CET302	STRUCTURAL ANALYSIS - II	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 multistoreyed structures using appropriate methods and tools. It utilises the procedures of force methods and displacement methods for analysing framed structures. Plastic theory and its applications are introduced to students. A very important topic of applications of principles of dynamics to analyse structures while undergoing dynamic deformations is also made familiar with. The course trains the students to develop mathematical models and helps to sharpen their analytical skills, which also helps the student to lay foundation for further advanced topics like finite element method.

Prerequisite: CET301Structural Analysis I

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	Understand the principles of plastic theory and its applications in structural analysis.	Understanding, Applying
CO2	Examine the type of structure and decide on the method of analysis.	Analysing, Applying
CO3	Apply approximate methods of analysis for framed structures to ascertain stress resultants approximately but quickly.	Analysing, Applying
CO4	Apply the force method to analyse framed structures.	Understanding,Analysing, Applying
CO5	Apply the displacement methods to analyse framed structures.	Understanding, Analysing, Applying
CO6	Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.	Remembering, Understanding, Applying

Mapping of course outcomes with program outcomes (Minimum requirement)

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

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	05	05	10
Understand	10	10	20
Apply	20	20	50
Analyse	15	15	20
Evaluate			
Create			

Mark distribution

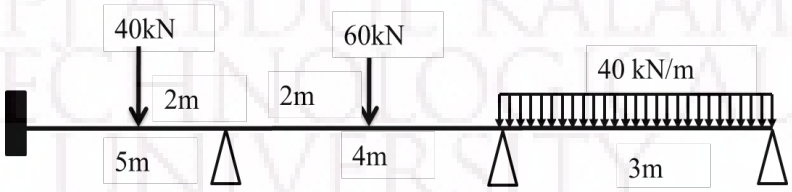
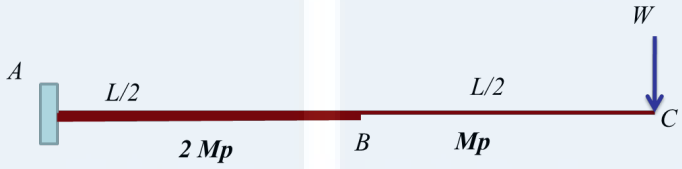
Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

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

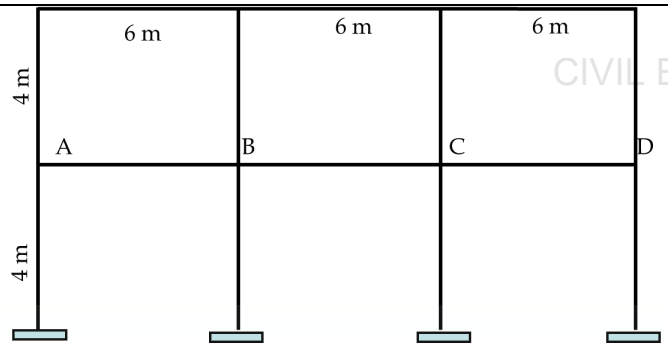
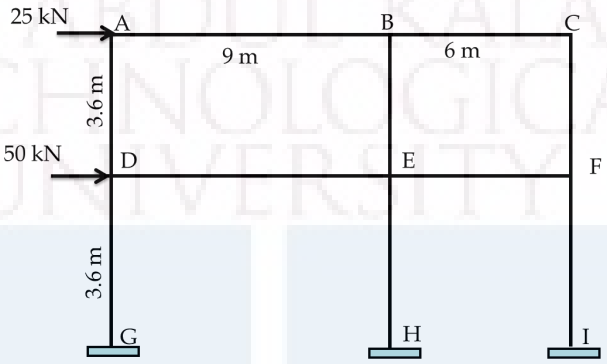
End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each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

Course Level Assessment Questions

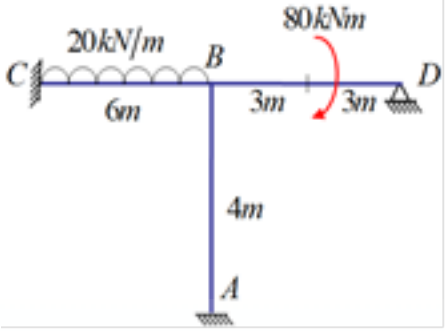
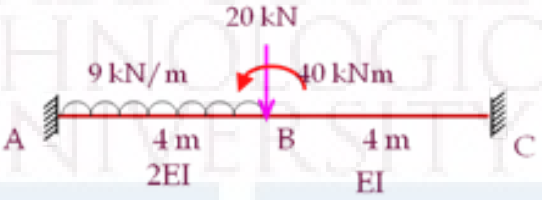
CO1:	**Understand the principles of plastic theory and its applications in structural analysis.**
1.	Derive an expression for the shape factor of a rectangular cross section.
2.	Explain the terms 'design plastic moment capacity of a member' and 'collapse load of a structure'
3.	Find the plastic moment capacity of the beam shown in figure. Assume uniform section throughout. 
4.	For the cantilever in Fig.2, determine the collapse load. 

CO2:	**Examine the type of structure and decide on the method of analysis.**
1.	Differentiate between force and displacement methods of analysis of framed structures.
2.	Explain how you will determine the suitability of force method or displacement method for analysis of a structure?
3.	Which are the situations in which an analyst uses approximate methods of structural analysis? What are their advantages and disadvantages?

CO3:	**Apply approximate methods of analysis for framed structures to ascertain stress resultants approximately but quickly.**
1.	What are the assumptions in cantilever method?
2.	Total dead load is 12 kN/m and total live load is 20 kN/m on ABCD. Analyse the frame for midspan positive moment on BC, using substitute frame method.

	
3.	Analyse the frame in figure using portal method. 

CO4:	**Apply the force method or displacement method to analyse structures accurately.**
1.	Derive stiffness matrix for the degrees of freedom shown for the beam in figure. 
2.	Prove that flexibility matrix is the inverse of stiffness matrix for a given set of actions and corresponding displacements.
3.	Analyse the beam in figure using flexibility method. 
4.	Determine all the member end moments for the frame shown in figure, using stiffness method.

	
5.	Determine the displacements at B for the beam shown in figure, using stiffness method. 
6.	Find all the joint displacements for the beam in Figure 5, using direct stiffness method. 

CO5:	**Remember basic dynamics, understand the basic principles of structural dynamics and apply the same to simple structures.**
1.	Explain the components of the basic dynamic system
2.	Derive an expression for the free-vibration response of a damped SDOF system.
3.	Explain transient and steady-state responses
4.	A vibrating system consists of a weight of W = 100kN and a spring with stiffness k = 20 N/m is viscously damped so that the ratio of two consecutive amplitudes is 1/0.85. Detemine: a) the natural frequency of the undamped system, b) the damping ratio, c) the damping coefficient and d) the damped natural frequency.

SYLLABUS

MODULE I – 9 hrs.

Plastic Theory: Introduction – plastic hinge concepts – plastic modulus – shape factor – redistribution of moments – collapse mechanisms – Plastic analysis of beams and portal frames by equilibrium and mechanism methods.(single storey and single bay frames only) – 6 hrs.

Approximate methods of analysis of multistoried frames:

Analysis for vertical loads-substitute frames-loading condition for maximum hogging and sagging moments in beams and maximum bending moment in columns – 3 hrs.

MODULE II – 9 hrs.

Approximate methods (continued): Wind load analysis of multistoried frames – portal method and cantilever method for lateral load analysis. – 2 hrs.

Matrix analysis of structures:

Definition of flexibility and stiffness influence coefficients - Concepts of physical approach – 1 hr.

Flexibility method: flexibility matrices for truss and frame elements-load transformation matrix-development of total flexibility matrix of the structure-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects. – 6 hrs.

MODULE III – 9 hrs.

Stiffness method: Development of stiffness matrices by physical approach-stiffness matrices for truss and frame elements-displacement transformation matrix-analysis of simple structures-plane truss and plane frame-nodal loads and element loads-lack of fit and temperature effects. – 9 hrs.

MODULE IV – 9 hrs.

Direct stiffness method: Introduction to direct stiffness method-Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates-assembly of load vector and stiffness matrix, solution of two span continuous beam-single bay single storey portal frame. – 9 hrs.

MODULE V

Structural dynamics:

Introduction - degrees of freedom - equation of motion, D'Alembert's principle-damping-free response of damped and undamped systems- logarithmic decrement-- single degree of freedom systems subjected to harmonic load - transient and steady state responses, simple portal frame problems. – 9 hrs.

Text Books:

1. James M Gere & William Weaver, Matrix Analysis of Framed Structures - (CBS Publishers)
2. Mechanics of Structures Vol I & II, Junnarkar S.B., Charotar Publishing House
3. Devdas Menon, Structural Analysis, Narosa Publications
4. Wang C.K., Intermediate Structural Analysis, McGraw Hill
5. Mario Paz, Structural Dynamics

References:

1. Pandit and Gupta, Structural Analysis – A Matrix Approach
2. Reddy C. S., Basic Structural Analysis, Tata McGraw Hill
3. Norris and Wilbur, Elementary Structural Analysis, Tata McGraw Hill
4. Punmia B. C., Strength of Materials and Mechanics of Structures, Laxmi Publications
5. RC Hibbeler, Structural Analysis
6. Wang C K, Matrix Method of Structural Analysis
7. Anil. K. Chopra, Dynamics of structures, Pearson Education/ Prentice Hall India,
8. Clough R.W. and Penzein, J., Dynamics of structures - Tata McGraw Hill
9. Madhujith Mukhopadhyay and Abdul Hamid Sheikh, Matrix and Finite Element Analysis of Structures, Ane Books India.
10. Rajasekharan&Sankara Subramanian, Computational Structural Mechanics
11. William T Thomson, Theory of vibration with application
12. Tse, Morse Hinkle, Mechanical Vibrations

Lecture Plan –Structural Analysis II

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module I: Total lecture hours: 9**		
1.1	Plastic Theory: Introduction – concept of plastic hinge	CO1	1
1.2	Plastic modulus – shape factor	CO1	1
1.3	Redistribution of moments – collapse mechanisms – plastic analysis of beams and portal frames by equilibrium and mechanism methods(single storey and single bay frames only)	CO1	4
1.4	Introduction to approximate methods of analysis of multistoried frames, analysis for vertical loads-substitute frames	CO2, CO3	1
1.5	Loading condition for maximum hogging and sagging moments in beams and maximum bending moment in columns – numerical problems	CO3	2
2	**Module II: Total lecture hours: 9**		
2.1	Approximate methods (continued): Wind load analysis of multistoried frames – portal method and cantilever method for lateral load analysis.	CO3	2
2.2	Introduction to matrix analysis of structures: Definition of flexibility and stiffness influence coefficients - Concepts of physical approach	CO2, CO4	1
2.3	Flexibility method: flexibility matrices for truss and frame elements	CO4	1
2.3	Load transformation matrix-development of total flexibility matrix of the structure	CO4	1
2.4	Analysis of simple structures-plane truss and plane frame-nodal loads and element loads	CO4	3
2.5	Lack of fit and temperature effects		1
3	**Module III: Total lecture hours: 9**		
3.1	Stiffness method: Development of stiffness matrices by physical approach	CO5	1
3.2	Stiffness matrices for truss and frame elements-displacement transformation matrix	CO5	2

3.3	Analysis of simple structures-plane truss and plane frame-nodal loads and element loads	CO5	5
3.4	Lack of fit and temperature effects	CO5	1
4	**Module IV: Total lecture hours: 9**		
4.1	Direct stiffness method: Introduction to direct stiffness method-global co-ordinates andlocal co-ordinates.	CO2, CO5	1
4.2	Rotation of axes in two dimensions, stiffness matrix of elements in global co- ordinates from element co-ordinates- assembly of load vector and stiffness matrix	CO5	2
4.3	Solution of numerical problems on two span continuous beam – single bay single storey portal frame	CO5	6
5	**Module V: Total lecture hours: 9**		
5.1	Structural dynamics: Introduction - degrees of freedom - equation of motion, D'Alembert's principle - Damping	CO6	2
5.2	Free response of damped and undamped systems	CO6	2
5.3	Logarithmic decrement	CO6	1
5.4	Single degree of freedom systemssubjected to harmonic load - transient and steady state responses	CO6	2
5.5	Simple portal frame problems	CO6	2

MODEL QUESTION PAPER

Reg.No.:_____		Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET302

Course Name: STRUCTURAL ANALYSIS II

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions; each question carries 3 marks.

1.	a)	Derive an expression for the shape factor of a rectangular cross section.
	b)	What are the advantages and disadvantages of approximate methods of structural analysis?
	c)	Derive flexibility matrix for the co-ordinates shown for the beam in figure. 
	d)	What are the assumptions in cantilever method?
	e)	Derive stiffness matrix for the degrees of freedom shown for the beam in figure. 
	f)	Prove that flexibility matrix is the inverse of stiffness matrix for a given set of actions and corresponding displacements.
	g)	Explain local co-ordinates and global co-ordinates.
	h)	Write down the steps involved in direct stiffness method.
	i)	Explain the components of the basic dynamic system.
	j)	Explain transient and steady-state responses.

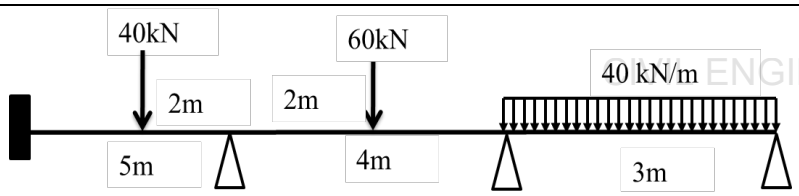
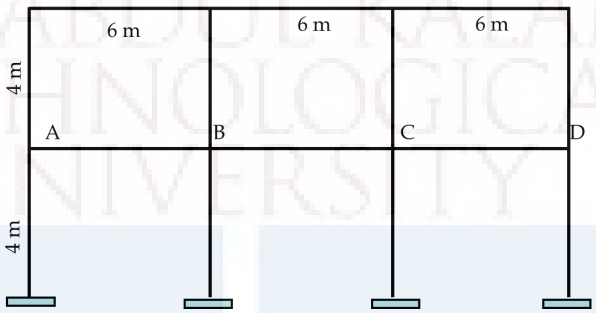
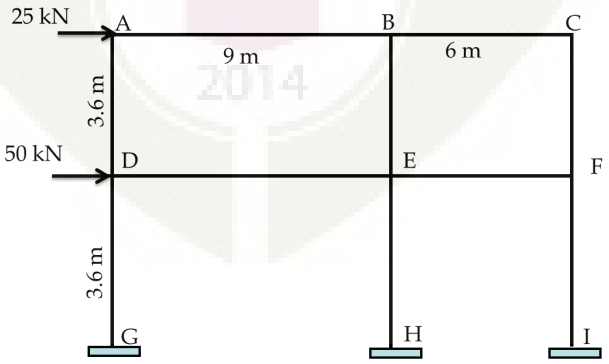
(10×3 marks = 30 marks)

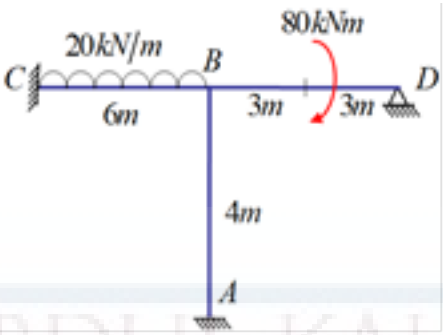
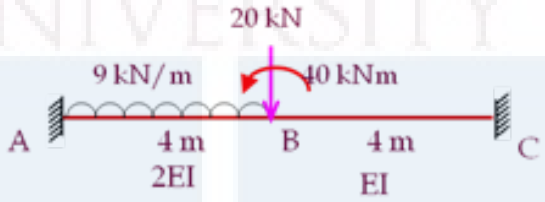
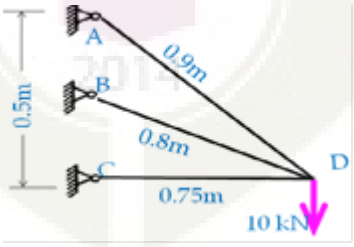
PART B

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

Module I

2.		Find the plastic moment capacity of the beam shown in figure. Assume uniform section throughout .

	 (14 marks)
3.	Total dead load is 12 kN/m and total live load is 20 kN/m on ABCD. Analyse the frame for midspan positive moment on BC, using substitute frame method.  (14 marks)
	Module II
4.	Analyse the beam in figure using flexibility method.  (14 marks)
5	Analyse the frame in figure using portal method. 
	Module III

6.	Determine all the member end moments for the frame shown in figure, using stiffness method.  	(14 marks)
7.	Determine the displacements at B for the beam shown in figure, using stiffness method.  	(14 marks)
	Module IV	
8.	Find all the joint displacements for the beam in Figure 5, using direct stiffness method.  	(14 marks)
9.	Find the joint displacements for the pin-jointed truss shown in figure, using direct stiffness method.  	(14 marks)
	Module V	

10.	Derive an expression for the free-vibration response of a damped SDOF system (Underdamped case only). (14 marks)
11.	A vibrating system consists of a weight of W = 100kN and a spring with stiffness k = 20 N/m is viscously damped so that the ratio of two consecutive amplitudes is 1/0.85. Detemine: a) the natural frequency of the undamped system, b) the damping ratio, c) the damping coefficient and d) the damped natural frequency (14 marks)
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CET 304	ENVIRONMENTAL ENGINEERING	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	4	0	0	4	2019

Preamble This course introduces students to various treatment technologies for drinking water and domestic waste water. Students will learn the role of an environmental engineer in ensuring public health. They will understand how engineering approach can enhance the environmental quality by scaling up the physical and biological purification processes that exist in nature.

