SEMESTER I

Discipline : CIVIL ENGINEERING
Stream : CE1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE100	PROBABILITY AND STATISTICS	DISCIPLINE CORE	3	0	0	3

Preamble: The objective of this course is to expose the students to the fundamental concepts of probability and statistics. The course aims to equip the students to find solutions for many real-world civil engineering problems and to understand basic data analysis tools by applying the principles of statistics.

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

CO 1	To create an awareness of the concepts of statistics and probability distributions
CO 2	To formulate and test hypotheses for civil engineering problems
CO 3	To apply statistical data analysis tools such as ANOVA and experimental designs
CO 4	To build regression models for civil engineering applications and to identify the principal components
CO5	To apply the concepts of data analysis for a time series

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3	2		3			2
CO 2	3	2	2	3	3		2
CO 3	3	2	2	3	3		2
CO 4	3	2	2	3	3		2
CO5							

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	5
Create	5

Mark distribution

Total Marks	CIA	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation: 40 marks

Micro project/Course based project	:	20 marks
Course based task/Seminar/Quiz	:	10 marks
Test paper, 1 no.	:	10 marks

The project shall be done individually. Group projects are not permitted. The project may include the implementation of theoretical computation using software packages.
The test papers hall include a minimum 80% of the syllabus.

End Semester Examination: 60 marks

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A contain 5 numerical questions (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students), with 1 question from each module, having 5 marks for each question. Students shall answer all questions. Part B contains 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student shall answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Syllabus

Module 1- Introduction to probability distributions

Sample Space and Events, Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence. Random Variables–discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance.

Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions, Fitting of binomial and Poisson distributions.

Module 2- Statistical Inference

Populations and samples. Sampling distribution of the mean(sigma known and unknown), Sampling distribution of the variance(sigma known and unknown).Interval estimation:-Confidence interval for mean and variance.-Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.-Test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence

Module 3- Analysis of variance

Analysis of variance. Completely randomized designs and randomized block designs.- Latin square designs -Factorial experiments: Two-factor experiments (overview only)

Module 4- Correlation and regression models

Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient- Multiple linear regression, normal equations -Principal components (brief overview only)

Module 5-Time Series Models

Components of time series. Identifying linear trend: semi averages method and least squares method. Smoothing: moving averages, weighted moving averages, exponential smoothing using one smoothing coefficient. Forecasting, measuring forecasting accuracy

Course Plan

No	Topic	No. of Lectures
1	**Introduction to probability distributions**	
1.1	Sample Space and Events, Axioms of Probability, Addition rules, Conditional Probability, Multiplication and Total Probability rules, Independence.	1
1.2	Random Variables–discrete and continuous random variables, Probability mass functions and probability density functions. Cumulative distribution functions, Mathematical Expectations, mean and variance.	2
1.3	Standard discrete distributions-Binomial and Poisson distribution. Standard continuous distributions –Exponential and Normal distribution, Mean and variance (derivation is not required). Computing probability using the above distributions, Fitting of binomial and Poisson distributions.	5
2	**Statistical Inference**	
2.1	Populations and samples. Sampling distribution of the mean(sigma known and unknown), Sampling distribution of the variance(sigma known and unknown).Interval estimation:- Confidence interval for mean and variance.	2
2.2	Tests of hypotheses:-Null hypothesis and alternative hypothesis, Type I and Type II errors.	2

2.3	Test of significance of (i) Mean (ii) Mean of two samples (iii)Proportions (iv) Variance (v) Two variance (vi) Paired t-test (vii) Chi-square test of goodness of fit (viii) Chi-square test for independence	4
3	**Analysis of variance**	
3.1	Analysis of variance. Completely randomized designs and randomized block designs.	4
3.2	Latin square designs	2
3.3	Factorial experiments: Two-factor experiments (overview only)	2
4	**Correlation and regression models**	
4.1	Linear regression and correlation, method of least squares, normal regression analysis, normal correlation analysis, correlation coefficient	4
4.2	Multiple linear regression, normal equations	2
4.3	Principal components (brief overview only)	2
5	**Time Series Models**	
5.1	Components of time series. Identifying linear trend: semi averages method and least squares method.	2
5.2	Smoothing: moving averages, weighted moving averages, exponential smoothing using one smoothing coefficient.	3
5.3	Forecasting, measuring forecasting accuracy	3
	Total hours	40

Reference Books

1. Gupta. S. C. and Kapoor. V. K, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 2020
2. Benjamin, Jack.R and Comell.C, Allin, Probability, Statistics and Decision for Civil Engineers, Mc- McGraw-Hill.
3. Johnson RA , Miller I, Freund J. Miller and Freund’s Probability and Statistics for Engineers (9th edition) Pearson. 2018.
4. Response Surface Methodology: Process and Product Optimization Using Designed Experiments, 4th EditionRaymond H. Myers, Douglas C. Montgomery, Christine M. Anderson-Cook ISBN: 978-1-118-91601-8 February 2016.
5. Introduction to Time Series Analysis and Forecasting Second Edition, DOUGLAS C. MONTGOMERY, CHERYL L. JENNINGS, MURAT KULAHCI, John Wiley & Sons, 2015.
6. Papoulis A, Pillai SU Probability, Random Variables and Stochastic Processes McGraw Hill 2022
7. Schiller J, Srinivasan RA, Spiegal M Schaum's Outline of Probability and Statistics, 2012 McGraw Hill
8. Ross S Introduction to Probability and Statistics for Engineers and Scientists Elsevier 6th Edition 2021

Model Question Paper

XXXX PROBABILITY AND STATISTICS

Time: 3 Hrs Max. Marks:60

PART A

(Answer all Questions: Each question carries 5 marks)

1. Explain the concept of mean, median and mode, and its applicability in various contexts with suitable examples.

2. Explain Type I and Type II errors with example.

3. What are the assumptions involved in Analysis of Variance (ANOVA)?

4. Obtain Karl Pearson's correlation coefficient for Stress and Performance.

Observation no.	1	2	3	4	5
Performance	75	80	85	90	95
Stress	80	75	80	60	55

5. Explain briefly the components of time series.

PART B

(Answer any five questions: Each carry 7 marks)

6. The number of products sold by a shop keeper follows Poisson distribution, with a mean of 2 per week. (i) Find the Probability that in the next 4 weeks the shop keeper sells exactly 3 products. (ii) The shop keeper monitors sales in periods of 5 weeks. Find the probability that in the next 15 of these 5-week period, there are exactly 10 periods in which more than 5 products are sold.

7. After conducting series test on ProbabilityandStatistics the following scores were obtained for Batch A and Batch B. Conduct a hypothesis testing for checking the equality of variance in scores of two batchesat a significant level corresponding to a β error probability of 0.9.

A	35	40	42	30	12	50	45	28	26	30
B	20	24	28	26	18	50	50	48	48	09

8. In order to evaluate safety performance of employees across 3 departments, 5 employees across each department were randomly monitored and their safety behaviour on a hundred scale is given below. Do the departments differ in their safety behaviour?

Department	1	2	3	4	5
A1	68	73	75	65	78
A2	85	85	78	86	79
A3	73	77	72	70	76

9. Develop a Regression Equation between A and Busing Method of Least Square. Consider B as the dependent variable. Explain the significance of estimated slope.

Observation no.	1	2	3	4	5
A	75	80	85	90	95
B	80	75	80	60	55

10. Foodgrain production (in lakh tones) is given below. Find the Trend by using 3-yearly and 4-yearly movingaverage method, tabulate the trend values and predict the production for the year 2022.

Years	Production
2008	40
2009	60
2010	45
2011	85
2012	130
2013	135
2014	150
2015	120
2016	200

11. An evaluation of teaching methods shows the following outcomes.

Method of Teaching	No of students	Average marks obtained	Population Standard Deviation
Chalk and Talk Method	32	70	5
PPT and Talk Method	29	65	8

Conduct hypothesis testing for the mean difference of the teaching methods at a significant level corresponding to a Type I error probability of 0.01.

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CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE001	ADVANCED DESIGN OF STRUCTURES	PROGRAM CORE 1	3	0	0	3

Preamble: The course covers advanced topics related to the behaviour and design of reinforced concrete and steel structures. The advanced topics include yield line method of analysis, grid floor and flat slab design, beams, and foundation design. The course also covers advanced design concepts for specific structural steel applications.

Course Outcomes: After the completion of the course on Advanced Design of Structures the student will be able to.

