; IDF curves	CO1	1

	(conceptual idea only).		
1.10	Water losses-Infiltration-measurement by double ring infiltrometer, Horton's equation; concept of infiltration indices	CO1	1
1.11	Evaporation-measurement by IMD land pan, control of evaporation	CO1	1
Module II (9 Hours)			
2.1	Runoff- Components, factors affecting runoff, Computation of runoff by different methods.	CO1	1
2.2	Runoff computation by rational formula and from infiltration indices	CO1	1
2.3	Hydrograph analysis-Hydrograph from isolated storm-Base flow separation	CO1	1
2.4	Concept of unit hydrograph-assumptions, uses, applications	CO1	1
2.5	Computation of storm/flood hydrograph ordinates of different duration by method of superposition	CO1	1
2.6	Computation of storm/flood hydrograph ordinates of different duration by development of S– Hydrograph	CO1	1
2.7,2.8	Problems	CO1	2
2.9	Floods-methods of design flood estimation –Empirical methods; SPF and PMF, Return period (conceptual ideas only)	CO1	1
Module III (7 Hours)			
3.1	Irrigation-Benefits and ill effects, lift and flow irrigation	CO2	1
3.2	Types of irrigation, Irrigation efficiencies	CO2	1
3.3	Soil water plant relationships	CO2	1
3.4	Computation of crop water requirement: depth and frequency of Irrigation	CO2	1
3.5	Duty and delta-Factors affecting and method of improving duty	CO2	1
3.6	Estimation of crop water requirement by using the concepts of duty and delta	CO2	1
3.7	Problems	CO2	1
Module IV (11 Hours)			
4.1	Streamflow measurement- measurement of stage and velocity	CO3	1
4.2	Stage-discharge curve- Selection of site for stream gauging station,	CO3	1
4.3	Computation of discharge (Area-velocity method)-problem	CO3	1
4.4	Flow duration curves-uses and characteristics	CO3	1
4.5	River behavior-meandering-meander parameters, Objectives of river training	CO3	1
4.6	Types of river training works	CO3	1

4.7	Reservoirs- types, zones, yield of reservoir	CO4	1
4.8	Storage capacity and yield-by mass curve method	CO4	1
4.9	Reservoir sedimentation-control of sedimentation, trap efficiency	CO4	1
4.10	Useful life of reservoir-computation.	CO4	1
4.11	Problems	CO4	1
Module V (7 Hours)			
5.1	Vertical distribution of ground water - classification of saturated formation (Review)	CO5	1
5.2	Aquifer properties- Darcy's law	CO5	1
5.3	Steady radial flow to a well-unconfined aquifers	CO5	1
5.4	Steady radial flow to a well-unconfined aquifers	CO5	1
5.5	Problems	CO5	1
5.6	Types of wells-open wells and tube well, Types of tube wells - description	CO5	1
5.7	Estimation of yield of an open well- pumping test and recuperation test	CO5	1

Pages: 3

Model Question Paper

Reg No.:…….. QP
CODE:……..

Name:……

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

Course Code: CET 307

Hydrology and Water Resources Engineering

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain the different forms of precipitation
2. What are the methods of control of evaporation from water bodies?
3. Define unit hydrograph. Explain its uses
4. State the limitations of rational formula for runoff estimation
5. Explain irrigation efficiencies
6. Define duty and delta. Obtain the relation between the two
7. Enlist the factors to be considered in the selection of site for a stream gauging station
8. Explain meandering of rivers
9. Define (i) Storativity (ii) Transmissibility
10. Explain well losses

Part B

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

Module I

11 (a) Explain the working of a Siphon type rain gauge with a neat sketch (5 Marks)

(b) The average rainfall of 5 rain gauge stations in the base stations are 89, 54, 45, 41 and 55 cm. If the error in the estimation rainfall should not exceed 10 %, how many additional gauges may be required to be installed in the catchment? (9 Marks)

OR

12.(a) Compare different methods for determination of mean precipitation from a catchment (6 Marks)

(b) Explain the use of double ring infiltrometer for the measurement of infiltration. How will you develop Horton's model? (8 Marks)

Module II

13.(a) The rates of rainfall for the successive 30 min period of a 3-hour storm are:1.6, 3.6, 5.0, 2.8, 2.2, 1.0 cm/hr. The corresponding surface runoff is estimated to be 3.6 cm. Estimate the ϕ-index (7 Marks)

(b) Explain the characteristics of a single peak hydrograph from an isolated storm. How will you separate the base flow? (7 Marks)