Prerequisite: CET 203 Fluid Mechanics and Hydraulics, CET 307 Hydrology &Water Resources Engineering

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	To appreciate the role of environmental engineering in improving the quality of environment	Understanding
CO2	To plan for collection and conveyance of water and waste water	Applying
CO3	To enhance natural water purification processes in an engineered environment	Analysing
CO4	To decide on appropriate technology for water and waste water treatment	Evaluating

Mapping of course outcomes with program outcomes (Minimum requirement)

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

Assessment Pattern

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

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

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

Course Level Assessment Questions

CO1:To be able to appreciate the role of environmental engineering in improving the quality of environment

1.Explain from a health perspective the need for treating drinking water and safe disposal of waste water

2.How to dispose the sludge from waste water treatment plant safely?

3.How to remove colloidal range particles from water to satisfy drinking water norms?

CO 2: To be able to plan for collection and conveyance of water and waste water

1.How design period is decided for water supply schemes?

2.Discuss various types of pumps used in a water supply scheme

3.Compare separate and combined sewerage systems

CO3: To be able to enhance natural water purification processes in an engineered environment

1.Discuss different types of aerators with their advantage and limitations

2.Design a continuous flow rectangular sedimentation tank for a population of 20,000 persons with an average per capita demand of 120 litres per day. Assume a detention period of 6 hours.

3.Design an activated sludge plantto treat 6.0 Mld of sewage with BOD of 210 mg/l. The final effluent should be 30 mg/l

CO4: To be able to decide on appropriate technology for water and waste water treatment

1. Compare aerobic and anaerobic biological processes for treating waste water

2.Explain in detail the different disinfection techniques available for water and waste water treatment?

3.Discuss the treatment method available for high strength waste water

SYLLABUS

Module 1

Introduction to environmental engineering and role of environmental engineers-enhancing natural purification processes in an engineered environment-public health perspective for treating water and waste water - 1hr

Water quantity estimation:
Population forecast- water demand estimation-types of demand- demand fluctuation -3 hrs

Estimation for waste water quantity:
Dry weather flow and storm water flow-population equivalent-design period - 2 hrs
Collection and conveyance:
water intake structures- -gravity flow and pressure flow systems- 1 hr

Systems of sewerage: separate and combined-types of pumps for water and waste water conveyance - 2 hrs

Module 2

Layout plan of a conventional water treatment plant- site selection-concept of unit operations and unit processes-Screening-types of screens -aeration -aerator types- 3 hrs

Theory and principles of sedimentation-Stoke's law-Types of settling -Design of plain sedimentation tanks - 4 hrs

Mechanisms of coagulation and flocculation, popular coagulants and feeding devices -2 hrs

Module 3

Filtration of water-theory of filtration-types of filters - design of arapid sand filter - 3hrs

Disinfection of water - various methods - advantages and limitations -2 hrs

Lay out of water distribution network-types-methods of distribution-network analysis -Hardy cross and equivalent pipe methods-4 hrs

Module 4

Layout plan of a conventional waste water treatment plant- site selection- concept of primary, secondary and tertiary treatment- 1hr

Unit operations in waste water- primary treatment -equalization of flow- 2hrs

Secondary treatment methods-basic concepts of biological unit processes-aerobic and anaerobic- attached and suspended growth processes (Concepts only)- 2 hr

Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant - 3hrs

Trickling filter (Concept only)- types- construction & operation - 1 hr

Module 5

Anaerobic treatment of high strength waste water- Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only)- 2 hrs

Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Root-zone systems (Concepts only)- 3 hrs

Low cost sanitation systems- Design of a septic tank and soak-pit - 2 hr

Sludge treatment (concepts only) -thickening- digestion- dewatering- drying- composting- 2hrs

Text Books:

1. Howard S Peavy, Donald R Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Education , 2013
2. Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, Mc Graw Hill Education, 2014
3. S.K.Garg, Water Supply Engineering, Khanna Publishers. 2010
4. G S Birdie, Water Supply and Engineering, Dhanapat Rai Publishing Company, 2014
5. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGrawhill Education, 2007
6. S.K. Garg, Sewage disposal and air pollution engineering, Khanna Publishers. 2008

References:

1. Metcalf and Eddy, Waste Water Engineering, Tata McGraw Hill publishing Co Ltd, 2003
2. Syed R Qasim, Edward M Motley, Guang Zhu, Water Works Engineering-Planning, Design & Operation, PHI Learning, 2012.
3. Syed R Qasim, Wastewater Treatment Plants-Planning, Design & Operation, CRC Press,1999

Lecture Plan- Environmental Engineering

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module 1: Total Lecture Hours -9**		
1.1	Introduction to environmental engineering and role of environmental engineers-enhancing natural purification processes in an engineered environment-public health perspective for treating water and waste water	CO1	1
1.2	Water and waste water quantity estimation: Population forecast- water demand estimation-types of demand- demand fluctuation	CO2	3
1.3	Estimation for waste water quantity- dry weather flow and storm water flow-population equivalent-design period	CO2	2
1.4	Collection and conveyance: water intake structures- -gravity flow and pressure flow systems-	CO2	1
1.5	Systems of sewerage: separate and combined-types of pumps for water and waste water conveyance	CO2	2
2	**Module II: Total Lecture Hours- 9**		
2.1	Layout plan of a conventional water treatment plant- site selection-concept of unit operations and unit processes-Screening-types of screens-aeration-aerator types	CO1,CO4	3
2.2	Theory and principles of sedimentation-Stoke's law-Types of settling -Design of plain sedimentation tanks	CO3	4
2.3	Mechanisms of coagulation and flocculation, popular coagulants and feeding devices	CO3	2
3	**Module III: Total Lecture Hours-9**		
3.1	Filtration of water-theory of filtration-types of filters - design of rapid sand filter	CO3,CO4	3
3.2	Disinfection of water - various methods - advantages and limitations	CO4	2
3.3	Lay out of water distribution network-methods of distribution-network analysis -Hardy cross and equivalent pipe methods	CO4	4
4	**Module IV: Total Lecture Hours- 9**		

4.1	Layout plan of a conventional waste water treatment plant- site selection- concept of primary, secondary and tertiary treatment	CO1	1
4.2	Unit operations in waste water- primary treatment - equalization of flow	CO3	2
4.3	Secondary treatment methods- basic concepts of biological unit processes-aerobic and anaerobic- attached and suspended growth processes (Concepts only)	CO4	2
4.4	Activated sludge process- basic concepts-design of a conventional Activated Sludge Plant	CO3	3
4.5	Trickling filter (Concept only)- types- construction & operation	CO3	1
5	**Module V: Total Lecture Hours- 9**		
5.1	Anaerobic treatment of high strength waste water- Up flow Anaerobic Sludge Blanket (UASB) reactor (Concept only)	CO3	2
5.2	Natural waste water treatment systems-Oxidation Ponds and Lagoons-Wetlands and Root-zone systems (Concepts only)	CO3, CO4	3
5.3	Low cost sanitation systems- Design of a septic tank and soak-pit	CO3	2
5.4	Sludge treatment (concepts only) - thickening- digestion- dewatering- drying- composting	CO4	2

Model Question Paper

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

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET304
Course Name: ENVIRONMENTAL ENGINEERING

Max. Marks: 100 Duration: 3 Hours

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

1. Explain dry weather flow
2. What is an intake?
3. Why screens are used in water and waste water treatment plants?
4. What is hindered settling?
5. Compare slow sand filter and rapid sand filter
6. Explain the principle of disinfection
7. Discuss the unit operations and unit processes in a waste water treatment plant
8. Compare aerobic and anaerobic processes
9. How wetlands treat waste water?
10. Explain the working of a septic tank with a neat sketch

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

11. (a) Explain in brief different methods used for prediction of future population of a city (9 Marks)

    (b) What is fire demand? How will you calculate fire demand (5 Marks)

OR

12. (a) Explain the term "Design Period" (5 Marks)

    (b) Forecast the population of the town in the year 2040 from the following data using arithmetic increase method and geometric increase method

Year	1990	2000	2010	2020
Population	13400	19500	28500	36300

(9 Marks)

13. (a) Explain with sketches the types of aerators with advantages and limitations (6 Marks)

(b) Explain different types of settling (8Marks)

OR

14. (a) Explain the mechanisms of coagulation (5 Marks)

(b) Design a plain sedimentation tank for treating 6 MLD of water. Make suitable assumption. Prepare a neat sketch (9 Marks)

15. (a) Explain the theory of filtration (5 Marks)

(b) Explain and compare various disinfection methods (9Marks)

OR

16. Design a rapid sand filter to treat 10 million litres of raw water per day allowing 0.5% of filtered water for backwashing. Half hour per day is used for backwashing. Assume necessary data. (14 Marks)

17. (a) Discuss the role of an equalization tank at a waste water treatment plant (4Marks)

(b) Discuss in detail various biological processes available for treating waste water . (10 marks)

OR

18. (a)Explain primary, secondary and tertiary treatment phases (5 Marks)

(b) Design an activated sludge plant treat 6.0 Mld of domestic sewage having a BOD of 210 mg/l. The final effluent should have a BOD of 30 mg/l. (9 Marks)

19. (a) Discusssludge treatment processes for safe disposal (9 Marks)

(b) Explain the working of a UASB with neat sketch (5 Marks)

OR

20. Discuss natural waste water treatment systems with neat sketches (14 Marks)

CET306	DESIGN OF HYDRAULIC STRUCTURES	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 hydraulic design of different hydraulic structures and to develop the drawings of minor irrigation structures. This course equip the students to perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls and regulators and prepare drawings of the same. To impart the knowledge on causes of failure and design criteria of hydraulic structures like dams and canal structures

Pre-requisite: Fluid Mechanics and Hydraulics, Hydrology & Water Resources Engineering

Course outcome

After the course, the student will able to:

CO1	Elucidate the causes of failure, principles of design of different components of hydraulic structures
CO2	Describe the features of canal structures and perform the design of alluvial canals
CO3	Perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls, cross regulator.
CO4	Prepare the scaled drawings of different minor irrigation structures
CO5	Describe the design principles and features of dams and perform the stability analysis of gravity dams

CO - PO Mapping

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

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
(For the first internal test, minimum two designs should be included)
Assignment/Quiz/Course project : 15 marks
Assignment should be scaled drawings (in A_2 size sheet)
Total : 50 marks

End semester examination pattern – There will be three parts; Part A, Part B and Part C. Part A contains 2 questions each from Modules I and II, out of which student can answer any one. Total marks for this part will be 30. Each question can have maximum 2 sub-divisions and carry 15 marks. Part B will be for 50 marks with 25 mark for design and 25 mark for drawing based on Module III. In the drawing part, two views shall be asked. Part C will be for 20 Marks. Two full questions each from Modules IV and V carrying 10 mark should be asked and the student can answer any one from each module. The examination will be for 3 hours.

Course Code: CET306
Design of Hydraulic Structures
Course Level Assessment Questions

CO1	**Elucidate the causes of failure, principles of design of different components of hydraulic structures**
1	State Khosla's interim conclusions
2	Explain the causes of failure of weirs on permeable soils and state the remedial measures
3	Explain the corrections to be applied on % uplift pressure estimated by the method of independent variables
4.	Obtain the expression for floor thickness as per Bligh's theory

CO2	**Describe the features of canal structures and perform the design of alluvial canals**
1	State the functions of under-sluices and divide walls
2	Explain the classification of cross drainage structures
3	Describe the features of a Siphon well drop with a sketch
4.	Explain Kennedy's theory for the design of Alluvial channels
5.	Explain (i) level crossing (ii) canal siphon with sketches
6.	Design an irrigation canal through alluvial soils for the following data : Discharge =20 m^3/sec; Lacey's silt factor =1

CO3	**Perform the hydraulic design of minor irrigation structures such as cross drainage works, canal falls, cross regulator.**
CO4	**Prepare the scaled drawings of different minor irrigation structures**
1 (a) (b)	**Design a 1.5 m Sarda Type Fall for a canal carrying a discharge of 40 cumecs with the following data** Bed Level Upstream-105.0m Bed Level Downstream-103.5m Side Slopes of canal-1:1 Full Supply Level Upstream-106.8 m Bank level upstream-107.4 m Bed width-U/s and D/s-30 m Safe Exit Gradient for Khosla's theory-1/5 Draw to a suitable scale, the following views of the structure: (a) Half sectional plan at foundation level and at top level (b) Longitudinal sectional elevation

2. (a)	Design a 1.8 m trapezoidal notch fall for the following data: Details above drop: Full supply discharge= 5.5 cumec Bed width= 5 m Bed level= 19.8 Full supply depth=1.6 m Level at the top of the bank=22.4 The bank top width is 1.8 m Details below drop: Full supply discharge= 5.5 cumec Bed width= 5 m Full supply level=19.6 Level at the top of the bank=20.6 The bank top width is 1.8 m
(b)	Prepare the following drawings to a suitable scale (a) Half sectional plan at foundation level (b) Section along the centre line of the canal

CO5	**Describe the design principles and features of dams and perform the stability analysis of gravity dams**
1	Explain the features of different types of spillways
2	State the functions of Galleries and Keys in gravity dam
3	Obtain the expression for base width of elementary profile of gravity dams for no tension criteria
4	Differentiate low dams and high dams
4.	Explain the causes of failure of earth dams
5.	Enlist the design criteria of earth dams
6.	State the limitations of thin cylinder theory

Course Code: CET 306
Design of Hydraulic Structures
Syllabus

Module I

Diversion headwork-components and functions; Weirs – types and causes of failure- Impervious floor of hydraulic structures –Bligh's theory, Design of vertical drop weir; Design of impervious floor of hydraulic structures by Khosla's theory

Module II

Canals-types, Cross section of unlined canals and alignment; Design of canals through alluvial soils- Kennedy's theory and Lacey's silt theory. Canal structures- cross drainage structures-types; Canal falls-Necessity, types

Module III

Hydraulic design and drawing of canal structures
(i) Aqueduct; (ii) Siphon Aqueduct; (iii) Canal drop (Trapezoidal Notch Fall); (iv) Sarda type fall (trapezoidal crest- impervious floor design using Khosla's theory); (iv) Cross regulator (impervious floor design using Khosla's theory)

Module IV

Dams-types; Gravity Dams-computation of forces-modes of failure and stability criteria, stability analysis. Elementary and practical profile, limiting height of gravity dams, Galleries, joints, keys, water stops, instrumentation, grouting (brief description only)

Module V

Earth dams-types, causes of failure and design criteria, Arch dams- thin cylinder theory; Spillways-types-Ogee spillway profile; Energy dissipation- stilling basins-Indian standard Type I and Type II (description only)

Text Books:

- Sathyanarayana M. C. Water Resources Engineering-Principles and Practice, New Age International Publishers. 2009
- Garg S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi 2006.
- KR Arora. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors, New Delhi. 2010.