CO 1	Analyse and design slabs using yield line theory
CO 2	Apply IS code provisions for the analysis, design and detailing of flat slabs
CO 3	Design of continuous beams and pile foundation
CO 4	Design of beam column connections in steel buildings
CO 5	Design large span roofing systems for industrial structures

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2	1			
CO 2	1		3	2	1		
CO 3			3	2	1		
CO 4			3	2	1		
CO 5			3	2	1		

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	20
Apply	30
Analyse	10
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Micro project/Course based project : 20 marks
Course based task/Seminar/Quiz : 10 marks
Test paper, 1 no. : 10 marks

The project shall be done individually. Group projects are not permitted. The project may include the implementation of theoretical computation using software packages.

The test papers hall include a minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 221TCE001

ADVANCED DESIGN OF STRUCTURES

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain the characteristic features of yield line.
2. Discuss the following: i) Applications of flat slab ii) Components of flat slab
3. Discuss the design procedure of a pile cap.
4. Explain the types of moment resisting connections in a steel beam-column connection.
5. Explain the different collapse mechanisms in plastic analysis.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Design a RC grid floor to cover a floor area of 11m x 16m. The spacing of ribs in mutually perpendicular direction is 1.6 m c/c. Live load on floor is 3 kN/m^2. Analyse the grid floor by IS 456 method and design suitable reinforcement for the grid floor.

7. Design an interior panel of a flat slab with panel size 6m x 6m by providing drop. The size of columns is (500 x 500) mm and live load on the panel is 4kN/m^2. Use M20 grade concrete and Fe415 steel.

8. Design a continuous beam of two spans supported on stone masonry walls using the limit state method and allowing 15% redistribution of moments. The following data may be assumed.

   Clear span between the supports = 6m

   Width of masonry supports = 330mm

   Thickness of RC slab = 150mm, Spacing of continuous beams = 3m c/c

Self weight of floor finish = 0.4 kN/m^2, LL on the floor = 4kN/m^2

Characteristic cube strength of concrete = 20N/mm^2

Characteristic strength of steel = 415N/mm^2

9. Design a pile foundation under a column transmitting a load of 800kN. The pile is to be driven in to hard stratum available at a depth of 12m. Use M20 concrete and Fe 415 steel.

10. Design a bracket connection to transfer an end reaction of 225kN at an eccentricity of 300mm from the face of the column flange. Design a bolt joint connecting the Tee flange with the column flange.

11. A bracket plate 10mm thick is used to transmit a reaction of 100kN at an eccentricity of 140mm from flange. Design the weld.

12. An Industrial building of plan 15m×30m is to be constructed as shown in Fig.E1. Using plastic analysis, analyse and design the single span portal frame with gabled roof. The frame has a span of 15m, the column height is 6m and the rafter rise is 3m and the frames are spaced at 5m centre-to-centre. Purlins are provided over the frames at 2.7m c/c and support AC sheets. The dead load of the roof system including sheets, purlins and fixtures is 0.4kN/m^2 and the live load is 0.52kN/m^2.

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Syllabus

Module 1

Yield line method of analysis of slabs: – Characteristic features of yield lines, analysis by virtual work method, Yield line analysis by equilibrium method, Design of grid floor approximate method (IS code method)

Module 2

Design of flat slabs: – Introduction, components–IS Code recommendations, IS code method of design, with and without drop, interior and exterior panels.

Module 3

Design of continuous beams: - Redistribution of moments, Design concepts of Pile foundation: Pile and Pile cap design of end bearing piles.

Module 4

Beam-column connection in steel buildings: - Connection Configurations, Simple, Semi-rigid and Rigid Connections, Bolted frame connection, Bolted bracketed connection, Welded frame connection, Welded bracketed connection, Moment resistant connections.

Module 5

Industrial steel buildings: - Building configuration and components, Loads and load combinations, Industrial floor, Roof systems

Plastic analysis, Shape factor, Collapse mechanisms, Design of portal frames.

Course Plan

No	Topic	No. of Lectures
1	**Yield line method of analysis and grid floor design (8)**	
1.1	Concept of yield line and Characteristics	1
1.2	Virtual work method of analysis	2
1.3	Equilibrium method of analysis	2
1.4	Design of grid floor	3
2	**Design of flat slabs (8)**	
2.1	Introduction–components. IS code method of design	1
2.2	Design of flat slab with drop, interior and exterior panel design	3
2.3	Design of flat slab without drop, interior and exterior panel design	3
3	**Design of beams and foundation (8)**	
3.1	Design of continuous beams and IS code provisions	2
3.2	Redistribution of moment	2
3.3	Design of pile and pile cap for end bearing piles.	4
4	**Beam-column connection in steel buildings (9)**	
4.1	Types of connections and configurations	1

4.2	Simple, Semi-rigid and Rigid Connections	1
4.3	Design of bolted frame connection,	2
4.4	Design of bolted bracketed connection	2
4.5	Design of welded frame and bracketed connection	2
4.6	Moment resistant connections: concept only	1
5	**Industrial steel buildings: (9)**	
5.1	Introduction, building configuration and components	1
5.2	Loads and load combinations as per IS code	1
5.3	Industrial floors and roof systems	1
5.4	Plastic analysis, Shape factor	2
5.5	Collapse mechanisms: beam, sway, gable, joint and combined mechanisms	2
5.6	Design of portal frames	2

Reference Books

1. S. Unnikrishna Pillai, Devadas Menon, "Reinforced Concrete Design", Tata McGraw-Hill Publishing Company Ltd.
2. N. Krishna Raju., "Design of Reinforced Concrete Structures", CBS Publishers and Distributors.
3. B. C. Punmia, Ashok K Jain, Arun K Jain, "Reinforced Concrete Vol :II", Lakshmi Publications.
4. P. C. Varghese, "Limit State Design of concrete structures", Prentice Hall of India Private Ltd.
5. P. C. Varghese, "Foundation Engineering", Prentice Hall of India Private Ltd.
6. S. Ramamrutham, "Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company.
7. S. S. Bhavikatti , "Advance R.C.C Design Vol II", New Age International Private Limited
8. IS: 456-2000, SP 16, SP 24, SP 34.
9. N. Subrhamanyan, "Design of Steel Structures", Oxford Publication.
10. Horne, M.R. and Morris L.J., "Plastic Design of Low -rise frames", Granada Publishing.
11. S. K. Duggal, "Design of Steel Structure", Tata Mc Graw Hill.
12. Kuzamanovic B.O. and Willems N., "Steel Design for Structural Engineers", Prentice Hall.
13. IS: 800, "Code of practice for General Construction in steel".
14. IS: 875 - (Part I to V) – "Code of practice for structural safety of building loading standards"

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221TCE002	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	PROGRAM CORE 2	3	0	0	3

Preamble: The course provides the concept of planning, scheduling and controlling techniques necessary for construction projects.

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

CO 1	Estimateactivity durationand resource requirements for work activities.
CO 2	Analyse and apply Critical Path Method and PERT for construction schedules.
CO 3	Optimize resource requirements.
CO 4	Explain the latest trends in scheduling in the construction industry

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		2	1			
CO 2	1		3	2			
CO 3	1		2				
CO 4			1				

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Micro project/Course based project	:	20 marks
Course based task/Seminar/Quiz	:	10 marks
Test paper, 1 no.	:	10 marks

The project shall be done individually. Group projects are not permitted. The project may include the implementation of theoretical computation using software packages.

The test papers hall include a minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the Univeristy. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating totheoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry 7 marks.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code:221TCE002

CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain the factors affecting choice of technology and construction method?
2. Define different types of activity floats.
3. Explain the concept of time cost trade off.
4. Describe the term 'Resource Levelling'.
5. Explain the indices which denote the time efficiency of construction projects.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Explain with an example of concreting, the need for universal coding system for identifying activities.
7. The following details regarding the activities of a project are given.

Activity	A	B	C	D	E	F	G	H
Immediate Predecessor	None	None	A	A	A	B, C	D	E, F, G
Duration (weeks)	4	12	9	15	7.5	9	3.5	5

i. Prepare an Activity on Node Diagram.

ii. Prepare a schedule of activities.

iii. Find the expected duration of the project.

iv. Determine the critical activities.

v. Find the total and free floats of all activities.

8. The details given below pertain to a construction project. The three time estimates of activities are given as a, m and b.

i. Draw the AoN network, determine the critical path and the project completion time.

ii. What is the probability of not meeting the target time of 22 days

Activity		A	B	C	D	E	F	G
Predecessor		None	None	None	A	B	C	D, E
Duration (days)	a	1	1	2	2	3	2	2
	m	3	4	6	2	6	5	5
	b	5	7	10	8	15	8	14

9. The District Corporation intends to install a road traffic regulatory signal in a heavy traffic prone area. The total installation work has been broken down into six activities. The normal and crash durations and crash cost of the activities as expected are given in the table.