OR

14. Find out the ordinates of a storm hydrograph resulting from a 9 hr storm with rainfall of 2, 5.75 and 2.75 cm during subsequent 3 hr intervals. The ordinates of 3hr unit hydrograph at 3 hr intervals are 0, 100, 355, 510, 380, 300, 260, 225,165, 120,85, 55,30, 22, 10, 0 (cumecs). Assume an initial loss of 0.5 cm and ϕ-index of 2.5 mm/hr and abase flow of 10 cumecs. (14 Marks)

Module III

15. (a) Differentiate lift irrigation and flow irrigation. (4 Marks)

(b) Estimate the frequency of irrigation required for certain crop for the following data: Root zone depth = 90 cm Field capacity = 22 %, Wilting point=12 % Dry density of soil=1500 kg/$m^{3.}$ Daily Consumptive use =22 mm. Assume 70 % depletion of available moisture as an indicator for application of water (10 Marks)

OR

16. (a) Explain the benefits and ill effects of irrigation (4 Marks)

(b) What are the factors affecting duty? How can you improve the duty of water.

(10 Marks)

Module IV

17 (a) Explain the use of current meter for velocity measurement in streams (7 Marks)

(b) Explain the method of determination of useful life of a reservoir. (7 Marks)

OR

18 (a) Explain the features of different types of groynes (8 Marks)

(b) Explain the types of storage reservoirs (6 Marks)

Module V

19 (a) State Darcy's law and its limitations (4 Marks)

(b) The following observations were recorded during a pumping out test on a tube well penetrating fully in an aquifer: Well diameter: 25 cm, Discharge from the well: 300 m^3/hr, RL of original water surface before pumping started: 122.000, RL of water in the well at constant pumping: 117.100 , RL of water in the observation well: 121.300, RL of impervious layer: 92.000, radial distance of observation well from the tube well: 50 m. Determine : (a) field permeability coefficient of the aquifer (b) radius of zero drawdown.

(10 Marks)

OR

20.(a) Explain the method of determination of yield of an open well (7 Marks)

(b) Explain the working of a strainer type tube well with a sketch (7 Marks)

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

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

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO1 0	PO1 1	PO1 2
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
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 : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

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, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of ‘disaster risk’

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples
2. What are the steps to effective disaster communication? What are the barriers to communication?
3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
2. Explain the importance of communication in disaster management
3. Explain the benefits and costs of stakeholder participation in disaster management
4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India
2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction
3. What are Tsunamis? How are they caused?
4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

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

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of 'disaster risk'
5. List the strategies for disaster risk management 'before', 'during' and 'after' a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context of disaster management
[4]

OR

12. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages?

[8]

b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]

15. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

Teaching Plan

	Module 1	**5 Hours**
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

CEL331	MATERIAL TESTING LAB II	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	3	2019

Preamble: The course aims to enrich the students to gain hands-on experience in conducting laboratory tests on various construction materials and thereby evaluate material quality and performance.

Prerequisite: Basics of Construction Engineering Materials.

General Instructions to Faculty:

1. Any 12 of the 15experiments included in the list of experiments need to be performed mandatorily. Virtual Lab facility cannot be used to substitute the conduct of these mandatory experiments.
2. The laboratory should have possession of modern testing equipment such as Rebound hammer, ultrasonic pulse velocity,rebarlocator,core cutter, concrete penetrometer and crack detection microscope at least for demonstration purposes.
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages such as may be required for making various plots.

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

Course Outcome	Course Outcome Description
CO 1	To describe the basic properties of various construction materials
CO 2	Characterize the physical and mechanical properties of various construction materials.
CO3	Interpret the quality of various construction materials as per IS Codal provisions.

Mapping of course outcomes with program outcomes:

CO/PO	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	2	2	2	1	3	-	-	2	2	-	2
CO 2	3	2	2	2	1	3	-	-	2	2	-	2
CO 3	3	2	2	2	1	3	-	-	2	2	-	2

Assessment Pattern:

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance	:	15 marks
Continuous Assessment	:	30 marks
Internal Test (Immediately before the second series test)	:	30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work	: 15 Marks
(b) Implementing the work/Conducting the experiment	: 10 Marks
(c) Performance, result and inference (usage of equipment and trouble shooting)	: 25 Marks
(d) Viva voce	: 20 marks
(e) Record	: 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. M.S.Shetty , Concrete Technology, Theory and Practice , S.Chand&Company, 2014 A.M.Neville and J.J Brooks, Concrete Technology,Second edition, Pearson.
2. **IS codes on cement:**IS 1489(Part 1& 2):1991 Specification for Portland pozzolana cement,IS 269:1989 – Specification for ordinary Portland cement, 33 grade,IS 8112 : 2013- Specification for ordinary Portland cement, 43 grade, IS 12269 : 2013- Specification for ordinary Portland cement, 53 grade,
3. **IS codes on aggregate**:IS 2386(Part 1):1963 Methods of test for aggregates for concrete: Part 1 Particle size and shape, IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking, IS 383:1970Specification for Coarse and Fine aggregate from natural sources of concrete
4. **IS codes on fresh and hardened concrete:** IS 1199:1959 Methods of sampling and analysis of concrete, IS 10262:2019 Concrete mix proportioning- Guidelines, IS 516:1959 Methods of tests for strength of concrete.
5. **IS codes on brick and tiles:**IS 3495 (Part 1 to 4):1992 Methods of tests of burned clay bricks,IS 1077:1992 Common burned clay building bricks (specification),IS 654:1992 Clay roofing tiles Mangalore pattern (specification).
6. IS 13311 (Part 1 & 2):1992Non - destructive testing of concrete-methods of test.

SYLLABUS

Exercise 1. Testing of Cement: Fineness,normal consistency,initial & final setting time.

Exercise 2. Testing of Cement: Specific gravity and compressive strength

Exercise 3. Study on soundness of cement.

Exercise 4. Testing of Coarse and Fine Aggregate: Sieve analysis.

Exercise 5. Testing of Coarse and Fine Aggregate: Water absorption, bulk density, void ratio, porosity and specific gravity.

Exercise 6. Test on bulking of sand.

Exercise 7. Test on coarse aggregate crushing value

Exercise 8.Tests on fresh concrete :Measurement of workability of concrete by slump cone test and compacting factor test.

Exercise 9. Study on workability of concrete by Vee-Bee test and flow test.

Exercise10. Concrete mix design by IS code method and casting of cubes, cylinders with designed concrete mixes.

Exercise 11. Tests on hardened properties of concrete: Compressive, split and flexural strength.

Exercise 12.Tests on hardened properties of concrete: Modulus of elasticity of concrete

Exercise 13. Tests on brick, floor and roof tiles as per IS codal provision.

Exercise 14. Study on Non-destructive tests on hardened concrete (Rebound hammer, ultrasonic pulse velocity and Rebar locator).

Exercise 15. Study on concrete core cutter, concrete penetrometer and crack detection microscope.

CEL 333	GEOTECHNICAL ENGINEERING LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		PCC	0	0	3	2	2019

Preamble:

Objective of the course is to familiarize students with the laboratory tests used to determine physical, index and engineering properties of geomaterials.

Prerequisite: CET 204 GEOTECHNICAL ENGINEERING I

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

CO1	Identify and classify soil based on standard geotechnical experimental methods.
CO2	Perform and analyze permeability tests.
CO3	Interpret engineering behavior of soils based on test results.
CO4	Perform laboratory compaction, CBR and in-place density test for fill quality control in the field.
CO5	Evaluate the strength of soil by performing various tests viz. direct shear test, unconfined compressive strength test and triaxial shear test.
CO6	Evaluate settlement characteristics of soils.

Mapping of course outcomes (COs) with program outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				1				2	2		
CO2	3				2				2	2		
CO3	3	2							2	2		
CO4	3				1				2	2		
CO5	3				2				2	2		
CO6	3	1			2				2	2		

Mark distribution

Total Marks	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)	End Semester Examination (ESE) Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.

a) Preliminary work : 15 marks

b) Implementing the work/ Conducting the experiment : 10 marks

c) Performance, result and inference (usage of equipments and trouble shooting) : 25 marks

d) Viva voce : 20 marks

e) Record : 5 marks

General instructions:

Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

References

1. IS codes relevant to each test

2. C. Venkatramaiah, Geotechnical Engineering, New Age International publishers, 2012

3. Gopal Ranjan and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International Publishers, 2012

4. K. R. Arora, Soil Mechanics and Foundation Engineering, Standard Publishers, 2011

SYLLABUS

Part A

Estimation of physical and index properties of the given soil: After performing the set of experiments, students are expected to infer the results of the experiments in their engineering behavior.

1. Determination of Water Content and Specific Gravity
2. Sieve Analysis
3. Hydrometer/pipette Analysis
4. Atterberg Limits (Liquid Limit, Plastic Limitand Shrinkage Limit)
5. Swelling Test

6. Field Density determination

Part B

Determination of engineering properties of the given soil: Students should be familiarize with the tests to be performed to determine the engineering properties of the given soil and interpret the results for field application.

7. Permeability Test
8. Standard Proctor Compaction Test
9. Heavy compaction
10. California Bearing Ratio Test
11. Direct Shear test
12. Unconfined Compression Test
13. Consolidation Test

Study/demonstration

14. Triaxial test