References:

- Punmia B.C.Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering. Laxmi Publications (P) Ltd 2009.
- Modi P.N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors, New Delhi 2009.
- Varshney, R.S. Theory & Design of Irrigation Structures -Vol III, Nem Chand & Bros., Roorkee

Course Code: CET 306
Design of Hydraulic Structures
Course Plan

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Introduction to different types of Irrigation structures	CO2	1
1.2	Layout of diversion headwork- components and functions	CO2	1
1.3	Causes of failure of weirs on permeable soils and remedies	CO1	1
1.4	Bligh's theory, problem	CO1	1
1.5	Design of vertical drop weir	CO1	1
1.6	Khosla's theory-Interim conclusions and Khosla's first problem	CO1	1
1.7, 1.8	Khosla's method of independent variables- use of charts and corrections	CO1	2
Module II (8 Hours)			
2.1	Types of canals, alignment of canals	CO2	1
2.2	Typical cross sections of unlined canals	CO2	1
2.3	Design of channels through alluvial soils- Kennedy's theory	CO2	1
2.4, 2.5	Lacey's silt theory- problems	CO2	2
2.6	Classification of cross drainage structures	CO2	1
2.7, 2.8	Canal falls – necessity and types	CO1	2
Module III (15 Hours)			
3.1-3.3	Hydraulic design of Aqueduct and demonstration of drawing	CO3, CO4	3
3.4-3.6	Hydraulic design of Siphon Aqueduct and demonstration of drawing	CO3, CO4	3
3.7-3.9	Hydraulic design of Canal drop (Trapezoidal Notch Fall) and demonstration of drawing	CO3, CO4	3
3.10-	Hydraulic design of Sarda Fall with trapezoidal crest and	CO3, CO4	3

3.12	demonstration of drawing		
3.13-3.15	Hydraulic design of Cross regulator and demonstration of drawing	CO3, CO4	3
Module IV (7 Hours)			
4.1	Dams-Types, Computation of Forces acting on dams	CO5	1
4.2	Stability analysis- modes of failure and stability criteria of gravity dams	CO5, CO1	1
4.3	Stresses-No tension criteria, derivation of principal stress	CO5, CO1	1
4.4	Problems on stability analysis of gravity dams	CO5, CO1	1
4.5	Elementary and practical profile of gravity dams	CO5, CO1	1
4.6	Functions and types of galleries, keys and water stops etc in dams	CO5	1
4.7	Instrumentation and grouting of dams	CO5	1
Module V (7 Hours)			
5.1	Arch dams- types, thin cylinder theory	CO5, CO1	1
5.2	Most economical central angle of arch dam, Limitations of thin cylinder theory	CO5, CO1	1
5.3. 5.4	Earth dams, types, causes of failure and design criteria	CO5, CO1	2
5.5	Spillways- Types	CO5	1
5.6	Ogee spillway profile	CO5, CO1	1
5.7	Energy dissipation below spillways-stilling basins	CO5, CO1	1

Model Question Paper
Reg No.:…….. **QP**
CODE:……..

Name:……

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

Course Code: CET306

Design of Hydraulic Structures

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

- *Use of Khosla's chart and Blench Curves and Montague Curves are permitted in the Examination Hall*
- *Assume suitable design data wherever necessary*

PART A

(Answer one full question from each module, each question carries 15 marks)

Module I

1 (a) State the functions of undersluices and divide walls (6 Marks)
(b) Explain Khosla's corrections (9 Marks)

OR

2. (a) State and explain Bligh's theory (5 Marks)
(b) Explain the causes of failure of weirs on permeable soils and state the remedial measures (10 Marks)

Module II

3. (a) Explain the factors to be considered in the alignment of canals (5 Marks)
(b) Explain the classification of cross drainage structures (10 Marks)

OR

4. (a) Compare Kennedy's theory and Lacey's theory. (6 Marks)
(b) Design an irrigation canal through alluvial soils for the following data:
Discharge =20 m^3/sec; Lacey's silt factor = 1 (9 Marks)

PART B

(Answer any ONE full question)

Module III

5. **a**) Design a suitable cross drainage work for the following hydraulic particulars:

(25 Marks)

Canal

Full supply discharge = 50 m^3/sec
Full supply level=202.00
Full supply depth= 1.2 m
Bed width=36
Cross section is trapezoidal with side slope 1.5H:1V

Drain

High flood discharge = 450 cumecs
Bed level=199.3
High flood depth=2 m

b) Develop the drawings of:

(a) Half plan at top and half at foundation level (15 Marks)

(b) Section along the canal (10 Marks)

OR

6. **a**) Design a 2 m trapezoidal notch fall for the following data: (25 Marks)

Details above drop:

Full supply discharge= 5.5 cumec
Bed width= 6 m Bed level= 12.00
Full supply depth=1.5 m
Level at the top of the bank=14.5
Bank top width is 3 m

Details below drop:

Full supply discharge= 5.5 cumec
Bed width= 6 m
Full supply level=11.5
Level at the top of the bank=12.5
Bank top width is 3 m

b) Develop the drawings of:

(a) Half sectional plan at foundation level (15 Marks)

(b) Section along the centre line of the canal (10 Marks)

PART C

(Answer one full question from each module, each question carries 10 marks)

Module IV

7 (a) Obtain an expression for principal stress at the toe of a gravity dam (5 Marks)

(b) Explain elementary profile of gravity dam. How you will develop the practical profile from it? (5 Marks)

OR

8 (a) Differentiate consolidation grouting and curtain grouting (4 Marks)

(b) Determine the uplift force at the base of gravity dam of base width 25 m, height of water in the u/s face = 30 m, free board 3m, top width 6 m and height of water in the d/s face = 5 m. The drainage gallery is at a distance of 5 m from the u/s end. (6 Marks)

Module V

9 (a) State the limitations of thin cylinder theory (4 Marks)

(b) Explain the classification of earth dams with sketches (6 Marks)

OR

10 (a) Explain the design features of Ogee spillways (4 Marks)

(b) Explain the hydraulic and structural causes of failure of earth dams (6 Marks)

CET312	ADVANCED COMPUTATIONAL METHODS	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of different numerical computational procedures. The course aim to equip the students to find solutions for many real-world engineering problems by applying appropriate numerical methods

Pre-requisite: Engineering Mathematics

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

Course Outcome	Description	Prescribed learning level
CO1	Describe the procedures or principles of numerical computational approaches	Remembering/understanding
CO2	Obtain the solution of simultaneous equations or eigen value problems	Applying
CO3	Apply appropriate data smoothing technique for a given set of data	Applying
CO4	Obtain the numerical solutions of ordinary differential equations	Applying
CO5	Obtain the numerical solutions for solving boundary value problems of ordinary and partial differential equations	Applying
CO6	Describe the concepts or apply discretization based solution methods	Remembering/applying

CET312 Advanced Computational Methods		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	1	1										
	CO2	3	3										
	CO3	3	3										
	CO4	3	2										
	CO5	3	3										
	CO6	3	3										

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/Course project	:	15 marks
Total	**:**	**50 marks**

Note: Enough exposure to practical examples from civil engineering should be given to the students. One assignment/course project should be based on the coding of practical civil engineering problems

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

Course Level Assessment (Sample) Questions

CO1: Describe the procedures or principles of numerical computational approaches

1. Enlist the different errors in numerical computation
2. Explain the procedure of Newton-Raphson method for solving system of non linear equations
3. Explain the procedure of multiple linear regression
4. Compare Lagrange and Hermite interpolation
5. Explain the stability of numerical solutions of ordinary differential equations
6. Explain the procedure of modified Euler's method for solving ordinary differential equations
7. Describe the classification of partial differential equations
8. Explain Crank- Nicolson implicit scheme

9. Explain collocation method
10. Describe the principle of meshless method

CO2: Obtain the solution of simultaneous equations or eigen value problems

1. Find all the eigen values and eigen vectors of the following matrix by Jacobi's transformation

$$A = \begin{bmatrix} 10 & 3 & 2 \\ 3 & 5 & 1 \\ 2 & 1 & 0 \end{bmatrix}$$

2. Apply Gauss Seidal iteration method to solve the equations

20x+y-2z=17; 3x+20y-z= -18; 2x-3y+20z=25

CO3: Apply appropriate data smoothing technique for a given set of data

1. Fit the quadratic splines with M(0)=0 f''(0)=0 for the following data. Hence fiand f(2.5)

x	0	1	2	3
y	1	2	33	244

2. Evaluate $\int_0^1 \frac{1}{1+x^2} dx$ using (i) Simpson's 3/8 rule taking h=1/6 (ii) Weddle's rule taking h=1/6

CO4: Obtain the numerical solutions of ordinary differential equations

1 Apply Milne's method to find the solution of $y' = x - y^2$ in the range $0 \le x \le 1$ for the boundary condition

2. Using fourth order Runge-Kutta method, find y for z=0.1, 0.2 and 0.3 , given $y' = xy + y^2$ y(0)=1

CO5: Obtain the numerical solutions for solving boundary value problems of ordinary and partial differential equations

1. Solve $\nabla^2 u = 10(x^2 + y^2 + 10)$ over the square with side x=0=y; x=3=y with u=0 on the boundary and mesh length =1

2. Solve $\frac{d^4y}{dy^4} + 81y = \phi(x)$ with

x	1/3	2/3	1
y	81	162	243

$y(0)=y'(0)=y''(1)=y'''(1)=0$

CO6: Describe the concepts or apply discretization based solution methods

1 Explain the procedure of weighted residual approaches for solving boundary value problems
2. Explain the different steps in Finite element analysis
3. Explain the characteristics of different types of elements in FEM
4. Solve $y''+y+x=0$ in the range $0 \le x \le 1$ by Galerkin's method. Given $y(0)=y(1)=0$

Course Code: CET312
Advanced Computational Methods
Syllabus

Module I

Introduction to numerical methods-Errors in numerical computation – System of linear algebraic equations –Ill-conditioned systems – Symmetric and Banded systems. Elimination methods – Gauss Elimination (review), Gauss Seidel iteration, Factorization method-Choleski's method. System of non linear equations – Newton-Raphson method. Eigen value problems - largest and smallest eigen values- Power method, Jacobi's transformation

Module II

Lagrangian and Hermite interpolation, Spline interpolation-Quadratic and Cubic splines (example of equal intervals), Data smoothing by least squares criterion- Non- polynomial models like exponential model and power equation, Multiple linear regression. Numerical integration-Newton – Cotes open quadrature formule-Trapezoidal rule, Simpson's rules, Weddles rule

Module III

Solution of first-order ordinary differential equations-stability of solution, Use of Taylor series, Euler's method, Modified Euler's method, Predictor-corrector method – Milne's method, Fourth order Runge-Kutta method; Higher order equations of initial value type by Runge-Kutta method.

Module IV

Ordinary differential equations of the boundary value type – Finite difference solution.

Partial differential equations in two-dimension-types, Elliptic equations-Laplace Equation and Poisson's equation, Parabolic equations – Explicit finite difference method –Bender-Schmidt method. Crank-Nicholson implicit method, Finite difference method – Problems with irregular boundaries

Module V

Weighted residual methods for initial value problems and boundary value problems – Collocation method, Subdomain method, Method of least squares, Galerkin's method.

Introduction to FEM- outline of the procedure – Types of 1D, 2D and 3D elements- element properties- polynomial form- shape function form- equilibrium and compatibility in the solution- convergence requirements, boundary conditions. Conceptual ideas of finite volume, boundary element and meshless methods.

Text Books

1. Grewal B. S., *Numerical Methods for Engineers & Scientists, Khanna Publishers*.
2. Rajasekharan S., *Numerical Methods in Science and Engineering,* S Chand & Company, 2003.

References:

1. Gerald and Wheatly*, Applied Numerical Analysis,* Pearson Education.
2. Chapra S. C. and R. P. Canale, *Numerical Methods for Engineers,* McGraw Hill, 2006.
3. Smith G. D. *Numerical solutions for Differential Equations,* McGraw Hill.
4. Ketter and Prawel*, Modern Methods for Engineering Computations,* McGraw Hill.
5. Rajasekharan S., *Numerical Methods for Initial and Boundary value problems,* Khanna Publishers, 1989.
6. Terrence. J. Akai, *Applied Numerical Methods for Engineers,* Wiley Publishers, 1994.
7. Krishnamoorthy C S, *Finite Element Analysis- Theory and Programming*, Tata McGraw Hill, New Delhi., 1994
8. Bathe K J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall, New Delhi. 1982
9. Chandrupatla T R and Belegundu A D, *Introduction to Finite Elements in Engineering*, Pearson Education, New Delhi 1998
10. Rajasekharan S, *Finite Element Analysis in Engineering Design*, Wheeler, New Delhi
11. Hutton D V, *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Education Private Ltd, New Delhi

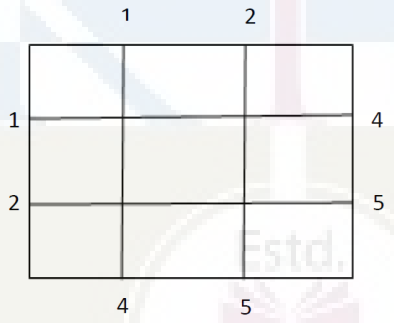
Course Plan: Advanced Computational Methods

Module	Topic	Course outcome addressed	No of Hours
Module I (7 Hours)			
1.1	Introduction to numerical methods-Necessity, Errors in numerical computation	CO1	1
1.2	System of linear algebraic equations, Ill-conditioned systems, Symmetric and Banded systems	CO1	1
1.3	Direct and indirect methods of solution of linear equations- Gauss elimination method(review), Gauss Siedal iteration	CO1, CO2	1
1.4	Factorization method-Choleski's method	CO1, CO2	1
1.5	System of non linear equations – Newton-Raphson Method	CO1, CO2	1
1.6	Eigen value problems, Power method-largest & smallest Eigen values	CO1, CO2	1
1.7	Jacobi's transformation	CO1, CO2	1
Module II (7 Hours)			
2.1	Lagrangian and Hermite interpolation	CO1, CO3	1
2.2	Spline interpolation - Quadratic and Cubic splines	CO1, CO3	1
2.3	Problems on interpolation	CO3	1
2.4	Data smoothing by least squares criterion- Non- polynomial models like exponential model, power equation	CO1, CO3	1
2.5	Multiple linear regression	CO1, CO3	1
2.6	Numerical integration- Newton – Cotes open quadrature	CO1, CO3	1
2.7	Problems on numerical integration	CO3	1
Module III (7 Hours)			
3.1	Solution of first-order ordinary differential equations ; stability of solutions	CO1	1
3.2	Solution of first-order ordinary differential equations by use of Taylor series.	CO1, CO4	1
3.3	Euler's method	CO1, CO4	1
3.4	Modified Euler's method	CO1, CO4	1
3.5	Predictor-corrector methods – Milne's method	CO1, CO4	1