Activity	A	B	C	D	E	F
Predecessor	-	-	-	A	B	C, D, E
Normal time (days)	9	8	15	5	10	2
Crash time (days)	6	5	10	3	6	1
Crashing cost/day (Rs.)	30,000	40,000	45,000	15,000	20,000	60,000

i. Draw the project network and find the normal and minimum duration of the work.

ii. Compute the additional cost if the District Corporation wants to complete the project within the shortest possible duration.

10. How can resource planning be used to advantage in construction projects.
11. Explain the benefits of Management Information System.
12. Explain the significance of the following indices in Earned Value Analysis:

i. Schedule Variance

ii. Cost Variance

iii. Cost Performance Index.

Syllabus

Module 1

Basic concepts in the development of construction plans choice of technology and construction method - Defining work tasks – Defining precedence relationships among activities -Estimating activity duration.Estimating resource requirements for work activities - Coding Systems.

Module 2

Relevance of construction schedules. The Critical Path Method -Presenting project schedules with Activity - on - Node diagrams – Leads and Lags - Calculations for critical path scheduling -Activity floats and schedules -Scheduling with uncertain duration - Programme Evaluation and Review Technique - Calculations for Monte Carlo schedule simulation.

Module 3

Crashing and Time / Cost Tradeoffs - Resource oriented scheduling - Scheduling with resource constraints.

Module 4

Updating construction schedules – S curves – Management Information Systems.

Module 5

Earned Value Analysis - Measures of performance- Use of advanced scheduling techniques with awareness on scheduling software

Course Plan

No	Topic	No. of Lectures
1	**MODULE I (6 hours)**	
1.1	Basic concepts in the development of construction plans- Choice of technology and construction method	1
1.2	Defining work tasks – Defining precedence relationships among activities	2
1.3	Estimating activity duration	1
1.4	Estimating resource requirements for work activities -coding systems	2

2	**MODULE II (9 hours)**	
2.1	Relevance of Construction Schedules. The Critical Path Method	2
2.2	Presenting project schedules with Activity - on - Node diagrams, Leads and Lags	1
2.3	Calculations for critical path scheduling	1
2.4	Activity Float and Schedules	2
2.5	Scheduling with uncertain duration - Programme Evaluation and Review Technique	2
2.6	Calculations for Monte Carlo schedule simulation	1
3	**MODULE III (8 hours)**	
3.1	Crashing andTime / Cost Tradeoffs	2
3.2	Resource oriented scheduling	3
3.3	Scheduling with resource constraints	3
4	**MODULE IV (7 hours)**	
4.1	Updating construction schedules	3
4.2	S curves	1
4.3	Management Information Systems	3
5	**MODULE V (9 hours)**	
5.1	Earned Value Analysis - Measures of performance	3
5.2	Use of advanced scheduling techniques with awareness on scheduling software	6

Reference Books

1. Chitkara. K.K(1998) "Construction Project Management: Planning Scheduling and Control",Tata McGraw Hill Publishing Company, New Delhi,
2. Calin M. Popescu, ChotchalCharoenngam (1995), "Project Planning, Scheduling and Controlin Construction : An Encyclopaedia of terms and Applications", Wiley, New York, 34
3. Chris Hendrickson and Tung Au(2000), "Project Management for Construction – FundamentalConcepts for Owners, Engineers, Architects and Builders", Prentice Hall Pittsburgh,
4. Moder, J., C. Phillips and E. Davis (1983) "Project Management with CPM, PERT andPrecedence Diagramming", Van Nostrand Reinhold Company, Third Edition, Willis, E. M,Scheduling Construction Projects
5. John Wiley & Sons, Halpin, D. W (1985). "Financial and Cost Concepts for ConstructionManagement", John Wiley & Sons. New York.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221LCE003	ADVANCED STRUCTURAL ENGINEERING LAB	LABORATORY	0	0	2	1

Preamble: To familiarize the students with the different sophisticated instrumentations used in the laboratory and field for testing materials and structural components. The lab also focuses on design of buildings, preparation of design drawings and scheduling construction projects.

Course Outcomes: After the completion of the course on Advanced Structural Engineering Lab, the student will be able to:

CO 1	Perform basic test for the constituent materials of concrete
CO 2	Perform mix design for various types of concrete as per IS guidelines
CO 3	Calibrate the instruments used in the lab
CO 4	Analyse the behaviour of steel and reinforced concrete structural elements.
CO 5	Perform scheduling of construction projects
CO 6	Prepare building drawings and lab reports

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1			1			
CO 2			2				
CO 3	1						
CO 4	2		2	1			
CO 5			2				1
CO 6		3					

(1-Weak, 2-Medium, 3- strong)

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	100	–	–

Continuous Internal Evaluation Pattern:

The laboratory courses will be having only Continuous Internal Evaluation and carries 100 marks. Final assessment shall be done by two examiners; one examiner will be a senior faculty from the same department.

LIST OF EXPERIMENTS

Study of Instruments

1. Study of various instruments used for determining the material properties of concrete, steel, SCC etc
2. Study of instruments used for determining the durability of materials
3. Calibration of various instruments and equipment used in the lab

Material Testing and Mix Design

4. Review of testing methods of cement, coarse aggregate and fine aggregate as per Indian Standards.
5. Design of concrete mixes.

Testing of Concrete and Structural Members

6. Experimental study of behaviour of
   a) RCC structural elements
   b) Steel structural elements
7. Accelerated curing experiments for concrete.
8. Non- destructive testing of concrete
   a) Rebound hammer
   b) Core cutting
   c) Ultrasonic pulse velocity
   d) Pullout test
   e) Detection of embedded reinforcements

Building Design

9. Analysis and design of a multi-storied building using a suitable software
10. Preparation of detailed structural drawing of multi-storied structures using suitable CAD software
11. Development using BIM for 3D digital model visualization

Estimation and Scheduling

12. Activity identification and calculation of quantities of a multi-storied building.
13. Rate analysis and cost estimation of the building project
14. Preparation and delivery of the bid or proposal of an engineering construction project.
15. Scheduling and project planning using a suitable software.

General Instructions to Faculty:

Any 8 of the 15 experiments included in the list of experiments need to be performed mandatorily.

SEMESTER I

PROGRAM ELECTIVE I

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE100	STRUCTURAL DYNAMICS	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: The course provides the basic concepts of structural dynamics and the theoretical background to perform dynamic analysis of structures. The course focuses on analysis of single and multi-degree of freedom systems. Anintroduction to distributed parameter systems is also given in the course.

Course Outcomes: After the completion of the course on Structural Dynamics, the student will be able to the following:

CO 1	Model single and multi-degree freedom systems for dynamic analysis and develop equations of motion
CO 2	Perform dynamic analysis of single degree freedom systems
CO 3	Perform dynamic analysis of multi - degree freedom systems
CO 4	Analyse and design vibration isolation systems
CO 5	Apply numerical techniques to solve vibratory systems and perform dynamic analysis using software.
CO 6	Perform dynamic analysis of distributed parameter systems

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1	1			
CO 2	2		2	1	1		
CO 3	2		2	1	1		
CO 4	2		2	2	1		
CO 5	3		3	3	2		
CO 6	1		1				

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	40
Analyse	20
Evaluate	-
Create	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Evaluation shall only be based on application, analysis or design-based question

Preparing a review article based on peer reviewed Original publications (minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/Data collection and interpretation : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern: The end semester examination will be conducted by the respective College. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating totheoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 221ECE000

STRUCTURAL DYNAMICS

Max. Marks: 60 Duration: 2.5 hours

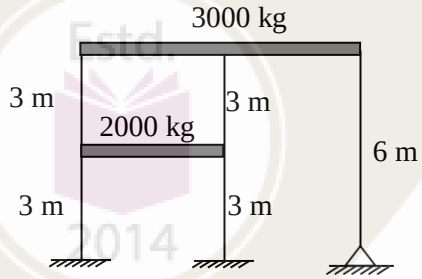
PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. A SDOF system with m = 20 kg, k = 12.5 kN/m and c = 1.5 kN-s/m is given an initial velocity of 50 m/s. Obtain the equation of displacement response and comment about the type of motion.

2. A simple beam of span 4 m having uniform cross section with moment of inertia 5×10^6 cm^4 supports at its centre a machine weighing 7000 kg. The motor runs at 300 rpm and its rotor is out of balance to an extent of 20 kg at an eccentricity of 250 mm. What will be the amplitude of the steady state response if the equivalent viscous damping of the system is assumed 10 % of critical? Neglect mass of the beam.

3. Develop spring-mass model of the shear building frame shown. Take flexural rigidity of all column as 250 kNm^2.



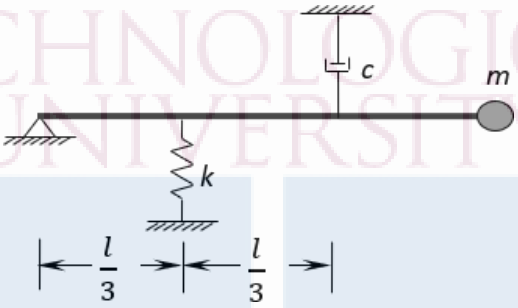
4. Derive the equation of motion for an undamped 2-DOF spring-mass system subjected to harmonic support motion

5. Explain Lagrange's equation. Derive the equation of motion of a SDOF spring-mass system using Lagrange's equation.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. A rigid bar of length *l* having mass μ per unit length is hinged at one end and carries a mass *m* at the other end. It is supported using a spring and a viscous damper as shown in figure. Derive the equation of motion for small oscillations. Find the undamped natural frequency and critical damping coefficient.



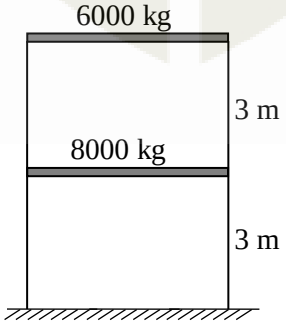
7. A delicate instrument of weight 200 kg is to be mounted on a factory floor using a vibration isolation suspension. The floor is vibrating with an amplitude of 0.25 mm and frequency 15 Hz. The maximum displacement that can be tolerated by the instrument for reliable operation is 0.1 mm. Find the stiffness of the suspension springs assuming 5% of critical damping.

8. A portable harmonic loading machine is used to conduct a test on a single storied building. Harmonic loads of magnitude 1960 N are applied at the floor level at two different frequencies. The test data is given below:

Frequency of load (rad/s)	Response amplitude (cm)	Phase angle (degrees)
8	1.50	7
10	2.25	13

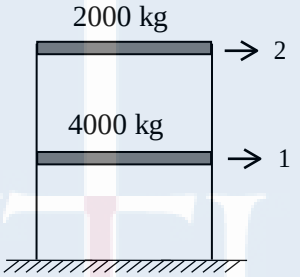
Evaluate the mass, stiffness and damping of the structure, assuming it as a SDOF spring-mass system.

9. Find the natural frequencies and mode shapes of the two storey shear building frame shown in figure. Flexural rigidity of the columns $= 2 \times 10^6$ Nm^2. Sketch the mode shapes also.



10. For a two degrees of freedom lumped mass system, $M = \begin{bmatrix} m & 0 \\ 0 & 2m \end{bmatrix}$; $K = \begin{bmatrix} 2k & -k \\ -k & 3k \end{bmatrix}$ and the modal matrix $\Phi = \begin{bmatrix} 1 & 1 \\ 1 & -0.5 \end{bmatrix}$. The natural frequencies are given by $\omega_1^2 = \frac{k}{m}$ and $\omega_2^2 = \frac{5}{2}\frac{k}{m}$. The first mass of the system is subjected to a harmonic force $P_0 \cos(\Omega t)$. Determine the response of each of the masses. Neglect damping.

11. For the frame shown in figure the natural frequencies are 15.81 rad/s and 31.62 rad/s. The modal matrix $\Phi = \begin{bmatrix} 1 & 1 \\ 2 & -1 \end{bmatrix}$. Neglecting damping, obtain the response of the floors due to a constant ground acceleration of $0.3g$, where $g = 9.81$ m/s^2.



12. Find the first three natural frequencies and mode shapes of a simply supported beam of span L having uniform flexural rigidity EI and mass $\overline{m}$ per unit length. Sketch the mode shapes also.

Syllabus

Module 1

Vibration studies and its importance to structural engineering applications – Types of dynamic loading – Systems with single degree of freedom – Elements of a vibratory system – Mathematical model for single degree of freedom systems - Equation of motion. Undamped and damped free vibration of single degree of freedom system.Measurement of damping from free vibration response - Logarithmic decrement.

Module 2

Response of single degree of freedom systems to harmonic loading, Measurement of damping from forced response – Half power band width method. Impulse response function, Response of single degree of freedom systems subjected to impulse, periodic and general loading- Duhamel integral. Single degree freedom subjected to support motion. Numerical solution of single degree of freedom systems –Central Difference Method - Newmark – β method.Vibration isolation –Transmissibility.Concept of tuned mass damper.

Module 3

Multi-degree of freedom (MDOF) systems – Equation of motion. Shear building concept and models for dynamic analysis –Evaluation of natural frequencies and mode shapes by solution of characteristic equation. Co-ordinate coupling - Orthogonality of normal modes.Mode superposition method of analysis, Free vibration response of MDOF systems due to initial conditions.

Module 4

Forced vibration analysis of multi-degree of freedom systems, Response of multi degree of freedom systems to support motion.Introduction to earthquake analysis, Response spectrum – concept.

Module 5

Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods.Flexural vibration of beams, natural frequencies and mode shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only), Variational formulation of the equation of motion – Hamilton’s principle - Lagrange’s equation.

Course Plan

No	Topic	No. of Lectures
Module I (9)		
1.1	Vibration studies and its importance to structural engineering applications – Types of dynamic loading – Systems with single degree of freedom – Elements of a vibratory system – Mathematical model for single degree of freedom systems - Equation of motion.	4
1.2	Undamped and damped free vibration of single degree of freedom system.	4
1.3	Measurement of damping from free vibration response - Logarithmic decrement.	1
Module II (9)		
2.1	Response of single degree of freedom systems to harmonic loading, Dynamic Magnification Factor. Measurement of damping from forced response – Half power band width method.	3
2.2	Impulse response function, Response of single degree of freedom systems subjected to step loading, rectangular and triangular impulses. Response to general loading- Duhamel integral.	3
2.3	Numerical solution of single degree of freedom systems – Central Difference Method - Newmark – β method.	3
Module III (9)		
3.1	Single degree of freedom system subjected to support motion. Vibration isolation –Transmissibility. Tuned mass damper.	2
3.2	Multi-degree of freedom systems – Equation of motion.	2
3.3	Shear building concept and models for dynamic analysis – Evaluation of natural frequencies and mode shapes by solution of characteristic equation.	3
3.4	Co-ordinate coupling –Orthogonality of normal modes.	1
3.5	Mode superposition method of analysis – free vibration response of MDOF systems.	1
Module IV (7)		
4.1	Forced vibration analysis of multi-degree of freedom systems.	4
4.2	Response of multi degree of freedom systems to support motion.	2
4.3	Introduction to earthquake analysis, Response spectrum – Concept.	1
Module V (6)		
5.1	Distributed mass (continuous) systems – differential equation of motion – Axial vibration of rods.	1
5.2	Flexural vibration of beams, natural frequencies and mode	3

	shapes of simply supported beam. Evaluation of frequencies and mode shapes of cantilever beam and fixed beam (formulation only).	
5.3	Variational formulation of the equation of motion – Hamilton's principle - Lagrange's equation.	2

Reference Books

1. Clough R W and Penzien J, Dynamics of Structures, McGraw Hill, New Delhi.
2. Biggs J M, Introduction to Structural dynamics, McGraw Hill, New Delhi.
3. Mario Paz, Structural Dynamics – Theory and Computation, CBS Publishers and Distributors, Delhi.
4. Mukhopadhyay M, Structural Dynamics - Vibrations and Systems, Ane Books India, Delhi.
5. Humar J, Dynamics of Structures, CRC Press, Netherlands.
6. Anil K Chopra, Dynamics of Structures- Theory and Application to Earthquake Engineering, Pearson Education, New Delhi.
7. Roy R Craig, Structural Dynamics – An Introduction to Computer Method, John Wiley & Sons, Newyork.
8. Thomson W T, Theory of Vibration with Application, Pearson Education, New Delhi.
9. Weaver W, Timoshenko S P, Young D H, Vibration Problems in Engineering, John Wiley & Sons, USA.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE001	THEORY OF ELASTICITY	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: The course exposes the students to advanced concepts of strength of materials. Students are introduced to two- and three-dimensional problems in rectangular and polar coordinate systems to describe stress and strain in an elastic continuum. An introduction to plasticity is also provided.

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

CO 1	Develop the concept of stress-strain tensors and their relationships in 3D continuum problems.
CO 2	Idealize physical problems into plane stress and plane strain problems and solve them using stress functions.
CO 3	Describe the state of stress and strain developed in solids due to applied loads
CO 4	Compute the effect of torsion in thin-walled and irregular closed/open sections.
CO 5	Apply various failure criteria for general stress states at points.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2	1		2		1		
CO 3	1		1		1		
CO 4	1		3		1		
CO 5	1						

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	20
Evaluate	15
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 221ECE001

THEORY OF ELASTICITY

Max. Marks: 60 Duration: 2.5 hours

PART A

Answer all questions; each question carries 5 marks

1. Comment on Octahedral plane and octahedral stresses.
2. Differentiate between plane stress and plane strain problems with suitable examples.
3. What do you mean by strain energy and strain energy density?
4. Explain Prandtl's membrane analogy.
5. Scrutinise yield criteria and its significance.