3.6	Fourth order Runge-Kutta method-Problems	CO1, CO4	1
3.7	Higher order equations of initial value type by Runge-Kutta method	CO1, CO4	1
Module IV (7 Hours)			
4.1	Ordinary differential equations of the boundary value type – Finite difference solution.	CO1, CO5	1
4.2	Partial differential equations in two-dimension- types. Laplace Equation	CO1, CO5	1
4.3	Poisson's Equation and its solution	CO1, CO5	1
4.4	Parabolic equations – Explicit finite difference method- Schmidt method	CO1, CO5	1
4.5	Crank-Nicholson implicit method	CO1	1
4.6	Finite difference method – Problems with irregular boundaries	CO1, CO5	1
4.7	Problems	CO5	1
Module V (7 Hours)			
5.1	Weighted residual methods for initial value problems and boundary value problems – Collocation method – Subdomain method	CO1, CO6	1
5.2	Method of least squares – Galerkin's method	CO1, CO6	1
5.3	Introduction to FEM- outline of the procedure	CO1, CO6	1
5.4	Types of 1-D, 2-D and 3-D finite elements	CO1, CO6	1
5.5	Element properties- polynomial form- shape function form	CO1, CO6	1
5.6	Equilibrium and compatibility in the solution- convergence requirements; Boundary conditions	CO1, CO6	1
5.7	General awareness on finite volume, boundary element and mesh less methods and their difference with FEM	CO1, CO6	1

Course Code: CET312
Advanced Computational Methods
(Model question paper)

Qn No	Question	Marks	Course outcome (CO) Assessed
	Part A **(Answer ALL Questions)**		
1	Enlist the different errors in numerical computation	3	CO1
2	Explain symmetric and banded systems	3	CO1
3	Explain Hermite interpolation	3	CO1
4	Describe mulitiple linear regression	3	CO1
5	Explain Taylor's method for solution of differential equations	3	CO1
6	Explain stability of solutions of differential equations	3	CO1
7	Explain Crank Nicholson implicit method	3	CO1
8	State the types of partial differential equations with examples	3	CO1
9	Describe the principle of meshless method	3	CO1
10	Explain convergence requirements in finite element analysis	3	CO1
	Part B **(Answer ANY ONE FULL question from each module)**		
	Module I		
11	Sole by Choleski's method $\begin{bmatrix} 2 & -3 & -1 & 2 \\ -1 & -1 & 2 & -2 \\ 1 & -1 & 1 & 1 \\ 3 & 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 15 \\ -13 \\ 4 \\ 3 \end{bmatrix}$	14	CO2
12	Find the largest eigen value by power method $A=\begin{bmatrix} 2 & 12 & 2 \\ 2 & 4 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	14	CO2
	Module II		
13	Obtain the cubic spline approximation of the given data and	14	CO3

	determine $y(0.5)$ and $y'(0.2)$ x 0 1 2 3 y -5 -4 3 6		
14	Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ using (i) Simpson's 3/8 rule and Weddle's rule	14	CO3
	Module III		
15	Find $y(0.1)$, $y(0.2)$ given $\frac{dy}{dx} = x - 2y =$ x - 2y, $y(0)=1$ taking $h=0.1$ using 4^{th} order Runge-Kutta method.	14	CO4
16	Solve $y' = 1 + y^2$ y(0)=0Find y(0.8) and y(1) by Milne's predictor corrector method	14	CO4
	Module IV		
17	Solve the boundary value problem $xy''+y=0$, $y(1)=1$,$y(2)=2$ take $h=1/4$	14	CO5
18	Solve the equation $uxx + uyy = 0$ for the square mesh with boundary value as shown in figure 	14	CO5
	Module V		
19	Solve $y''+y+x=0$ in the range $0 \le x \le 1$ by Galerkin's method. Given $y(0)=y(1)=0$	14	CO6
20 (a)	Explain in detail the steps of finite element analysis	8	CO1, CO6
20 (b)	Explain forms of shape functions in finite element analysis	6	CO1, CO6

CET322	GEOTECHNICAL INVESTIGATION	CATEGORY	L	T	P	CREDIT	Year of Induction
		PEC	3	0	0	3	2019

Preamble:

Geotechnical Investigation is a course in the stream of Soil mechanics and foundation engineering. The course is aimed to impart to the students, a clear idea about how a geotechnical investigation program is to be planned and executed. It enables the students an in-depth knowledge of the various methods of geotechnical investigation and the field tests to be conducted in different situations. After the successful completion of the course, the students will be able to plan and execute the soil investigation at a site depending on the need and availability.

Prerequisite: CE 208 Geotechnical Engineering -1

Course Outcomes

CO 1	The students will be able to understand the procedure, applicability, and limitations of various methods of geotechnical investigation	Remembering, Understanding
CO 2	The students will be able to make engineering judgments and take appropriate decisions related to geotechnical investigations	Applying & Analysing
CO 3	The students will be able to understand the procedure and applications of penetration tests and geophysical tests for exploration of the soil profile	Remembering, Understanding
CO 4	The students will be able to choose the right soil sampling technique and analyse the dependability of samples collected	Applying & Analysing
CO5	The students will be able to understand the procedure and applications of field load tests and rock quality indices.	Applying & Analysing

Mapping of the Course Outcomes with Programme Outcomes

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

Assessment Pattern

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

Mark Distribution

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

Continuous Internal Evaluation (CIE) Pattern

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

End Semester Evaluation (ESE) 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.
Note : 1.Each part should have at least one question from each module. 2.Each question can have a maximum of 4 subdivisions (a, b, c, d)

Course Level Assessment Questions

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

Course Outcome 1 (CO1): The students will be able to understand the procedure, applicability, and limitations of various methods of geotechnical investigation.

1. Explain the various methods adopted for preliminary investigation.
2. What are the I.S. guidelines for deciding the number, size, spacing, and depth of boreholes?
3. What are the limitations of standard penetration test?

Course Outcome 2 (CO2): The students will be able to make engineering judgments and take appropriate decisions related to geotechnical investigations

1. Determine the bearing capacity, from a given SPT data.
2. Explain the procedures for geotechnical investigation of a profile which shows, rejection in SPT test.
3. What are the situations in which wash boring can be used as an exploration technique?

Course Outcome 3 (CO3): The students will be able to understand the procedure and applications of penetration tests and geophysical tests for exploration of the soil profile

1. Explain the procedure of determination of thickness of a strata using electrical resistivity method.
2. What are the effects of water table in geophysical methods?
3. What are the limitations of seismic refraction method?

Course Outcome 4 (CO4): The students will be able to choose the right soil sampling technique and analyse the dependability of samples collected.

1. What are the type of soil samples in a soil investigation procedure?
2. What are the factors affecting the quality of a soil sample?
3. Explain the methods of collection of soil samples.

Course Outcome 5 (CO5): The students will be able to understand the procedure and applications of field load tests and rock quality indices.

1. What are the limitations of a plate load test?
2. What are the situations in which pressure meter test becomes Ideal?
3. Explain the concept of subgrade reaction.
4. Explain the methods of representing the quality of rocks is a soil investigation report.

Syllabus

Module	Content
I	Introduction and practical importance - Objectives of soil exploration– Planning of a sub-surface exploration program –Collection ofexisting information, reconnaissance, preliminary and detailedinvestigation - I.S. and other guidelines for deciding the number, size,spacing, and depth of boreholes Methods of exploration - Open pits – Auger boring- -Wash boring,percussion drilling, rotary drilling

II	Sounding methods Standard Penetration Test – Procedure –corrections to be applied to observed N values – Numerical examples -Factors influencing the SPT results and precautions to obtain reliableresults – Merits/drawbacks of the test – Correlations of N value withvarious engineering and index properties of soils Static Cone Penetration Test – Procedure – Merits/drawbacks –Correlation of static CPT results with soil properties -Dynamic ConePenetration Test – Brief Procedure – Merits/drawbacks –Critical comparison of SPT, static CPT, and dynamic CPT
III	Geophysical methods – Seismic refraction method – Procedure, uses,limitations – Solution of numerical problems to estimate the velocityof seismic waves and the thickness of the upper layer of a two-layeredsoil system - Electrical resistivity method – Electrical profiling andelectrical sounding – Procedure, uses, limitationsStabilization of boreholes, Groundwater level estimation
IV	Soil sampling – Undisturbed, disturbed, and representative samples –Chunk and tube samples – Factors affecting sample disturbance andmethods to minimize them –Area ratio - Inside clearance – Outsideclearance - Recovery ratio –Ball check valve – Numerical Problems -Handling andtransportation of samples – Extrusion of samplesTypes of samplers – Thin-walled sampler – Piston sampler – Splitspoon sampler – Methods for collection of sand samples frombeneath the water table - Core retainers
V	Pressure meter test - Procedure –Uses – limitations, Flat Dilatometer Test (Brief only)Plate load test – Procedure, uses, and limitations – modulus of subgrade reaction- Solution of numerical problems using plate load test data Rock core sampling, Rock Quality Designation, Core Recovery Ratio –Bore log – Soil profile – Sub-soil investigation report

Textbooks:

1. Gopal Ranjan and Rao A.S.R., “Basic and Applied Soil Mechanics”, New Age International (P) Limited, New Delhi, 2002.
2. Venkata Ramaiah, “Geotechnical Engineering”, Universities Press (India) Limited, Hyderabad, 2000.

References:

1. Arora K.R., “Geotechnical Engineering”, Standard Publishers Distributors, New Delhi, 2006.
2. Joseph E. Bowles, „Foundation Analysis and Design“, Mc. Graw Hill Inc., New York, 1988.
3. Purushothamaraj P., Soil Mechanics and Foundation Engineering, Dorling Kindersley(India) Pvt. Ltd., 2013
4. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.

Course content and Lecture schedule

Module	Contents	Outcomes Addressed	Hours
I	**Module 1**		7
1.1	Introduction and practical importance - Objectives of soil exploration –	CO1	1
1.2	Planning of a sub-surface exploration program – Collection of existing information,	CO1	1
1.3	reconnaissance, preliminary and detailed investigation	CO1	1
1.4	I.S. and other guidelines for deciding the number, size, spacing, and depth of boreholes	CO1	1
1.5	Methods of exploration - Open pits – Auger boring-	CO1	1
1.6	Wash boring, percussion drilling, rotary drilling	CO1	2
	Module 2		7
II			
2.1	Sounding methods Standard Penetration Test – Procedure	CO3	1
2.2	corrections to be applied to observed N values – Numerical examples	CO2	1
2.3	Factors influencing the SPT results and precautions to obtain reliable results – Merits/drawbacks of the test	CO2	1
2.4	Correlations of N value with various engineering and index properties of soils	CO2	1
2.5	Static Cone Penetration Test – Procedure Merits/drawbacks	CO3	1
2.6	Correlation of static CPT results with soil properties	CO2	1
2.7	-Dynamic Cone Penetration Test – Brief Procedure – Merits/drawbacks – Critical comparison of SPT, static CPT, and dynamic CPT	CO3	1
	Module 3		7
III			
3.1	Geophysical methods – Seismic refraction method – Procedure	CO3	1
3.2	uses, limitations	CO3	1
3.3	Solution of numerical problems to estimate the velocity of seismic waves and the thickness of the upper layer of a two-layered soil system	CO3	2
3.4	Electrical resistivity method – Electrical profiling and electrical sounding – Procedure	CO3	1
3.5	uses, limitations	CO3	1
3.6	Stabilization of boreholes, Groundwater level estimation	CO4	1

	Module 4		7
IV			
4.1	Soil sampling – Undisturbed, disturbed, and representative samples –	CO4	1
4.2	Chunk and tube samples – Factors affecting sample disturbance and methods to minimize them –	CO4	1
4.3	Area ratio - Inside clearance – Outside clearance - Recovery ratio –Ball check valve –	CO4	1
4.4	Numerical Problems	CO4	1
4.5	Handling and transportation of samples – Extrusion of samples	CO4	1
4.6	Types of samplers – Thin-walled sampler – Piston sampler – Split spoon sampler –	CO4	1
4.7	Methods for collection of sand samples from beneath the water table - Core retainers	CO4	1
	Module 5		7
V			
5.1	Pressure meter test - Procedure – Uses – limitations,	CO5	1
5.2	Flat Dilatometer Test (Brief only)	CO5	1
5.3	Plate load test – Procedure, uses, and limitations –	CO5	1
5.4	modulus of subgrade reaction- Solution of numerical problems using plate load test data	CO5	2
5.5	Rock core sampling, Rock Quality Designation, Core Recovery Ratio	CO5	1
5.6	Bore log – Soil profile – Sub-soil investigation report	CO1	1

Model Question Paper

QP CODE:

Reg No.: _____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET 322

Course Name: GEOTECHNICAL INVESTIGATION

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. What are the objectives of soil exploration?
2. Differentiate preliminary investigation and detailed investigation.
3. Explain dilatancy correction to be applied to the N value.
4. List out the factors influencing SPT value.
5. Explain stabilization of borehole using Bentonite slurry.
6. Write the principle behind the seismic refraction method.
7. What are the precautions to be adopted during the transportation of sample?
8. Define i) Area ratio, ii) Inside clearance iii) Outside clearance
9. Differentiate between bore log and soil profile.
10. What is rock quality designation?

Part B

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

Module 1

11. a. Explain wash boring with the help of a sketch.

b. Explain the major steps involved in reconnaissance for a geotechnical investigation of a multi storied building.

OR

12. **a.** Differentiate preliminary investigation and detailed investigation.

b. Explain percussion drilling with the help of a sketch.

Module 2

13. **a.** The observed SPT value (N) in a deposit of fully submerged fine silty sand was 45 at a depth of 6.5m. The average saturated unit weight of soil is 19.5 kN/m3 Find the corrected SPT number.

b. Explain the factors influencing SPT value.

OR

14. **a.** The field N value in a deposit of fully submerged fine sand was 47 at a depth of 7m. The average saturated unit weight of the soil is 19kN/m3. Calculate the corrected N value.
    b. Explain the procedure for conducting SPT test with neat figure.

Module 3

15. **a.** Explain the seismic refraction method
    b. Explain the procedure to employ electrical sounding method.

OR

16. **a.** Explain the electrical profiling method.
    b. Explain stabilization of borehole using Bentonite slurry.

Module 4

17. **a.** Explain any two types of samplers used for undisturbed soil sample.
    b. If the external diameter of a sampling tube is 75 mm and area ratio is 20%, determine the thickness of sampling tube.

OR

18. **a.** Explain the factors affecting sample disturbance. What are the precautions to be taken in handling and transporting soil samples?
    b. Compute the area ratio of a thin walled tube sampler of external diameter 6.0 cm and wall thickness 2.25mm and comment on the type of soil sample obtained using this sampler.

Module 5

19. **a.** What is a bore log and draw an example of bore log?
    b. What are the salient features of a sub soil investigation report? With a neat sketch, explain the term ‘soil profile’.

OR

20. **a.** ExplainPressure meter test and comment on the Uses and limitations
    b. Two plate load tests with square plates were performed on a soil deposit. For a 30 mm settlement, the following loads were obtained. Determine the width of a square footing which would carry a net load of 1,500 kN for a limiting settlement of 30 mm.