PART B

Answer any five questions; each question carries 7 marks

6. The state of stress at a point is specified by the following stress components

$$\begin{matrix} 50 & 50 & 100 \\ 50 & 20 & 10 \\ 100 & 10 & 20 \end{matrix} \text{ MPa}$$

Determine the principal stresses and check the feasibility of stress invariants.

7. Given the following stress function

$$\phi\phi = x^3y + xy + y^3x$$

Determine the stress components and check whether it is a feasible stress function.

8. The strain components at a point on a steel object are €x = 0.001, €y = -0.003, €z = 0, €xy = 0, €yz = 0.015 and €xz = -0.001. E = 207×10^6 KPa and G = 80×10^6 KPa. Determine the value of strain energy density.
9. Derive the torsion equation and list out the assumptions used for the derivation.
10. Derive the governing differential equations of torsion problem by Saint-Venant's approach.
11. Write short notes on
    i. Stress strain curve for ductile material

ii. Yield surfaces
iii. Tresca's yield criteria

12. A circular shaft of inner radius 'r_1' and outer radius 'r_2' is subjected to a twisting moment so that the outer most fibre starts yielding. Determine the twisting moment applied to the shaft. Assume yield stress in shear for the shaft material equal to 'τ_0'. Also calculate the couple for full yielding and at elasto-plastic yielding.

SYLLABUS

Module 1

Basic concepts– Body force–Surface traction–Stresses and strains, Three dimensional stresses and strains – analysis, Transformation equations of 3D stresses & strains, Principal stresses & strains, States of stresses & strain, Equilibrium equations.

Module 2

Plane stress and plane strain– Analysis, Transformation equations, stress–strain relations, Equilibrium equations in Cartesian and polar coordinates, Airy's stress function– Biharmonic Equilibrium, Saint Venant's principle, 2D problems in Cartesian coordinate, Cantilever with concentrated load at free end, Cantilever with moment at free end.

Module 3

Strain Energy Density, Complementary Internal Energy Density, Elasticity and Strain Energy Density, Elasticity and Complementary Internal Energy Density, Generalized Hooke's Law, Anisotropic Elasticity, Isotropic Elasticity, Displacements-strains and compatibilityequations, Equilibrium equations and boundary conditions

Module 4

Torsion of prismatic bar– General solution, warping function approaches Saint Venant'stheory, warping function approaches Prandtl's stress function, Membrane analogy-torsion of irregular cross sections, Torsion of narrow rectangular cross sections, Torsion of multi celled thin wall open and closed sections.

Module 5

Introduction to plasticity – General concepts, Stress – Strain curve, Ideal plastic body – Plastic flow conditions,Theories of failure, Yield criteria – Simple applications, Elasto – plastic analysis for bending and torsion of bars, Residual stresses in bending and torsion.

Course Plan

No	Topic	No. of Lectures
1	**Module I : Elasticity (8)**	
1.1	Basic concepts– Body force–Surface traction–Stresses and strains	1
1.2	Three dimensional stresses and strains – analysis	1
1.3	Transformation equations of 3D stresses& strains	2
1.4	Principal stresses & strains	2
1.5	States of stresses & strain	1
1.6	Equilibrium equations	1
2	**Module II: Two-dimensional stress–strain problems (8)**	
2.1	Plane stress and plane strain– Analysis	1
2.2	Transformation equations, stress–strain relations	1
2.3	Equilibrium equations in Cartesian and polar coordinates	1
2.4	Airy's stress function– Biharmonic Equilibrium	2
2.5	Saint Venant's principle, 2D problems in Cartesian coordinate	1
2.6	Cantilever with concentrated load at free end	1
2.7	Cantilever with moment at free end.	1
3	**Module III: Elements of Theory of Elasticity (8)**	
3.1	Strain Energy Density	1
3.2	Complementary Internal Energy Density	1
3.3	Elasticity and Strain EnergyDensity,Elasticity and Complementary Internal Energy Density	2
3.4	Generalized Hooke's Law	1
3.5	Anisotropic Elasticity, Isotropic Elasticity	1
3.6	Displacements-strains and compatibility equations	1
3.7	Equilibrium equations and boundary conditions	1
4	**Module IV: Torsion (8)**	
4.1	Torsion of prismatic bar– General solution	1
4.2	Warping function approaches Saint Venant's theory.	1
4.3	Warping function approaches Prandtl's stress function	1
4.4	Membrane analogy-torsion of irregular cross sections	2
4.5	Torsion of narrow rectangular cross sections.	1
4.6	Torsion of multi celled thin wall open and closed sections.	2
5	**Module V: Plasticity (8)**	
5.1	Introduction to plasticity – General concepts, Stress – Strain curve	1
5.2	Ideal plastic body – Plastic flow conditions	1
5.3	Theories of failure	1
5.4	Yield criteria – Simple applications	1
5.5	Elasto –plastic analysis for bending and torsion of bars	2
5.6	Residual stresses.	2

Reference Books

1. Timoshenko S P and Goodier J. N, “Theory of Elasticity”, Tata McGraw HillInternational Student Edition.
2. Sadhu Singh, “Theory of Plasticity”, Khanna Publishers, Delhi
3. Srinath L. S, “Advanced mechanics of solids”, Tata McGraw– Hill Publishing CompanyLtd., New Delhi.
4. T. G. Seetharam, L. GovindaRaju, “Applied Elasticity”.Arthur P Boresi& Omar M SideBottom, “Advanced Mechanics of Materials”, John Wiley& Sons.
5. Sokolnikoff, “Mathematical Theory of Elasticity”, McGraw-Hill Inc.,US.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE002	MODERN CONSTRUCTION MATERIALS	Program Elective 1	3	0		3

Preamble: The main objective of this course is to develop a strong understanding of the material science of various construction materials and its influence on the performance of the materials in the structure.

Course Outcomes:

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

CO 1	Relate the fundamentals of materials science with properties and behaviour of materials.
CO 2	Explain the properties of various construction materials
CO 3	Explain the failure behaviour of materials under different loading conditions
CO 4	Decide the appropriateness of a material for a specific application

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2			2				
CO 3	1		2		2		
CO 4	1			1	2	1	

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	20
Apply	20
Analyse	15
Evaluate	5

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions.

Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.: _____

Name: _____

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

Course Code: 221ECE002

MODERN CONSTRUCTION MATERIALS

Time: 2.5 hrs. Max. Marks: 60

PART A

(Each question carries 5 marks. Answer ALL questions)

1 Explain any two types of chemical bonds and their influence on material properties.

2 How the slip along the atomic planes affects the material behaviour?

3 Explain any one rheological model. Also describe the suitability of that model for practical condition.

4 Explain how the micro structure of concrete influence its macro behaviour.

5 Explain the application of any two smart and intelligent materials used in construction industry. Correlate the material structure with the application.

PART B

(Each question carries 7 marks. Answer any 5 questions)

6 Describe wetting behaviour of liquids on solids. Also describe how this fundamental understanding can lead to development of new materials.

7 What is rheology? Explain the rheological parameters and their influence in the flow of liquids.

8 Explain the significance of target compressive strength and target mean strength in concrete mix design.

9 Describe the characteristics of bitumen and asphalt concrete. Explain why bitumen is a competitive choice as a pavement construction material.

10 Relate the properties of TMT steel with its production process. Explain why TMT steel is a better choice for buildings in earthquake prone area.

11 Explain the various failure theories. Give a comparison between them in terms of confining pressure.

12 Explain the structure, properties and applications of Fibre Reinforced Plastics.

Syllabus

Module 1

Bonds - Review of chemical bonds, states of matter, structure of materials, Movement of atoms, Development of microstructure;
Surface Properties: Introduction to Surface Energy, Surface Tension, wetting, Adhesion, Adsorption, Surfactants, Capillary Rise, Colloids.