Width of square plate in mm	**Load in kN**
300	38.2
600	118.5

CET332	TRAFFIC ENGINEERING AND MANAGEMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble : The course aims to impart in-depth knowledge pertinent to traffic flow theory, traffic management measures, capacity analysis, design of road intersections and road safety**.**

Prerequisite: CET 206 Transportation Engineering

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

CO 1	Identify the relationship among various traffic stream variables. (K2, K3)
CO 2	Apply traffic management measures and regulations so as to solve issues related to traffic flow in road network. (K2, K3)
CO 3	Explain the concept of capacity and LOS and its estimation for various traffic facilities (K2,K3)
CO 4	Identify the need for intersection control and design of various types.(K2,K3)
CO 5	Analyse causes of road accidents and suggest preventive measures (K2, K3)

Mapping of course outcomes with program outcomes

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

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (marks)
	Test 1 Marks	Test 2 Marks	
Remember	**5**	**5**	**20**
Understand	**10**	**10**	**40**
Apply	**5**	**5**	**20**
Analyse	**5**	**5**	**20**
Evaluate			
Create			

Mark Distribution

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

Continuous Internal Evaluation Pattern:

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

End Semester Examination Pattern:

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

Sample Course Level Assessment Questions:

Course Outcome 1 (CO1): Illustrate through diagrams the basic relationship between the fundamental variables of traffic flow.
Course Outcome 2 (CO2):.Suggest traffic management measures so as to avoid locking of vehicle flow due to turning traffic.
Course Outcome 3 (CO3): Define adjusted capacity. What are the measures of effectiveness used for urban roads and two lane highways?

Course Outcome 4 (CO4): Explain the hierarchy of intersection control. What do you understand by optimum cycle length?

Course Outcome 5 (CO5): With neat sketches differentiate between collision and condition diagram

Syllabus- Traffic Engineering and Management

Module 1	**Traffic Flow Characteristics**: ***Fundamental Parameters-*** speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow. ***Traffic stream models***: Single Regime models - Greenshields model, Greenberg logarithmic model Multi-regime models – Two and three regime linear models.
Module 2	**Regulation of Traffic** – Need and scope of traffic regulations- Motor Vehicle Act – Regulation of speed- Regulation of vehicles – Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations. **Traffic Management** – scope of traffic management measures – restrictions to turning movements – one way streets – tidal flow operations-Closing side streets – Exclusive bus lanes.
Module3	**Capacity and Level of service (LOS)**: Concept- Base capacity, Adjusted capacity, LOS definition, FactorsAffecting Capacity and LOS, Homogeneous and heterogeneous traffic conditions-vehicle types - Concept of PCU. Capacity and LOSanalysis –Single lane, Intermediate laneand two lane interurban roads- Base capacity and adjustment factors- Indo HCM (2017) Guidelines Capacity and LOS analysis of Urban roads - Base conditions- Adjustment factors- Indo HCM (2017) Guidelines
Module 4	**Intersections:** At-grade intersections- basic forms- conflict points -visibility triangle- design principles- Channelization. Roundabouts- Geometric layout, types- design elements. Traffic Signals –Warrants- pre-timed and traffic actuated. Design of signal timing at isolated intersections- Phase design-optimum cycle time (Webster's approach), green splitting- pedestrian phase -phase diagrams, timing diagram. Grade separated intersection: Grade separated intersections without interchange and with interchange- Three leg interchange, Four leg interchange and multileg interchange. **Traffic Control Measures** - Traffic Signs, Road Markings, and Traffic control aids.
Module 5	**Traffic Safety :** Road Safety Situation in India, Causes of road accidents –

	influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis of accident data, Collision and condition diagram, **Road Safety Audit**- concept and need- organizations involved- stages of road safety audit (brief description only)

Text Books:

1.Kadiyali L.R. Traffic Engineering and Transport planning, Khanna Publishers, 2011
2. Khanna S.K and Justo C.E.G; Highway Engineering, Nem Chand Publishers, 10th Ed,2018.
3. CAO' Flaherty, Transport planning and Traffic Engineering, Elsevier, 2006.

References

1. Roger P. Roess, William R. McShane& Elena S. Prassas, Traffic Engineering, Fourth Edition, Prentice-Hall, 2010.
2. Pignataro L. J., Traffic Engineering – Theory and Practice, Prentice Hall, 1973.
3. C. J. Khisty and B. K. Lall, Transportation Engineering: An Introduction,Prentice- Hall India, 2002.
4. P. Chakroborty and A. Das, Principles of Transportation Engineering, PrenticeHall of India Pvt. Ltd., 2003.
5. A. D. May, Traffic Flow Fundamentals, Prentice–Hall, 1990.
6. C.S. Papacostas, Transportation Engineering and Planning, Prentice-Hall India,2002.
7.Highway Capacity Manual (HCM), Transportation Research Board, USA, 2010.
8. Indian Highway Capacity Manual (Indo-HCM), CSIR, New Delhi, 2017
9. Relevant IRC codes

Course Content and lecture Schedule:

No.	Topic	Course Outcome	No. of Hrs
1	**Module 1**		Total:7
1.1	***Fundamental parameters-*** speed, density, volume, travel time, headway, spacing, time-space diagram, time mean speed, space mean speed and their relation. Fundamental diagrams of traffic flow.	CO1	2
1.2	**Single Regime models** - Greenshields model, Greenberg logarithmic model	CO1	3
1.3	**Multi-Regime models** – Two and three regime linear models.	CO1	2
2	**Module 2**		Total: 7

2.1	Need and scope of traffic regulations- Motor Vehicle Act – Regulation of speed- Regulation of vehicles – Regulations concerning driver- General rules concerning traffic- parking regulations- Enforcement of regulations.	CO2	4
2.2	Scope of traffic management measures – restrictions to turning movements – one way streets – tidal flow operations-Closing side streets –Exclusive bus lanes.	CO2	3
3	**Module 3**		Total: 7
3.1	**Capacity and Level of service (LOS)**: Concept- Base capacity, Adjusted capacity, LOS definition, Factors Affecting Capacity and LOS, Homogeneous and heterogeneous traffic conditions- vehicle types - Concept of PCU.	CO3	2
3.2	Capacity and LOS analysis –Single lane, Intermediate lane and two lane interurban roads- Base capacity and adjustment factors- Indo HCM (2017) Approach	CO3	3
3.3	Capacity and LOS analysis of Urban roads - Base conditions- Adjustment factors- Indo HCM (2017) approach	CO3	2
4	**Module 4**		Total: 9
4.1	**Intersections:** At-grade intersections- basic forms- conflict points -visibility triangle- design principles- Channelization.	CO4	2
4.2	**Roundabouts**- Geometric layout, types- design elements.	CO4	2
4.3	**Traffic Signals** - Warrants- pre-timed and traffic actuated. Design of signal timing at isolated intersections- Phase design- optimum cycle time (Webster's approach), green splitting- pedestrian phase -phase diagrams, timing diagram.	CO4	3
4.4	**Grade separated intersection:**Grade separated intersections without interchange, and with interchange- Three leg interchange, Four leg interchange and multileg interchange. **Traffic Control Measures** - Traffic Signs, Road Markings, Traffic control aids.	CO4	2
5	**Module 5**		Total: 5
5.1	**Traffic Safety :** Road Safety Situation in India, Causes of road accidents – influence of road, vehicle, driver and environmental factors - Pedestrian Safety, Collection and statistical analysis analysis of accident data, Collision and condition diagram,	CO5	3
5.2	**Road safety audit**- concept and need- organizations involved- stages of road safety audit (brief description only)	CO5	2

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH & YEAR
Course Code: **CET332**
Course Name: **TRAFFIC ENGINEERING AND MANAGEMENT**
Model Question Paper

Max. Marks:100 Duration: 3 hrs

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

1 Differentiate time mean speed and space mean speed.
2 Explain multi regime models citing examples.
3 Suggest traffic management measures so as to avoid locking of vehicle flow due to turning traffic.
4 Mention priority rules at intersections.
5 Explain base capacity and adjusted capacity.
6 Discuss the importance of passenger car units under heterogeneous traffic conditions.
7 How channelizing islands control speed and separate conflicts at intersections? Explain with sketches.
8 Which locations justify grade- separated intersections?
9 What is the basic difference between collision diagram and condition diagram?
10 What is the probability of involvement of exactly 5 drivers out of the 500 drivers who are employed in a bus operating company in an accident during a year. It has been found that on an average 1 in 100 drivers are involved in an accident every year.

(3 x 10=30 marks)

.

PART B
(Answer one full question from each module)

11 a. The data shown below were obtained from a highway stretch. Fit these data to Greenshields model and determine i) free speed ii) jam density iii) capacity and iv) speed at maximum flow 7

Speed (km/h)	Density (veh/km)
14.2	85
24.1	70
30.3	55
40.1	41
50.6	20

55	15

b. Explain single regime speed- density models 7

OR

12 a. Observers stationed at two sections XX and YY, 150m apart on a highway, record the arrival times of four vehicles as shown in the accompanying table. If the total time of observation at XX was 15 s, determine a) the time mean speed, b) the space mean speed and c) the flow at section XX. 7

Vehicle	Time of Arrival (Seconds)	
	Section XX	Section YY
A	T_0	T_0 +7.58
B	T_0 + 3	T_0 +9.18
C	T_0 +6	T_0 +12.36
D	T_0+12	T_0 +21.74

b. Using basic stream flow diagram, explain speed- density, speed- flow and flow-density relationships 7

13 a. Mention general principles governing speed limit in urban area and rural area. 7

b. Suggest traffic management measures that can take care of the imbalance in directional distribution of traffic during peak hours. 7

OR

14 Explain the aspects covered under regulation of vehicles and regulation concerning driver in motor vehicles act. 14

15 a. Explain the adjustment factors mentioned in Indo HCM (2017) that are to be considered in the capacity estimation of urban roads. 7

b. Differentiate base capacity and adjusted capacity of single lane interurban roads. 7

OR

16 a. What is level of service? What are the factors affecting capacity and level of service? 7

b. Explain the procedure mentioned in Indo HCM (2017) for the determination of base capacity and level of service of two lane two way interurban roads. 7

17 a. Draw a neat sketch of a full cloverleaf and show the movement of traffic. 7

b. Show conflict points at the following intersections 7

i) cross roads, both two way, ii)T-intersection, both two way roads iii) Y-intersection, one one-way iv) Cross roads, one way roads

OR

18 a. Explain briefly the various design factors that are to be considered in rotary intersection design. 7

b. Design a four phase signal timing plan for the data given below. The intersection is four legged. All approaches have 3 lanes and each lane is 3.5 m width. Saturation flow is 1800pcu/hr/lane. The equivalent hourly flows at the intersection are as shown below: Using the Webster model, determine the optimal cycle length for the intersection. Assume lost times equal to 3.5 s/phase, amber interval equal to 3 s, and all red period is not provided. Also draw the phase and timing diagram. 7

East bound			West bound			North bound			South bound		
L	T	R	L	T	R	L	T	R	L	T	R
280	850	80	320	700	120	50	280	40	35	360	10

19 a. What are the different methods for maintaining accident records? Briefly explain with neat sketches. 7

b. Explain various measures that may be taken to prevent accidents. 7

OR

20 a. Briefly explain various stages of road safety audit. 7

b. Explain any three statistical methods for analysis of accident data. 7

CET342	MECHANICS OF FLUID FLOW	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to expose the students to the fundamental concepts of different types of fluid flow.

Pre-requisite: CET203 Fluid Mechanics and Hydraulics

Course outcome

CO1	Describe and apply the principles of potential flow and viscous flow
CO2	Perform the computations of turbulent flows through pipes and pipe bends by recollecting the relevant hydraulic principles
CO3	Describe and apply the principles of the pressure and specific energy in open channel flow for practical applications
CO4	Describe and apply the principles of unsteady flow for practical applications in pipes and channels
CO5	Prepare physical models for performing experiments recalling the principles of fluid flow

CO-PO Mapping

MECHANICS OF FLUID FLOW		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3					1					
	CO2	3	3					1					
	CO3	3	3					1					
	CO4	3	3					1					
	CO5	3	3										

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 342
MECHANICS OF FLUID FLOW
(Course plan)

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Fluid flow: Types of fluid flow (Review)	CO1	1
1.2	Potential flow-velocity potential and stream function	CO1	1
1.3	Problems on velocity potential and stream function	CO1	1
1.4	Streamlines and equipotential lines, flow net-uses and limitations	CO1	1
1.5	Flow through pipes: Viscous flow - Shear stress, pressure gradient relationship Laminar flow-Basic concepts, Reynold's experiment	CO1	1
1.6	Laminar flow between parallel plates	CO1	1
1.7	Hagen-Poiseuille equation	CO1	1
1.8	Problems	CO1	1

Module II (7 Hours)			
2.1	Turbulent flow- fundamentals	CO2	1
2.2	Velocity profile- computations	CO2	1
2.3	Pipe roughness -friction factor- Moody's diagram; Hazen williems formula	CO2	1
2.4	Head loss due to friction in pipes-Nikuradse experiment with artificially roughened pipe	CO2	1
2.5	Reduction of carrying capacity of pipes with age	CO2	1
2.6	Flow through pipe bends- application of linear momentum principle	CO2	1
2.7	Problems on Flow through pipe bends	CO2	1
Module III (7 Hours)			
3.1	Open channel flow- uniform flow and critical flow computations- section factor	CO3	1
3.2	Hydraulic exponents for uniform flow and critical flow	CO3	1
3.3	Computation of discharge through compound channels	CO3	1
3.4	Pressure distribution in curvilinear flows- spillway crest and spillway buckets	CO3	1
3.5	Specific energy (review)- Application of Specific energy for channel transitions- hump and reduction in channel width	CO3	1
3.6	Application of Specific energy for channel transitions- reduction in channel width	CO3	1
3.7	Problems on Application of Specific energy for channel transitions	CO3	1
Module IV (7 Hours)			
4.1	Rapidly varied steady flow-hydraulic jumps –tail water conditions -types	CO4	1
4.2	Uses of hydraulic jumps for energy dissipation below spillways- jump height curve; tail water curve	CO4	1
4.3	Unsteady flow through open channels- Surges in open channels- Positive surges and negative surges (concept only)	CO4	1
4.4	Positive surges – derivation of equations-continuity and momentum	CO4	1

4.5	Problems on Positive surges	CO4	1
4.6	Unsteady flow through pipes –water hammer analysis	CO4	1
4.7	Problems on water hammer analysis	CO4	1
Module V (6 Hours)			
5.1	Experimental hydraulics- Dimensional analysis Dimensional analysis-Dimensions and dimensional homogeneity	CO5	1
5.2	Rayleigh method-Problems	CO5	1
5.3	Buckingham pi theorem- Problems	CO5	1
5.4	Model Analysis-Dimensionless numbers, Similitude	CO5	1
5.5	Model laws and scale ratios- Problems	CO5	1
5.6	Scale effect, distorted and undistorted models	CO5	1

Course Code: CET342
MECHANICS OF FLUID FLOW
Syllabus

Module I

Fluid flow: Types of fluid flow (Review) Potential flow-velocity potential, stream function, streamlines and equipotential lines, flow net-uses and limitations
Viscous flow –Reynold's experiment; Shear stress- pressure gradient relationship - Laminar flow through pipes (Hagen-Poiseulle Equation), laminar flow between stationary parallel plates

Module II

Turbulent flow- Computation, velocity distribution, Head loss due to friction in pipes-Nikuradse experiment with artificially roughened pipe, Friction coefficient for laminar and turbulent flows, Moody's diagram, reduction of carrying capacity of pipes with age. Hazen William's formula. Flow through pipe bends - application of linear momentum principle

Module III

Open channel flow-Hydraulic exponents and section factor for uniform and critical flow, Pressure distribution in curvilinear flows- spillway crest and spillway bucket. Computation of discharge through compound channels. Application of Specific energy for channel transitions-hump and reduction in channel width

Module IV

Rapidly varied steady flow-hydraulic jumps –types based on tail water conditions; Uses of hydraulic jumps for energy dissipation below spillways- jump height curve; tail water curve
Unsteady flow through open channels – Surges- positive surges (problems) and concept of negative surges; Transients in pipes-water hammer

Module V

Experimental hydraulics- Physical modeling-Dimensional analysis- Reyleigh's method Buckingham's pi- theorem, Similitude, Model laws for viscous and open channel flows- Reynold's and Froude's model law; Scale effect, distorted and undistorted models

Text Books:

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
3. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

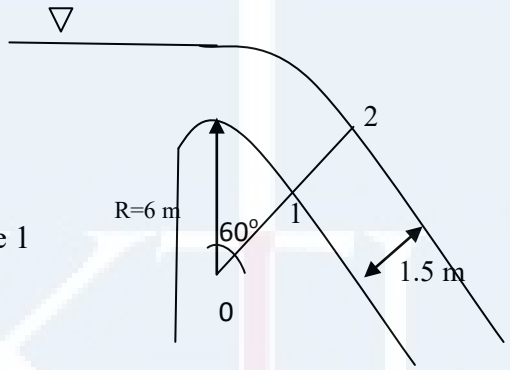
References

1. Streeter.V.L. Fluid Mechanics, Mc Graw Hill Publishers.
2. Bruce R Munson, Donald F Young . Fundamentals of Fluid Mechanics, John Wiley & sons, 2011.
3. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
4. Arora.K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.
5. Narasimhan S., A First Course in Fluid Mechanics, University Press (India) Pvt. Ltd., 2006.
6. Frank.M.White, Fluid Mechanics, Mc Graw Hill, 2013.
7. Mohanty.A.K. Fluid Mechanics, Prentice Hall, New Delhi, 2011
8. Narayana Pillai,N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.
9. Kumar.D.N. Fluid Mechanics and Fluid power Engineering, S.K.Kataria & sons, 2013.

Course Code: CET 342
MECHANICS OF FLUID FLOW
(Course Level Assessment Questions)

CO1	**Describe and apply the principles of potential flow and viscous flow**
1	Describe Reynold's experiment
2	Show that stream lines and equi potential lines intersect orthogonally
3	Crude oil of dynamic viscosity 1.5 Poise and relative density 0.9 flows through a 20 mm vertical pipe. The pressure gauges fitted at an upper point A measures 58.86 N/cm^2 while that fitted at another point B, 20 m below A reads 19.62 N/cm^2. Is the flow laminar ? Find the direction of flow and rate of flow.
4	Obtain the expression for local velocity of steady, uniform laminar flow through the space between two stationary parallel plates. Also show that the local velocity becomes average velocity at a point 0.211B from one of the plates, where B is the spacing between the plates
5	The velocity components in a two dimensional incompressible flow are $u = \frac{y^3}{3} + 2x - x^2 y$ and $v = xy^2 - 2y - \frac{x^3}{3}$. (i) Is the flow irrotational? (ii) Evaluate the potential function and stream function

CO2	**Perform the computations of turbulent flows through pipes and pipe bends**
1	Explain the use and characteristics of Moody's diagram
2	Describe the characteristics of velocity distribution in turbulent regime
3	Explain the role of surface aging in carrying capacity of commercial pipes
4	360 l/sec of water is flowing in a pipe. The pipe is bent by 120^o. The pipe bend measures 360 mm x 240 mm and volume of the bend is 0.14 m^3. The pressure at entrance is 73 kN/m^2 and the exit is 2.4 m above the entrance section. Find the magnitude of resultant force exerted on the bend.
5	A pipeline 30 cm diameter carries 300 l/s of petrol (density=600 kg/m3; dynamic viscosity=2.9 x 10^{-4} Pas). Calculate (i) the friction factor (ii) shear stress at the boundary (iii) shear stress and velocity at 5 cm from the pipe axis (iv) maximum velocity and thickness of laminar sublayer Assume the pipe to be hydrodynamically rough

CO3	**Describe and apply the principles of the pressure and specific energy in open channel flow for practical applications**
1	Explain hydraulic exponents in open channel computation
2	Derive the relations for Pressure distribution in curvilinear flows
3	A discharge of 15 cumecs flows through a rectangular channel 3 m wide. The depth of flow is 2 m. What is the minimum width beyond which the flow depth at upstream gets disturbed ?. A smooth hump of 0.1 m is built in the channel and at this section the width is 2.8 m. Analyze the water depth at contracted section and the upstream section.
4	For the flow over a spillway with circular arc shown in Figure 1, obtain the value of pressure at point 1for discharge q=5 m^3/s/m for a constant flow depth of 1.5 m assuming (i) forced vortex flow and (ii) free vortex flow Figure 1 

CO4	**Describe and apply the principles of unsteady flow for practical applications in pipes and channels**
1	Explain negative surges. Give examples
2	What is water hammer in pipes ?
3	A steel pipeline is 30 cm in diameter and has a wall thickness of 3 mm. The pipe is 1000 m long and conveys a flow of 100 l/s (Relative density =0.82).The static head at the outlet is 160 m of oil. If the working stress of steel is 0.1 kN/mm^2, calculate the minimum time of closure of a downstream valve. For oil, K=10^9 Pa and for steel E=2.14 x10^{11} Pa
4	A horizontal rectangular channel of 3 m width and 2 m water depth conveys water at 18 m^3/sec. If the flow rate is suddenly reduced to 2/3 of its original value, compute the height and velocity of the surge developed in the channel

CO5	**Prepare physical models for performing experiments recalling the principles of fluid flow**
1	Describe Reyligh's method of dimensional analysis
2	Describe scale effect in physical model studies
3	Explain similitude in hydraulic model studies
4	A 1:20 spillway model has a discharge of 2.25 m^3/s. what is the corresponding prototype discharge ? If a flood phenomenon takes 10 h to occur in the prototype, how long will it in the model ?
5	The discharge Q over a small rectangular weir is known to depend upon head H over the weir, the height of the weir P, acceleration due to gravity g, width of the weir L and fluid properties ρ, dynamic viscosity μ an surface tension σ. Express the relationship between the variables in dimensionless form $\frac{Q}{gH^{5/2}} = f\left[\frac{P}{H}, \frac{L}{H}, \frac{\mu}{H^{3/2}g^{1/2}\rho}, \frac{\sigma}{\rho g H^2}\right]$ using Buckingham π - theorem

Pages: 3

Model Question Paper

Reg No.:…….. **QP CODE:……..**

Name:……

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

Course Code: CET342
Course Name: MECHANICS OF FLUID FLOW

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

Part A

(Answer all questions; each question carries 3 marks)

1. Describe Reynold's experiment.
2. Explain the uses of flownet.
3. Describe the features of Moody's diagram.
4. Explain the concept of application of linear momentum principle in pipe bends.
5. Define section factor for uniform flow and critical flow computations and state their uses.
6. Describe the application of specific energy concept in channel transitions.
7. Enlist the classification of hydraulic jumps based on tail water conditions.
8. Differentiate positive surges and negative surges.
9. Explain similitude in hydraulic model studies.
10. Differentiate distorted and undistorted models.

Part B

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

Module I

11. (a) Derive Hagen-Poiseullie equation (10Marks)

    (b) Obtain the relation between mean velocity and maximum velocity of laminar flow between parallel plates (4 Marks)

Or

12. (a). The velocity potential for a two dimensional flow is $\phi = x(2y-1)$ at P(4,5) determine (i) the velocity and (b) stream function (10Marks)

12. (b) Show that the streamlines and equipotential lines are orthogonal to each other

(4 Marks)

Module II

13. The diameter of a pipe bend is 30 cm at inlet and 15 cm at outlet and the flow is turned through 120^o in a vertical plane. The axis at inlet is horizontal and the centre of the outlet section is 1.5 m below the centre of the inlet section. Total volume of water in the bend is 0.9 m3. Neglecting friction, calculate the magnitude and direction of force exerted on the bend by water flowing through it at 250 l/sec and when the inlet pressure is $0.15N/mm^2$

(14 Marks)

Or

14. A 300 mm diameter water supply pipe had a friction factor of 0.02 when freshly laid. After 10 years of service, the friction factor was found to be 0.025. what friction factor can be expected after another 15 years ? The pipe is assumed to be in rough turbulent flow regime (14 Marks)

Module III

15. Derive the pressure distribution in curvilinear flows (a) spillway crest (ii) spillway bucket (14 Marks)

Or

16. Uniform flow occurs in a 3m wide rectangular channel of bed slope 0.003 at a depth of 2.5 m. Due to sedimentation, the channel bed is raised at certain section. Calculate the maximum height of the hump which will cause any change in upstream depth. If the depth of water at upstream is raised to 2.9 m, determine the height of the hump. Take Manning's coefficient as 0.012 (14 Marks)

Module IV

17. In a wide tidal river, the velocity is 0.75 m/s and the depth of flow is 1.3 m. If a tidal bore is observed to move upstream with a velocity of 4 m/s in this river, determine the velocity and depth of flow after the bore had passed (14 Marks)

Or

18. A steel pipeline is 30 cm in diameter and has a wall thickness of 3 mm. The pipe is 1000 m long and conveys a flow of 100 l/s (Relative density =0.82).The static head at the outlet is 160 m of oil. If the working stress of steel is 0.1 kN/mm^2, calculate the minimum time of closure of a downstream valve. For oil, K=10^9 Pa and for steel E=2.14 x10^{11} Pa

(14 Marks)

Module V

19. (a) Explain Reyliegh's method of dimensional analysis. State its limitations

(8 Marks)

(b) A 1:50 spillway model has a discharge of 1.25 m^3/s. what is the corresponding prototype discharge ? If a flood phenomenon takes 12 h to occur in the prototype, how long will it in the model ? (6 Marks)

Or

20. A small sphere of density ρ_s and diameter D settles at a terminal velocity V in a liquid of density ρ_f and dynamic viscosity μ. Acceleration due to gravity g is known to be a parameter Express the functional relationships between these variables in the form

$$\frac{V}{\sqrt{gD}} = f\left[\frac{\rho_s}{\rho_f}, \frac{\mu}{\rho_f D\sqrt{gD}}\right]$$ using Buckingham π - theorem (14 Marks)

CET352	ADVANCED CONCRETE TECHNOLOGY	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: This course is aimed at exposing the students to the fundamentals of properties of concrete materials, its testing procedures, various types of concretes, NDT of concrete and mix design. After this course, students will be in a position to determine the properties of concrete materials, testing of concrete and do a mix design based on requirement.

Prerequisite: CET309 CONSTRUCTION TECHNOLOGY& MANAGEMENT

Course Outcomes:

Course Outcome	Description of Course Outcome	Prescribed learning level
CO 1	To recall the properties and testing procedure of concrete materials as per IS code	Remembering, Understanding
CO 2	To describe the procedure of determining the properties of fresh and hardened concrete	Remembering, Understanding
CO 3	To design concrete mix using IS Code Methods.	Applying & Analysing
CO4	To explain nondestructive testing of concrete	Remembering, Understanding
CO5	To describe the various special types of concretes	Remembering, Understanding

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	-	-	-	2	2	3	-	-	-	-	-
CO 2	3	-	-	-	2	2	3	-	-	-	-	-
CO 3	3	3	3	2	2	2	3	-	-	-	-	-
CO4	3	-	-	-	2	2	3	-	-	-	-	-
CO5	3	-			3	2	3					

CET 362	ENVIRONMENTAL IMPACT ASSESSMENT	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PEC	3	0	0	3	2019

Preamble : This course introduces the methodologies for identifying, predicting, evaluating and mitigating the impacts on environment due to any developmental project or activities. Students will learn how to prepare an impact assessment report and devise an environment management plan. Sufficient background will be provided on the environmental clearance procedures in India.

Prerequisite: NIL

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

Course Outcome	Description of Course Outcome	Prescribed learning level
CO1	To appreciate the need for minimizing the environmental impacts of developmental activities	Understanding
CO2	To understand environmental legislation & clearance procedure in the country	Remembering, Understanding
CO 3	To apply various methodologies for assessing the environmental impacts of any developmental activity	Applying &Analysing
CO 4	To prepare an environmental impact assessment report	Analysing& Evaluating
CO 5	To conduct an environmental audit	Analysing &Evaluating

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-
CO 3	2	-	-	3	2	-	3	-	-	-	-	-
CO4	-	-	-	2	-	2	2	3	-	3	-	-
CO5	-	-	-	2	1	-	2	2	-	2	-	-

Assessment Pattern

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

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

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

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

Course Level Assessment Questions

CO1:To be able to appreciate the need for minimizing the environmental impacts of developmental activities

1.Explain the evolution of EIA in India

2.Explain why EIA is needed for developmental projects.

3.What are the different ways in which development projects impact the water quality and quantity?

CO 2: To be able to understand environmental legislation & clearance procedure in the country

1.Two municipalities in Kerala plan to set up a Common Municipal Solid Waste Management Facility (CMSWMF). Explain the procedure required for the Environmental Clearance (EC) for the project as per the EIA Notification of 2006.(All CMSWMFs are category B projects)

2.Describe the procedure for obtaining environmental clearance according to EIA notification 2006.

3.The Environment (Protection) Act, 1986 is called an umbrella legislation. Substantiate the statement.

CO3: To be able to apply various methodologies for assessing the environmental impacts of any developmental activity

1.Prepare a simple checklist for assessment of socio economic impact due to the development of a highway.

2.Explain overlay mapping as an EIA method

3.Explain how to predict the impact of a highway project on air quality

CO4: To be able to prepare an environmental impact assessment report

1.Explain the Terms of Reference (ToR) for EIA report of a highway project

2.Explain the structure of EIA report

3.Explain the importance of an environmental management plan.

CO5: To be able to conduct an environmental audit

1.Explain the need for environmental auditing

2.What are the different types of environmental audits?

3. Explain the importance of ISO 14001 standard.

SYLLABUS

Module 1

Definition, Need for EIA, Evolution of EIA: Global & Indian scenario -Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution)Act 1981, The Environmental (Protection) Act 1986- Environmental standards for water, air and noise quality- EIA Notification 2006

Module 2

Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal-Form1-Category of projects-Generic structure of EIA report- Terms of Reference (ToR) -Types of EIA: strategic, regional, sectoral, project level- Rapid EIA and Comprehensive EIA- Initial Environmental Examination (IEE)

Module 3

EIA methodologies: Ad hoc, checklist, matrix, network and overlay-Impact Prediction, Evaluation and Mitigation-Prediction and assessment of the impact on water (surface water and groundwater), air, and noise environment- assessment of ecological impactsand Socio economic Impacts.

Module 4

Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP- Role of environmental monitoring program
Environment Audit: need for audit- audit types and benefits- environmental audit procedure
ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits

Module 5

EIA case studies (Indian)- a highway project, a hydro electric power plant, an air port project, a quarry mining project and a solid waste management project

Text Books:

1. Larry W Canter, “Environmental Impact Assessment”, McGraw Hill Inc. , New York, 1995
2. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997
3. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

References:

1. Lawrence, David P., Environmental Impact Assessment (Practical Solutions to Recurrent Problems), Wiley International, New Jersey.
2. Ministry of Environment & Forests, Govt. of India 2006 EIA Notification
3. Jain, R.K., Urban, L.V. and Stacey, G.S., Environment Impact Analysis, Von Nostrand Reinhold Company.