Module 2

Review of mechanical behaviour - Deformation, Stress, Strain, Hooke's Law, Stress-Strain Diagram; Response to stress – Elastic Properties, Plasticity, Yielding, Slip along atomic planes, Strain Hardening, Annealing; Response to stress - Ductile Failure, Brittle Fracture, Fatigue Failure, Creep; Probabilistic Fracture -Tensile and Compressive Strengths, Statistics of Strength;
Failure theories – Uni axial (Tensile) Behaviour of a Metal, Complex Inelastic Response, Multi axial Loading, Introduction to Rankine Theory, Tresca Criterion, von Mises Theory, Mohr coulomb Failure Theory

Module 3

Introduction to Fracture Mechanics - Stress concentration, Pure modes of fracture - Mode I or opening crack, Linear Elastic Fracture Mechanics, Brittle Ductile Transition, Brittle Fracture, Elasto-Plastic Fracture; Fracture in Polymers, Fracture in Composites, Fracture in Concrete.
Rheology - Time-Dependent Material Response, Rheological Models, Rheological Behaviour of Liquids, Thixotropy;
Thermal properties - Heat Capacity, Thermal Expansion, Thermal Stresses, Thermal Conductivity

Module 4

Metals - Structure, Properties and Applications of Iron and Steel, Aluminium;
Timber - Structure of Wood, Properties of Wood, Seasoning of Timber, Engineering Properties, Thermal Properties, Applications of Timber, Wood-Based Composites;
Concrete - Structure, Properties and Applications

Module 5

Bituminous materials - Structure of Bitumen, Specification of Bitumen, Asphalt Concrete Paving Mixtures;
Polymers and Plastics - Structure, Properties and Applications; FRP - Structure, Properties and Application; Glass – Types, properties and applications,
Smart and intelligent materials (shape memory alloys, magnetostrictive materials, piezo electric materials)

Course Plan

No	Topic	No. of Lectures
1	**Review of bonds; development of micro structure; surface properties**	
1.1	Introduction to the subject – Need to understand the material structure – Relationship between micro structure to macro structure behaviour	1
1.2	Bonds - Review of chemical bonds, states of matter, structure of materials	1
1.3	Movement of atoms, development of microstructure	2
1.4	Surface Properties: Introduction to Surface Energy, Surface Tension, Wetting, Adhesion	2
1.5	Surface Properties: Adsorption, Surfactants, Capillary Rise, Colloids	2
2	**Mechanical behaviour of materials; Failure theories**	
2.1	Review of mechanical behaviour - Deformation, Stress, Strain, Hooke's Law, Stress-Strain Diagram	1
2.2	Elastic Properties, Plasticity, Yielding, Slip Along Atomic Planes, Strain Hardening, Annealing	2
2.3	Ductile Failure, Brittle Fracture, Fatigue Failure, Creep.	1
2.4	Probabilistic Fracture -Tensile and Compressive Strengths, Statistics of Strength	1
2.5	Failure theories – Uni axial (Tensile) Behaviour of a Metal, Complex Inelastic Response, Multi axial Loading	1
2.6	Introduction to Rankine Theory, Tresca Criterion, von Mises Theory, Mohr-Coulomb Failure Theory	2
3	**Fracture mechanics; Rheology**	
3.1	Introduction to fracture Mechanics - Stress Concentration, Pure Modes of Fracture-Mode I or opening crack, Linear Elastic Fracture Mechanics, Brittle-Ductile Transition, Brittle Fracture, Elasto-Plastic Fracture	2
3.2	Fracture in Composites, Fracture in Concrete	2
3.3	Rheology - Time-Dependent Material Response, Rheological Models, Rheological Behaviour of Liquids, Thixotropy;	2
3.4	Thermal properties - Heat Capacity, Thermal Expansion, Thermal Stresses, Thermal Conductivity	2
4	**Structure, Properties and Application of Materials – Metals, Timber, Concrete**	
4.1	Metals - Structure, Properties and Applications of iron, steel and aluminium	2
4.2	Timber - Structure of Wood, Properties of Wood, Seasoning of Timber,	1
4.3	Engineering Properties, Thermal Properties, Applications of Timber	1
4.4	Wood-Based Composites	1
4.5	Concrete - Structure, Properties and Applications	3

5	**Structure, Properties and Application of Materials – Bitumen, Polymers and plastics, FRP, Glass, Smart and intelligent materials**	
5.1	Bituminous materials - Structure of Bitumen, Specification of Bitumen, Asphalt Concrete Paving Mixtures	2
5.2	Polymers and Plastics - Structure, Properties and Applications	2
5.3	FRP - Structure, Properties and Applications	1
5.4	Glass – Types, Properties and Applications	1
5.5	Smart and intelligent materials (shape memory alloys, magnetostrictive materials, piezo electric materials)	2

Reference Books

1. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, "The Science and Technology of Civil Engineering Materials", Prentice Hall, 1998
2. W.D. Callister, "Materials Science and Engineering: An introduction", John Wiley, 1994
3. J.M. Illston and P.L.J. Domone, "Construction Materials: Their nature and behaviour", Spon Press, 2001
4. P. Kumar Mehta and Paulo J. M. Monteiro, "Concrete, Microstructure, Properties and Materials", Indian Concrete Institute, Chennai.
5. V. Raghavan, "Materials Science and Engineering: A first course", Prentice Hall, 2004
6. R.A. Higgins, "Properties of Engineering Materials", Industrial Press, 1994
7. J.M. Gere, "Mechanics of Materials", Nelson Thornes, 2001
8. T.L. Anderson, "Fracture Mechanics: Fundamentals and applications", CRC Press, 1991
9. M.F. Ashby and D.R.H. Jones, "Engineering Materials 1", Elsevier, 2005
10. P.C. Varghese, "Building Materials", Prentice-Hall India, 2005.
11. A.M. Neville, "Properties of Concrete", Pearson Education, Delhi, 2004.

NPTEL Course for reference:

- NPTEL course on "Modern Construction Materials", Prof. Ravindra Gettu, IIT Madras
  https://onlinecourses.nptel.ac.in/noc20_ce05/preview

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE003	ADVANCED CONSTRUCTION TECHNIQUES	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: The course helps to study and understand various advanced construction techniques applied to engineering construction. The course covers construction practices for substructure and superstructures of heavy structures, construction sequences of various infrastructures and the different repairing techniques used in construction. Advanced techniques for demolition and dismantling of structure is also included.

Course Outcomes: After the completion of the course on Advanced Construction Techniques the student will be able to

CO 1	Describe the construction practices for sub structures and super structures of heavy structures.
CO 2	Explain the construction sequences of various infrastructures.
CO 3	Describe various repairing techniques in construction.
CO 4	Describe the advanced techniques in demolition and dismantling of structures.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1		1		
CO 2			1		1		
CO 3			1		1		
CO 4			1		1		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 221ECE003

ADVANCED CONSTRUCTION TECHNIQUES

Max. Marks: 60 **Duration: 2.5 hours**

PART A

(Answer ALL questions; each question carries 5 marks)

1. Describe the process of pipe jacking.
2. Discuss in detail about vacuum dewatering of concrete flooring.
3. Elaborate the construction sequence of silos.
4. Write a note on mud jacking.
5. Explain the sequence in which demolition of a building is carried out.

PART B

(Answer any FIVE questions; each question carries 7 marks)

6. What do you understand by deep-well dewatering systems?
7. What are the different launching techniques used for bridge construction? Explain in detail.
8. Make a detailed note on aerial transportation.
9. Describe the sequence of a bow string bridge construction.
10. Explain in detail about concrete paving technology.
11. Elaborate the process and techniques of laying underwater pipelines.
12. Discuss about the processing and disposal of demolition waste.

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Syllabus

Module 1

Sub structure construction- Box jacking and pipe jacking, Under water construction of diaphragm wall and basement, Tunnelling techniques, Piling techniques, Driving well and caissons, Sinking of cofferdams, Dewatering, underground excavation.

Module 2

Super structure construction- Concrete paving technology, Techniques of construction for continuous concreting operations in tall buildings of various shapes and various sections, Suspended formwork, Erection techniques of tall structures, Large span structures, Launching techniques. Ariel transporting.

Module 3

construction sequences - Erecting lattice tower, Construction sequence of cooling towers and chimneys, Construction sequence of silos, Construction sequence of skyscrapers, Sequence of bowstring bridges, Cable stayed bridges.

Module 4

Construction repair- waterproofing on concrete, pipeline laying, protecting sheet piles, mud jacking grout through slab foundation, micro piling for strengthening floor and shallow profile, subgrade waterproofing.

Module 5

Advanced techniques and sequence in demolition and dismantling- Types and methods of demolition, Preparatory operations before demolition and steps, Demolition sequence, Demolition equipment, Demolition waste processing and disposal, Demolition hazards.