Lecture Plan- Environmental Impact Assessment

Module	Topic	Course Outcomes addressed	No. of Lectures
1	**Module 1: Total Lecture Hours -7**		
1.1	Definition, Need for EIA, Evolution of EIA: Global & Indian scenario	CO1	1
1.2	Environmental legislations in India- The Water (Prevention & Control of Pollution) Act 1974, The Air (Prevention & Control of Pollution) Act 1981, The Environmental (Protection) Act 1986	CO2	3
1.3	Environmental standards for water, air and noise quality	CO2	1
1.4	EIA Notification 2006	CO2	2
2	**Module II: Total Lecture Hours- 7**		
2.1	Environmental clearance process in India: Screening, Scoping, Public Consultation, Appraisal- Form1- Category of projects	CO2	3
2.2	Generic structure of EIA report- Terms of Reference (ToR)	CO4	1
2.3	Types of EIA: strategic, regional, sectoral, project level-	CO3	1
2.4	Rapid EIA and Comprehensive EIA	CO3	1
2.5	Initial Environmental Examination (IEE)	CO3	1
3	**Module III: Total Lecture Hours-7**		
3.1	EIA methodologies: Ad hoc, checklist, matrix, network and overlay	CO3	3
3.2	Impact Prediction, Evaluation and Mitigation- Prediction and assessment of the impact on water (surface water and groundwater), air, and noise	CO3	2

	environment		
3.3	assessment of ecological impacts and Socio economic Impacts	CO3	2
4	**Module IV: Total Lecture Hours- 7**		
4.1	Environmental Management Plan (EMP): Goal and purpose- Importance of EMP- Content of an EMP	CO4	2
4.2	Role of environmental monitoring program	CO4	1
4.3	Environment Audit: need for audit- audit types and benefits- environmental audit procedure	CO5	2
4.4	ISO 14001 standards: Importance, salient features - Stages in implementation- Benefits	CO5	2
5	**Module V: Total Lecture Hours- 7**		
5.1	EIA case studies (Indian)- a highway project	CO1, CO4	2
5.2	Hydro electric power plant, air port project	CO1, CO4	3
5.3	Quarry mining project, solid waste management project	CO1, CO4	3

Model Question Paper

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CET362

Course Name: ENVIRONMENTAL IMPACT ASSESSMENT

Max. Marks: 100 Duration: 3 Hours

Part A

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

1. Explain the need for EIA
2. Why environmental (protection) act, 1986 is called an umbrella act?
3. Discuss screening of projects
4. What is rapid EIA?
5. What is ad hoc method for impact assessment?
6. How to predict the impact of a proposed food industry on the water quality of a nearby river
7. Explain the benefits of an environmental audit
8. What is ISO 14001 standard?
9. What are the impacts of a highway project on local air quality
10. Discuss the environment monitoring program for a quarry mining industry.

PART B

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

11. (a) Discuss environmental standards for water, air and noise (6 Marks)
    (b) Discuss evolution of EIA in India (8 Marks)

OR

12. (a) DiscussAir (Prevention & Control of Pollution) Act 1981 (5 Marks)
    (b) Explain salient features of EIA notification 2006 (9 Marks)

13. (a) Discuss environmental clearance process in India (10 Marks)
    (b) What is Form-1 ? (4 Marks)

OR

14. (a) What is Initial Environmental Examination? (5 Marks)
    (b) Explain different types of EIA (9 Marks)

15. (a) Discuss in detail EIA methodologies (10 Marks)
    (b) How can air quality modelling help in assessing the impact on air (4 Marks)

OR

16. (a) Explain the steps to assess the impacts on the ecological environment due to a project (7Marks)
    (b) Explain the steps involved in assessment of impacts on the water environment. (7 Marks)

17. (a) What are the different types of Environmental Audit? (5 Marks)
    (b) Discuss the content of an environment management plan .(9 marks)

OR

18. (a) Discuss the salient features of an Environmental Monitoring Plan (5 Marks)
    (b) Explain in detail the procedure for conducting an environmental audit (9 Marks)

19. Explain environmental clearance procedure for an airport (14 Marks)

OR

20. Discuss how to assess the impacts of a hydro electric project (14 Marks)

CET372	FUNCTIONAL DESIGN OF BUILDINGS	Category	L	T	P	Credit	Year of Introduction
		PEC	3	0	0	3	2019

Preamble: The general objective of this course is to provide an insight to the students to various aspects of functional design of buildings and innovative construction methods.

Pre-requisite: CE204 Construction Technology

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

CO1	Develop an understanding of acoustical design and noise control techniques
CO2	Understand elemental concepts of natural and artificial lighting designs
CO3	Know the principles involved in the design of buildings for thermal comfort and influence of climate on design of buildings
CO4	Have basic concept for electrical load calculation, plumbing design, HVAC load Calculation, functioning of elevators and escalators and rough cost estimation.
CO5	Acquire knowledge of innovative construction concepts

CET372 Functional Design of Buildings		PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	3	3										
	CO2	3	3										
	CO3	3	3										
	CO4	3	3										
	CO5	3	3										

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

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 14marks.

Course Level Assessment Questions
(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1)
1. Develop an understanding of acoustical design and noise control techniques
2. Applications of acoustics
3. Explain the acoustical considerations for offices, hospitals and industrial buildings

Course Outcome 2 (CO2)
1. Explain the purposes of lighting
2. Explain the basic concepts of natural and artificial lighting
3. Explain the different methods used for the design of natural lighting
4. Explain the different methods used for the design of artificial lighting

Course Outcome 3 (CO3)
1. Evaluate the principles involved in the design of buildings for thermal comfort
2. Explain the influence of climate on design of buildings
3. Compute solar radiation on different surfaces
4. Describe thermo physical properties of buildings

Course Outcome 4 (CO4)
1. Describe the basic concepts for electrical load calculation of structures
2. Explain the basic criteria for plumbing design
3. Calculation of HVAC load
4. Explain the functioning of elevators and escalators
5. Understand the rough cost estimation

Course Outcome 5 (CO5)

1. Understand traditional techniques in Tropical climate with vernacular buildings in Kerala
2. Explain the concepts of green building
3. Describe concepts for intelligent buildings
4. Explain innovative construction methods

Course Code: CET 372
FUNCTIONAL DESIGN OF BUILDINGS
Syllabus

Module I

Acoustical / Sonic Environment and acoustical comfort: Sound, Nature of sound- Behavior of sound in enclosed spaces-Concept of Geometric Acoustics-Reflection of sound and their applications- Absorption of sound-Sound absorption coefficient-Human Audibility range-Reverberation & Reverberation Time Calculation- Flanking paths- Sound absorption-materials and fixings- Reverberation-Sabine's formula-Eyrings modification.-Basic design of the elements for the required degree of sound insulation- Air and structure born noises-equivalent noise levels-day and night equivalent.

Acoustics, applications: Measures of noise control- Source-path and receiving end. TL value and computation of TL value, Acoustical defects- acoustical design of auditoriums and small lecture halls-Acoustical considerations of offices, hospitals and Industrial buildings.

Module II

Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings, Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Daylight penetration- Calculation of daylight factor. Design of side-lit windows-BIS and CBRI methods-skylights

Artificial lighting: Artificial lighting- illumination requirements-lux meter – lamps and luminaries – polar distribution curves– Color temperature and color rendering index- glare - Design of artificial lighting – lumen method – point by point method. Basic idea of street lighting and outside lighting

Module III

Thermal comfort: Factors affecting thermal comfort- effective temperature- thermal comfort indices-ET-CET Charts- Bioclimatic chart- Psychrometry and Psycrometric chart.

Earth-Sun relationship: Sun's apparent movement with respect to the earth. Solar angles-Computation of solar radiation on different surfaces-solar path diagram-shadow-throw concept and design of shading devices

Thermal design of buildings: Thermo physical properties of building materials and thermal control: passive and active building design- Steady and periodic heat flow through building envelope.

Design approaches: Climate conscious designs- Climatic zones in India- orientation and shape of buildings in different climatic zones- Passive solar-Active solar and Active approaches. Requirements of buildings in tropical areas-Thermal insulation

Module IV

Functional elements: Concept for electrical load calculation of structures- basic criteria for plumbing design – basic concept of HVAC load calculation – Basic concept of functioning of elevators and escalators- basic cost estimation.

Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure- Fire alarm system, and means of escape-Firefighting installations.

Module V

Functionality as per Vastusastra: Basic concepts- Governing criteria of functionality- Energy pattern- understand traditional techniques in Tropical climate with vernacular buildings in Kerala as case study.

Innovative concepts of functionality: Concept of green building- case studies on low energy and green buildings-Concepts of Intelligent building- Thirsty concrete- Blue roads- self healing concrete

Text Books and References:

1. Knudsen V.O. and Harris C.M., Acoustical Design in Architecture, John Wiley,1980

2. M David Egan , Architectural Acoustics, J.Ross Publishing,2007

3. Marshall Long, “Architectural Acoustics”, Second Edition, Academic Press, Waltham, USA, 2014

4. Bureau of Indian standards, Handbook on Functional Requirement of Buildings – SP:41(S and T)-1987

5. Pritchard, D.C., "Lighting", Longman Scientific & Technical, Harlow,1995.

6. Benjamin Evans, "Daylight in Architecture", McGraw - Hill Book Company, Newyork,1981.

7.Koenigseberger, Manual of tropical Housing and Building Part I – Climatic design, Orient Longman,2011

8. AjithaSimha.D, Building Environment, Tata McGraw Hill Publishing Co., New Delhi,1985

9. Jain. V.K., "Design and Installation of Services in Building complexes &High Rise Buildings", Khanna Tech. Publishers, New Delhi,1986.

10. National Building Code of India (NBC2016)

11. Wayne Forster and Dean Hawkes, “Energy Efficient Buildings: Architecture, Engineering, and Environment”. W.W. Norton Company Inc.2002.

12. Bureau of Energy Efficiency, India. Design Guidelines for Energy Efficient Multi-Storey Buildings,2014.

Module	Topic	Course outcome addressed	No of Hours
Module I (8 Hours)			
1.1	Acoustical / Sonic Environment and acoustical comfort: Sound, Nature of sound- Behavior of sound in enclosed spaces	CO1	1
1.2	Concept of Geometric Acoustics-Reflection of sound and their applications- Absorption of sound-Sound absorption coefficient-	CO1	1
1.3	Human Audibility range-Reverberation & Reverberation Time Calculation- Flanking paths. Sound absorption-materials and fixings. Reverberation-Sabine's formula-Eyrings modification.	CO1	2
1.4	Basic design of the elements for the required degree of sound insulation- Air and structure born noises-equivalent noise levels- day and night equivalent	CO1	1
1.5	Acoustics, applications: Measures of noise control- Source-path and receiving end. TL value and computation of TL value, Acoustical defects-	CO1	1
1.6	Acoustical design of auditoriums and small lecture halls. Acoustical considerations of offices, hospitals and Industrial buildings.	CO1	2
Module II (6 Hours)			
2.1	Natural lighting: Visual task requirements, Units of Light, Light, Vision and Buildings	CO2	1
2.2	Standards of Lighting and Visual comfort-The sky as a source of light, Daylight factor, Daylight penetration-Calculation of daylight factor.	CO2	1
2.3	Design of side-lit windows-BIS and CBRI methods-skylights	CO2	1
2.4	Artificial lighting: Artificial lighting- illumination requirements-lux meter – lamps and luminaries – polar distribution curves	CO2	1
2.5	Color temperature and color rendering index- glare - Design of artificial lighting – lumen method – point by point method. Basic idea of street lighting and outside lighting	CO2	2
Module III (8Hours)			

3.1	Thermal comfort: Factors affecting thermal comfort- effective temperature	CO3	1
3.2	Thermal comfort indices-ET-CET Charts- Bioclimatic chart-Psychrometry and Psycrometric chart.	CO3	1
3.3	Earth-Sun relationship: Sun's apparent movement with respect to the earth. Solar angles	CO3	1
3.4	Computation of solar radiation on different surfaces-solar path diagram-shadow-throw concept and design of shading devices	CO3	1
3.5	Thermal design of buildings: Thermo physical properties of building materials and thermal control- Passive andactive building design- Steady and periodic heat flow through building envelope.	CO3	1
3.6	Design approaches: Climate conscious designs- Climatic zones inIndia-orientationandshapeofbuildingsindifferentclimatic zones	CO3	2
3.7	Passive solar-Active solar and Active approaches. Requirements of buildings in tropical areas-Thermal insulation	CO3	1
Module IV (7 Hours)			
4.1	Functional elements: Concept for electrical load calculation of structures	CO4	1
4.2	Basic criteria for plumbing design	CO4	1
4.3	Basic concept of HVAC load calculation	CO4	1
4.4	Functional protection: Causes of fire, Mechanism of fire spread in buildings, classification of fire-High temperature effects and combustibility of building materials and structure- Fire alarm system, and means of escape. Firefighting installations	CO4	2
4.5	Basic concept of functioning of elevators and escalators and basic cost estimation ofservices.	CO4	2
Module V (6Hours)			
5.1	Functionality as per Vastusastra: Basic concepts- Governing criteria of functionality - Energy pattern	CO5	1
5.2	Understand traditional techniques in Tropical climate with vernacular buildings in Kerala as case study	CO5	2
5.3	Innovative concepts of functionality: Concept of green building-case studies on low energy and green buildings-	CO5	2
5.4	Concepts of Intelligent building- Thirsty concrete- Blue roads-self healing concrete	CO5	1

MODEL QUESTION PAPER

Reg. No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CET372

Course Name: FUNCTIONAL DESIGN OF BUILDINGS

Max.Marks: 100 Duration: 3hours

Part A

(Answer all questions; each question carries 3 marks)

1. Write briefly about the audibility range of human beings. (3 Marks)
2. Discuss any three common acoustical defects seen in an auditorium. (3 Marks)
3. What are the advantages and disadvantages of sky lighting? (3 Marks)
4. Briefly describe polar distribution curves (3 Marks)
5. What are the thermal insulating materials used to maintain comfortable conditions inside a building? (3 Marks)
6. What do you understand by the following (i) Solar Constant (ii) Solar Azimuth (iii) Solar Altitude (3 Marks)
7. Write short note on "Handling capacity of Lifts" (3 Marks)
8. Briefly describe firefighting installations (3 Marks)
9. Describe self healing concrete. (3 Marks)
10. List out the advantages of self healing concrete. (3 Marks)

PART B

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

Module – 1

11. (a) TL value of a 16m^2 solid wall is 45 dB. If a hole of 2 cm^2 is drilled through it, find the reduction in TL value? (10 Marks)

    (b) Discuss how the TL value of a separating wall varies with its mass. (4 Marks)

12. (a) Explain how sound intensity varies with distance from a point source

I. In free field

II. In a reverberant field (8 Marks)

(b) What you mean by Acoustical Day Time and Acoustical Night Time. Explain the concepts of $L_{eq}$and L_{dn}? (6Marks)

Module – 2

13. (a) Explain the procedure of design of Artificial lighting by Lumen Method. (7 Marks)

(b) A point source of light has an intensity 2000 candela in the vertically downward direction. The intensity reduces with the angle and reaches 1000 cd at the horizontal direction (90degrees with vertical). If the source is mounted 4m above the working plane, find the illumination due to this light source at points (i) directly under the lamp (ii) at 3m away in the same plane.

(7 Marks)

14. (a) Define the different components of daylight factor? (6 Marks)

(b) What do you understand by the concepts Passive solar design, Active solar design and active design? (8 Marks)

Module – 3

15. (a) Explain the considerations to be made in achieving thermal comfort in hot & dry and Warm and humid regions? (7 Marks)

(b) Explain the concept of shadow angles and shadow throws. How shadow throws are used in the design of shading devices? (7 Marks)

16. (a) Explain the concept of comfort zone based on Bio-climatic chart (7 Marks)

(b) What is Psychrometry? What are the usual input parameters to a Psychrometric chart? What are the various informations we get from a Psychrometric chart? (7 Marks)

Module – 4

17. Explain the features, operation arrangements, location and types of Elevators in public buildings. (14 Marks)

18. Explain the high temperature effects and combustibility of building materials and structures

(14Marks)

Module – 5

19. (a) Explain the concepts of green building. (7 Marks)

(b) Describe LEED and GRIHA ratings for the evaluation of green buildings. (7 Marks)

20. Describe the modern construction materials and its merits (14 Marks)

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

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

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

Mapping of course outcomes with program outcomes

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

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	Lifelong learning

Assessment Pattern

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

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
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	: 30 marks
Part B	: 70 marks

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 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments

deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, 'Principles of Micro Economics', Cengage Publications
2. Gregory N Mankiw, 'Principles of Macro Economics', Cengage Publications
3. Dwivedi D N, 'Macro Economics', Tata McGraw Hill, New Delhi.
4. Mithani D M, 'Managerial Economics', Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, 'International Economics', McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India's exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE: **PAGES:3**

Reg No:_____ **Name :_____**

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

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

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

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?

2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?

3. In the production function Q= $2L^{1/2}K^{1/2}$ if L=36 how many units of capital are needed to produce 60 units of output?

4. Suppose in the short run AVC 4. Suppose in the short run AVC<P<AC. Will this firm produce or shut down? Give reason.

5. What is predatory pricing?

6. What do you mean by non- price competition under oligopoly?

7. What are the important economic activities under primary sector?

8. Distinguish between a bond and share?

9. What are the major components of balance of payments?

10. What is devaluation? **(10 x 3 = 30 marks)**

PART B

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

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.

    b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.

    b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?

    b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.

    b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

    i. If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
    ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales?

    c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		**7 Hours**
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		**7 Hours**
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		**6 hours**
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

CET308	COMPREHENSIVE COURSE WORK	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	1	0	0	1	2019

Preamble: The course is designed to ensure that the student have firmly grasped the foundational knowledge in Civil Engineering familiar enough with the technological concepts. It provides an opportunity for the students to demonstrate their knowledge in various Civil Engineering subjects.

Pre-requisite: Nil

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

CO1	Learn to prepare for a competitive examination
CO2	Comprehend the questions in Civil Engineering field and answer them with confidence
CO3	Communicate effectively with faculty in scholarly environments
CO4	Analyze the comprehensive knowledge gained in basic courses in the field of Civil Engineering

CET 308 Comprehensive Course Work		PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
	CO1	3	1	1			2							1	1	
	CO2	3	1				2				3					
	CO3	3	1			1	2				3				1	
	CO4	3	3			1	2									

Assessment pattern

Bloom's Category	End Semester Examination (Marks)
Remember	25
Understand	15
Apply	5
Analyze	5
Evaluate	
Create	

End Semester Examination Pattern:

A written examination will be conducted by the University at the end of the sixth semester.The written examination will be of objective type similar to the GATE examination.Syllabus for the comprehensive examination is based on following five Civil Engineering core courses.

CET 201- Mechanics of Solids

CET 203- Fluid Mechanics and Hydraulics

CET 205- Surveying& Geomatics

CET 204- Geotechnical Engineering I

CET 309–Construction Technology and Management

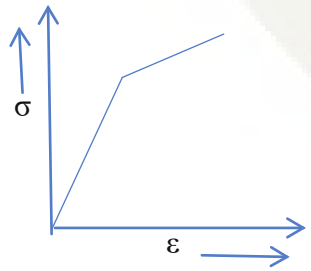
The written test will be of 50 marks with 50 multiple choice questions (10 questions from each module) with 4 choices of 1 mark each covering all the five core courses. There will be no negative marking. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practising questions based on the core courses listed above.

Written examination	:	50marks
Total	**:**	**50 marks**

Course Level Assessment and Sample Questions:

1) Poisson's ratio for an incompressible isotropic material is:
   A) 0.25 B) 0.5 C) Zero D) Indeterminate

2) The following stress-strain curve is obtained for a material. It indicates



A) Rigid body behaviour
B) Perfectly plastic behaviour

C) Elastic-linear strain hardening behaviour
D) Elastic- plastic behaviour

3) A principal plane is one where the shear stress will be:
A) Maximum B) Minimum C) Zero D) Coverage of principal stress

4) In a differential manometer, the flowing fluid is water and the gauge fluid is mercury. If the manometer reading is 100mm, the differential head in meters is:
A) 13.6 B) 1.36 C)1.47 D)1.26

5) A rectangular open channel carries a flow of $2m^3$/sec/m, what is the value of minimum specific energy?
A) 0.74m B) 1.11m C) 1.48m D) 1.85m

6) A pipe has diameter 0.4m, length 0.1km and coefficient of friction 0.005. What is the length of an equivalent pipe which has diameter 0.2m and coefficient of friction 0.008?
A) 195m B) 19.5m C)1.95m D) 1950m

7) The true bearing of a line is 40°30'. Declination is 3°W. The magnetic bearing of line is:
A) 43°30' B) 37°30' C) 36°30' D) 44°30'

8) Points C and D are 1530m apart across a wide river. The following reciprocal levels are taken with one level.

Level at	Reading on	
	C	D
C	3.810 m	2.165 m
D	2.355 m	0.910 m

The true difference in elevation between C and D is:

A)1.645 m B) 1.545 m C) 1.745 m D) 1.345 m

9) Fore bearing of a line is 540°. Declination is 2°W. True bearing of line is:
A)222° B) 218° C) S 42°E D) S 38° E

10) The dry density of a soil is 1.5 g/cc. If the saturation water content were 50%, then its saturated density and submersed density would respectively be,
A)1.5 g/cc and 1.0g/cc B)2.0 g/cc and 1.0 g/cc C)2.25 g/cc and 0.25 g/cc
D)2.50 g/cc and 1.50 g/cc

11) A clay sample has a void ratio of 0.50 in dry state and if the specific gravity of solids is 2.70, its shrinkage limit will be
A)12% B)13.5% C)18.5% D)22%

12) A non–homogenous soil deposit consists of a silt layer sandwiched between a fine–sand layer at top and a clay layer below. Permeability of the silt layer is 10 times the permeability of the clay layer and one–tenth of the permeability of the sand layer. Thickness of the silt layer is 2 times the thickness of the sand layer and two–third of the thickness of the clay layer. The ratio of equivalent horizontal and equivalent vertical permeability of the deposit is _____.
A)10.967 B)10.968 C)10.969 D)None of these

13) Which cement contains high percentage of C_3S and less percentage of C_2S?
A) Rapid Hardening Cement B) Ordinary Portland Cement C) Quick Setting Cement D) Low Heat Cement

14) Workability of concrete is measured by _____
A) Vicat apparatus test B) Slump test C) Minimum void method D) Talbot Richard test

15) The shortest possible time in which an activity can be achieved under ideal circumstances is known as _____
A) Pessimistic time estimate B) Optimistic time estimate C) Expected time estimate D) None of these

Course Code: CET 308

Comprehensive Course Work

MODULE 1

Concept of stress and strain, Hooke's law, Stress-strain diagram of mild steel;Axially loaded bars.Temperature stress in composite bars, Poisson's ratio, Elastic constants and the relationship between them.Beams, Concept of bending moment and shear force, Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams for different type of loads. Theory of simple bending; Shear stress in beams. Principal stresses and principal planes in 2D problems, maximum shear stress; Mohr's circle .

MODULE 2

Fluid properties; Fluid statics, measurement of fluid pressure. Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating andsubmerged bodies, metacentre and metacentric height; continuity equation in one, two and three dimensions.Bernoulli's equation and its applications; Pipe flow- computation of major and minor losses in pipes,equivalent pipe.

Open channel flow, velocity distribution in open channels, uniform flow computations, Most economical sections, Specific energy, Critical flow; Hydraulic jump.

MODULE 3

Introduction to Surveying- Principles, Linear, angular and graphical methods.Bearing of survey lines, Local attraction, Declination; Principles of levelling, Methods of levelling. Theodolite surveying, Measurement of horizontal and vertical angle; Triangulation. Traverse Surveying, Checks in closed traverse; Theory of Errors – Types, theory of least squares, Weighting of observations. Total Station – concept of EDM, principles and working. GPS-Components and principles. Remote Sensing.

MODULE 4

Definitions and properties of soil, 3 phase system, Index properties of soil, Soil classification, Effective stress, Quick sand condition, Stress distribution, Permeability of soil, Darcy's law, Factors affecting permeability, Laboratory tests, Consolidation, Normally consolidated, over consolidated and under consolidated soils, Time factor, Coefficient of consolidation, Compaction Tests – OMC and MDD, shear strength of soil, Triaxial compression test, Unconfined compression test, Direct shear test and Vane shear test

MODULE 5

Cement: Manufacturing, chemical composition, Types, Tests, Hydration of cement. Properties of fresh concrete and hardened concrete. Types of stone masonry – composite walls - cavity walls and partition walls - Construction details and features. Finishing works: Plastering, Pointing, Painting – objectives and types. Prefabricated construction – advantages and disadvantages, Prefabricated building components. Causes of failures in RCC and Steel structures. Types of tenders, Types of contracts. Types of Schedules. Network analysis –CPM, PERT – concepts and problems

CEL332	TRANSPORTATION ENGINEERING LAB	CATEGORY	L	T	P	CREDIT	Year of Introduction
		PCC	0	0	3	2	2019

Preamble: The objective of this course is to enable students to assess the quality of various pavement materials and their suitability in highway construction. The course is designed to make student familiar with mix design and do functional evaluation of pavements.

Prerequisite: CET 206 Transportation Engineering I

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Analyse the suitability of soil as a pavement subgrade material
CO 2	Assess the suitability of aggregates as a pavement construction material
CO 3	Characterize bitumen based on its properties so as to recommend it as a pavement construction material.
CO 4	Design bituminous mixes for pavement layers
CO 5	Assess functional adequacy of pavements based on roughness of pavement surface.

Mapping of Course Outcome with Programme Outcome

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

Course level assessment questions

CO1 : Determine CBR value of the given sample of soil. Comment on its suitability as a subgrade material.

CO2 : Find the impact value of the given sample of aggregates. Assess its suitability as a pavement construction material based on specifications given relevant codes/guidelines.

CO3 : Determine softening point of the given sample of bitumen.

CO4 : Determine optimum binder content of the given bituminous mix by Marshall method of mix design.

CO5 : Determine IRI value of the given road surface using MERLIN. Comment on the condition of road surface comparing standard values.

Assessment pattern

Bloom's Taxonomy	Continuous Internal Evaluation (CIE) (Marks)	End Semester Examination (ESE) (Marks)
Remember	10	15
Understand	10	15
Apply	40	40

Marks Distribution

Total marks	CIE (marks)	ESE (marks)	ESE duration
150	75	75	3 hours

Continuous Internal Assessment (CIE) pattern

Attendance: 15 marks

Continuous Assessment: 30 marks

Internal Test: 30 marks

End Semester examination (ESE)pattern

The following guidelines should be followed regarding award of marks

Preliminary Work: 15 marks

Conduct of Experiment: 10 marks

Tabulation of readings, Calculation, Result and Inference: 25 marks

Viva: 20 marks

Record: 5 marks

General Instructions regarding ESE

End semester evaluation is to be conducted under the equal responsibility of both internal and external examiners. The students shall be allowed for the ESE only on submitting the duly certified record. External examiner shall endorse the record.

Syllabus

List of Experiments

1. Test on soil : 1 session
2. Tests on coarse aggregates : 6 sessions
3. Tests on bitumen : 4 sessions
4. Mix design of bituminous mix : 1 session
5. Functional evaluation of pavement : 1 session

Course Content and Practical Schedule

Expt. No	List of Experiments	Course Outcome	No.of Hours
1	**Test on soil** California Bearing Ratio Test (soaked/unsoaked specimen)	**CO1**	3
2	**Test on Coarse Aggregate** Specific Gravity and Water Absorption Test	**CO 2**	3
3	Aggregate Impact Test		3
4	Los Angeles Abrasion Test		3
5	Aggregate Crushing Value Test		3
6	Shape Test (Angularity number, flakiness index, Elongation index, Combined flakiness and elongation index)		3
7	Stripping value of road aggregates		3
8	**Tests on Bitumen** Determination of grade of bitumen based on viscosity	**CO 3**	3
9	Softening point		3
10	Ductility of bitumen		3
11	Flash and fire point of bitumen		3
12	**Design of Bituminous Mix** Design of bituminous mix by Marshall method of mix design	**CO4**	3
13	**Functional Evaluation of Pavement** Use of MERLIN apparatus to determine road roughness	**CO5**	3

***Any twelve experiments are mandatory**

Reference Books

1. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A.,"Highway Materials and Pavement Testing", Nem Chand & Bros., Roorkee

2. G. Venkatappa Rao, K. Ramachandra Rao, Kausik Pahari and D.V. Bhavanna Rao.,"Highway Material Testing and Quality Control", I.K. International.

3. L.R.Kadiyali and N.B Lal., "Principles and Practices of Highway Engineering", Khanna Publishers.

CEL 334	CIVIL ENGINEERING SOFTWARE LAB	CATEGORY	L	T	P	CREDIT	Year of Introduction
		LAB	0	0	3	2	2019

Preamble: The course aims to train the students to use different software tools needed for professional practice in civil engineering. Also. the field expertise needed for undertaking the surveying activity using modern instruments and hence to prepare the necessary engineering documentation are included in this laboratory course.

Prerequisite: Civil Engineering drawing, structural analysis and design courses, surveying lab.

General Instructions to Faculty:

1. All exercise listed in the syllabus need to be performed mandatorily.
2. The laboratory should have possession of required software and survey equipment for effective delivery of laboratory sessions
3. Periodic maintenance and calibration of various testing instruments needs to be made.
4. Use of data visualization packages needs to promoted 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 undertake analysis and design of multi-storeyed framed structure, schedule a given set of project activities using a software.
CO 2	To prepare design details of different structural components, implementation plan for a project.
CO3	To prepare a technical document on engineering activities like surveying , structural design and project planning.

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 troubleshooting) : 25 Marks
(d) Viva voce : 20 marks
(e) Record : 5 Marks

General instructions:

Practical examination to be conducted immediately after the second series test and covering entire syllabus given below. Evaluation is to be conducted by 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. N Krishna Raju, Structural Design and Drawing, Second Edition, Universities Press (India), Private Limited, Hyderabad, 2009

2. Reference Manual of the Relevant Software

3. Satheesh Gopi, Dr. R Sathikumar, N Madhu, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2006

4. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, US, 2015

SYLLABUS

1. Analysis and design of steel and RCC elements using any standard software used in the industry.

   Exercise 1: Analysis and design of continuous and cantilever beams

   Exercise 2; Analysis and design of plane truss and frames

   Exercise 3:Analysis and design of multi-storied RCC framed structures.

2. Preparation of structural drawings of slabs and beams

   Exercise 4:Detailed structural drawing of one way / two ay and continuous slabs.

   Exercise 5: Detailed structural drawing of singly reinforced / double reinforced Beams.

   Exercise 6: Detailed structural drawing of continuous / flanged beams.

   Exercise 7: Detailed structural drawing of foundation units – isolated and combined footing (rectangular)

3. Use of Building Information Modelling tools

   Introduction to BIM process and describe the workflow in using BIM in the building lifecycle (Theory discussion – 2 hours)

   Exercise 8: Preparation of building model from a given architectural drawing of a residential unit and perform model based cost estimation

   Exercise 9:Create a schedule and import it into the 4D modelling environment, so that each activity in the schedule can be linked to an object in the model.

   Exercise 10:Develop schedules for the construction of slabs, walls, columns, beams and windows of a section of a residential building

   Exercise 11:Effect of rescheduling the activities to complete the project in minimum time frame.

4. Use of Project Management Software (MS Project/Primavera)

   Introduction to project management -CPM & PERT (Theory class-2 hours)

   Exercise 12:Preparation of Bar Chart/Gantt Charts/CPM/PERT Charts

Exercise 13: To find the critical Path based on the given set of activity / event data

Exercise 14:Practice on Resource allocation and Project Monitoring(Cost and Time).

4. Field exercise to use Total Station

Exercise 15: Field exercise on preparation of contour map for a given terrain using advanced surveying instruments like Total Stations (The survey activity undertaken shall be of at least 5000 Sq. m)