Course Plan

No	Topic	No. of Lectures
1	**Sub Structure Construction (8)**	
1.1	Box jacking and pipe jacking	1
1.2	Under water construction of diaphragm wall and basement	1
1.3	Tunnelling techniques	1
1.4	Piling techniques, Driving well and caissons	2
1.6	Sinking of cofferdams	1
1.7	Dewatering	1
1.8	Underground excavation	1
2	**Super Structure Construction (7)**	
2.1	Concrete paving technology	1
2.2	Techniques of construction for continuous concreting operations in tall buildings of various shapes and various sections	1
2.3	Suspended formwork	1
2.4	Erection techniques of tall structures	1
2.5	Large span structures	1
2.6	Launching techniques	1
2.7	Ariel transporting	1
3	**Construction Sequences (8)**	
3.1	Erecting lattice tower	1
3.2	Construction sequence of cooling towers and chimneys	2
3.3	Construction sequence of silos	1
3.4	Construction sequence of skyscrapers	2
3.5	Sequence of bowstring bridges	1
3.6	Sequence of cable stayed bridges	1
4	**Construction Repair (7)**	
4.1	Waterproofing on concrete	2
4.2	Pipeline laying	1
4.3	Protecting sheet piles	1
4.4	Mud jacking grout through slab foundation	1
4.5	Micro piling for strengthening floor and shallow profile	1
4.6	Subgrade waterproofing	1
5	**Advanced Techniques And Sequence In Demolition And Dismantling (6)**	
5.1	Types and methods of demolition	1
5.2	Preparatory operations before demolition and steps	1
5.3	Demolition sequence	1
5.4	Demolition equipments	1

5.5	Demolition waste processing and disposal	1
5.5	Demolition hazards	1

Reference Books

1. Mohammad Najafi (2021), *Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal.* The McGraw-Hill
2. Robert T. Ratay (2012), *Temporary Structures in Construction, Third Edition.* McGraw-Hill
3. Alan Macnab (2002), *Earth Retention Systems Handbook.* The McGraw-Hill Companies, Inc.
4. Richard Lambeck , John Eschemuller (2009), *Urban Construction Project Management. McGraw-Hill Construction Series.* (*1st edition*). The McGraw-Hill Companies, Inc.
5. P. Kumar Mehta, Paulo J.M Monterio (2014), *Concrete: microstructure properties and materials,4th edition.* The McGraw-Hill Companies, Inc.
6. Robert T. Ratey (2010), *Forensic Structural Engineering Handbook, Second Edition.*The McGraw-Hill Companies, Inc.
7. Kristian B Dahl1, Aja Anta Mageroy Tonnessen (2017), *Tresfjord Bridge – a human friendly and traffic efficient structure.* IOP Publishing
8. Mohiuddin A. Khan (2010), *Bridge and Highway Structure Rehabilitation and Repair.* McGraw-Hill Education
9. Alexander James Wallis-Tayler (2017), *Aerial or wire-rope tramways; their construction and management,* Andesite Press
10. Joseph J. Carr, George W. Hippisley (2012), *Practical Antenna Handbook, 5th edition*
11. Eric Kleinert (2015), *HVAC and Refrigeration Preventive Maintenance, 1st Edition.* McGraw-Hill Education
12. Albert Allison Houghton (2012), *Practical Silo Construction; A Treatise Illustrating and Explaining the Most Simple and Easiest Practical Methods of Constructing Concrete Silos of All Types; With Unpatented Forms and Molds.* Hardpress Publishing
13. Akbar R. Tamboli (2012), *Tall and Supertall Buildings: Planning and Design,* McGraw-Hill Education
14. Roger L. Brockenbrough, Frederick S. Merrit (2020), *Structural Steel Designer's Handbook, Sixth Edition.* McGraw-Hill Education
15. Alexander Newman (2021), *Structural Renovation of Buildings: Methods, Details, and Design Examples, Second Edition.*. McGraw-Hill Education

16. Robert W. Day (2010), *Foundation Engineering Handbook: Design and Construction with the 2009 International Building Code, 2nd Edition*.The McGraw-Hill Companies, Inc.
17. M. Rashad Islam (2022), *Construction Safety: Health, Practices, and OSHA,1st Edition*. McGraw Hill
18. George Tchobanoglous, Frank Kreith (2002), *Handbook of Solid Waste Management, 2nd Edition.* The McGraw-Hill Companies, Inc.

SEMESTER I

PROGRAM ELECTIVE II

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE006	FINITE ELEMENT METHOD	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: The course aims to give a fundamental knowledge on finite element method. Students will be able to comprehend FEM as a numerical technique to solve partial differential equations representing various problems in structural mechanics.

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

CO 1	Analyse the structures using energy principles and variational formulation
CO 2	Explain the procedure of finite element method and derive the shape functions of various elements
CO 3	Derive the stiffness matrix of various elements used for the analysis of structures
CO 4	Analyse of structures using finite element techniques

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2	1		1				
CO 3	1		1				
CO 4	1		3	2	2		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	20
Evaluate	15
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Micro project/Course based project: 20 marks

Course based task/Seminar/Quiz: 10 marks

Test paper, 1 no.: 10 marks

The project shall be done individually. Group projects not permitted.

Test paper shall include minimum 80% of the syllabus

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 221ECE006

FINITE ELEMENT METHOD

Max. Marks: 60 Duration: 2.5 hours

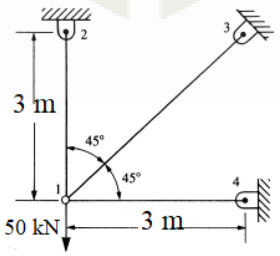
Answer all questions; each question carries 5 marks

1. What is meant by structural idealisation
2. Define degree of continuity and differentiate C0 and C1 elements
3. Explain the significance of static condensation in FEA
4. Evaluate the integral I = $\int_{-1}^{1}(3^x - x)dx$ using two and three Gauss points
5. Compare the structural behaviour of thin and thick plates with the help of classical plate bending theories

PART B

Answer any five questions; each question carries 7 marks

6. Analyse a cantilever beam subjected to concentrated load "W" at free end using Rayleigh Ritz method
7. Derive the shape functions of beam element using Hermition interpolation
8. Analyse the given assembly of truss elements using finite element techniques and determine the x and y displacements at node 1. Also determine stress in each element. E = 2.0x10^6 Pa and A= 15cm^2 for all elements



9. What are isoparametric elements? derive the stiffness matrix of plane bilinear isoparametric element

10 Discuss about displacement functions for plate elements. Prove that rectangular plate element with 12 degrees of freedom is not fully compatible

11 Explain the design procedure of finite element analysis

12 Derive shape functions of quadratic quadrilateral element having 9 nodes using Lagrange interpolation

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Syllabus

Module 1

Introduction to Finite Element Method – Historical development – Advantages – disadvantages – Outline of the FE procedure

Basics of elasticity - Equations of equilibrium – Strain -displacement relation – stress - strain (constitutive) relation- Plane stress and plane strain problems

Energy principles -Principle of virtual work - Approximate methods – Rayleigh Ritz method – Weighted Residual Method

Module 2

Displacement functions - convergence and compatibility requirements –- Types of finite elements - Degree of continuity– C0 and C1 elements

Shape functions – General coordinates – Natural coordinates - Development of shape functions for truss, CST, LST and beam elements

Shape functions of beam element using Hermition interpolation

Lagrange and Serendipity elements – Shape functions using Lagrange interpolation

Module 3

Development of stiffness matrix for bar element, beam elements and triangular elements

Development of consistent nodal load vector- patch test - static condensation.

Analysis of assembly of 2D truss elements, plane frames using finite element techniques

Module 4

Numerical integration - Gauss quadrature technique

Concept of isoparametric formulation- Plane bilinear element- Subparametric and superparametric elements

Module 5

Analysis of plate bending – Basic equation of thin plate theory- Reissner-Mindlin theory – plate elements and applications

Introduction to shell elements

Assembly procedure and storage techniques of stiffness matrix- Band width minimization – Gauss elimination

Discussion of modelling and analysis using recent finite element software packages

Course Plan

No	Topic	No. of Lectures
1	**Module I : Total lecture hours : 11**	
1.1	Historical development of FEA – Advantages and disadvantages	1
1.2	Outline of Finite Element Procedure	1
1.3	Basics of elasticity	1
1.4	Plane stress and plane strain problems	1
1.5	Energy principles - Principle of virtual work - Principle of stationary potential energy	1
1.6	Rayleigh Ritz method	3
1.7	Weighted residual method – Galerkin method	3
2	**Module II : Total lecture hours : 8**	
2.1	Convergence and compatibility requirements of displacement functions	1
2.2	Types of finite elements, Degree of continuity - C0 and C1 elements	1
2.3	General coordinates and Natural coordinates	1
2.4	Development of shape functions for truss elements, CST elements, LST elements	2
2.4	Development of shape functions for beam element using Hermitian interpolation	1
2.5	Lagrange and Serendipity elements, Shape functions of 1D and 2D elements by Lagrange interpolation	2
3	**Module III : Total lecture hours : 8**	

3.1	Development of stiffness matrix for bar element, beam element	1
3.2	Development of stiffness matrix for triangular elements	1
3.3	Development of consistent nodal load vector	1
3.4	Patch test - Static Condensation.	1
3.5	Analysis of assembly of 2D truss elements using finite element techniques	2
3.6	Analysis of plane frame using finite element techniques	2
4	**Module IV : Total lecture hours : 8**	
4.1	Numerical integration - Gauss quadrature technique	2
4.2	Concept of isoparametric formulation,	1
4.3	Isoparametric formulation of Plane bilinear element	2
4.4	Subparametric and superparametric elements	1
4.5	Numerical problems on Isoparametric formulation	2
5	**Module V : Total lecture hours : 8**	
5.1	Analysis of plate bending – Basic equation of thin plate theory- Reissner-Mindlin theory – plate elements and applications	3
5.2	Introduction to shell elements	1
5.3	Assembly procedure and storage techniques of stiffness matrix- Band width minimization	2
5.4	Gauss Elimination	1
5.4	Discussion of modelling and analysis using recent finite element ssoftware packages	1

Reference Books

1. Cook R D et al., Concepts and Applications of Finite Element Analysis, John Wiley & Sons, Singapore.
2. Krishnamoorthy C S, Finite Element Analysis- Theory and Programming, Tata McGraw Hill, New Delhi
3. Rajasekharan S, Finite Element Analysis in Engineering Design, Wheeler, New Delhi
4. Chandrupatla T R and Belegundu A D, Introduction to Finite Elements in Engineering, Pearson Education, New Delhi
5. Bathe K J, Finite Element Procedures in Engineering Analysis, Prentice Hall, New Delhi
6. Zienkiewicz O C and Taylor R W., Finite Element Method, Elsevier Butterworth-Heinemann, UK
7. Logan D L, A First Course in Element Method, Thomson, 2007

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE007	HIGH RISE STRUCTURES	PROGRAM ELECTIVE 1	3	0	0	3

Preamble: Due to urbanization and lack of land, it has become inevitable to construct high rise structures. This subject will make the students aware of the various structural systems for high rise structures and the suitability of each towards different varying parameters. The course provides the basic principles involved in the design of high-rise structures. Different types of loads acting on a high-rise building are to be discussed after which the structural system required to take these loads are to be dealt with. The methods of analysis of high-rise structure are also to be discussed.

Course Outcomes: After the completion of the course on High-Rise Structures the student will be able to

CO 1	Describe the design philosophy and design criteria for tall buildings.
CO 2	Identify the characteristics of wind and earthquake loads acting on high rise structure.
CO 3	Choose and apply appropriate structural systems for different sizes and heights of structures
CO 4	Analyse the effect of gravity and lateral loads on structural members of tall structures.
CO 5	Analyse the behaviour of different structural forms and systems to carry lateral loads of high-rise structures
CO 6	Apply modelling and analysis methods for high rise buildings.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2	1		2				
CO 3	1		3	2	1		
CO 4	1		2				
CO 5	1		2				
CO 6	2		3		1		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	
Understand	
Apply	40

Analyse	20
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code: 222ECE007

HIGH-RISE STRUCTURES

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain the factors affecting the growth, height and structural forms of tall buildings.
2. Discuss the different types of gravity loads and associated parameters to be considered for the analysis and design of a tall building.
3. List with sketches, three floor systems suitable for high rise structures.
4. Explain the behaviour of high-rise structures with braced frames.
5. Discuss the advantages of outrigger braced structure over core structure.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Discuss the design criteria for high rise structures.
7. Explain the need of wind tunnel test. What are the different types of wind tunnel experiments for high rise buildings.
8. Explain the different performance levels of building considered in Performance based seismic design.
9. A three-span beam each of 4m span carries a dead load of 6 kN/m for all the spans and 4kN/m for the two consecutive spans from right. Determine the support moments for the beams, if it is simply supported through out.
10. Discuss the advantage of a wall frame structure over framed or wall structures.
11. Discuss the different types of modelling for high rise structures.

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Syllabus

Module – 1

Definition and need of tall building - Historic background - factors affecting growth. Design Criteria, Design Philosophy of High-Rise structures, Materials for construction of high rise structures.

Module – 2

Different types of Loadings – Gravity Loads, Wind Load, Static and Dynamic methods, Wind Tunnel test, Seismic Load, Performance Based Seismic Design

Module – 3

Structural form, Floor systems, Rigid frame Structures, Portal method, Cantilever method, approximate analysis of drift

Module – 4

Braced frames, Infilled frames, behaviour of infilled frames Shear wall Structures-behaviour of shear wall structures, Coupled shear walls, Wall frame structures- behaviour of wall frame.

Module – 5

Tubular structures-framed tube structures-bundled tube structures-braced tube structures, Core structures, Outrigger-Braced Structures, Foundations for tall structures-pile foundation-mat foundation, Modelling for analysis for high rise structures – approximate analysis, accurate analysis and reduction techniques, Discussion of various Finite Element Packages for the analysis of High-Rise Structures.

Course Plan

No	Topic	No. of Lectures
Module – 1		
1.1	Definition and need of tall building - Historic background - factors affecting growth	1
1.2	Design Criteria, Design Philosophy of High-Rise structures	2
1.3	Materials	2
2.1	Dead and live load, live load reduction techniques	2
Module – 2		
2.2	Sequential loading, Impact loading	1
2.3	Wind Loading - Wind Characteristics, Static and Dynamic wind effects - Analytical and wind tunnel experimental method	3

2.4	Seismic Loading - Earthquake loading-equivalent lateral force method, modal analysis, Introduction to Performance based seismic design	3
Module – 3		
3.1	Structural form, Floor systems, Rigid frame Structures, rigid frame behaviour	3
3.2	Approximate determination of member forces by gravity loading-two cycle moment distribution	3
3.3	Approximate determination of member forces by lateral loading-Portal method, Cantilever method	2
Module – 4		
4.1	Braced frames- Types of bracings-behaviour of bracings, behaviour of braced bents-method of member force analysis-method of drift analysis	2
4.2	Infilled frames, behaviour of infilled frames-stresses in infill-forces in frame- design of infill and frame (no numerical)-horizontal deflection	2
4.3	Shear wall Structures-behaviour of shear wall structures - proportionate wall systems, non-proportionate wall systems (no analysis required)- horizontal deflection, Coupled shear walls - behaviour of coupled wall structures	2
4.4	Wall frame structures- behaviour of wall frames	2
Module – 5		
5.1	Tubular structures-framed tube structures-bundled tube structures-braced tube structures	1
5.2	Core structures, Outrigger-Braced Structures	1
5.3	Foundations for tall structures-pile foundation-mat foundation	2
5.4	Modelling for analysis for high rise structures – approximate analysis, accurate analysis and reduction technique.	2
5.5	Discussion of various Finite Element Packages for the analysis of High-Rise Structures	1

Text Books

1. Bryan Stafford Smith and Alex Coull, Tall Building structures: Analysis and Design, Wiley-Interscience, New York, 1991.

2. Bungale S Taranath, Structural Analysis and Design of Tall Buildings, Tata McGraw Hill,1988.

Reference Books

1. Robert L Wiegel, Earthquake Engineering. Prentice Hall, 1970.

2. Kolousek V, Pimer M, Fischer O and Naprstek J, Wind effects on Civil Engineering Structures. Elsevier Publications, 1984

3. IS 16700:2017, Criteria for Structural Safety for Tall Concrete Buildings, BIS

4. High Rise Building Structures, Wolfgang Schueller, Wiley

5. Designing and installation of services in building complexes and high rise buildings, Jain, V.K., Khanna Publishers, New Delhi.

6. High rise structures; design and constructions practices for middle level cities, Gupta, Y.P., New Age International Publishers, New Delhi..

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE008	CONSTRUCTION MANAGEMENT AND ENGINEERING ECONOMICS	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: The course provides a basic awareness of scientific management thoughts and an in-depth knowledge of projects, the various types and their planning and management. The students will be exposed to the concepts of engineering economics which will facilitate economic decision-making. Students are introduced to systematic knowledge of management information systems in decision-making.

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

CO 1	Describe the concept and basic principles of scientific management and the various phases in the planning of construction projects
CO 2	Explain MIS effectiveness, efficiency criteria and failure ofMIS
CO 3	Apply the concepts of engineering economics in economic decision making
CO 4	Describe construction accounting and long-term and short-termfinancing
CO 5	Describe the need for PPP projects and the importance of risk allocation inthe projects and compare and contrast the various PPP models

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1				1
CO 2			1				1
CO 3			2	2			1
CO 4			1				1
CO 5			1				1

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewedoriginal publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating tothe theoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

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

Course Code:221ECE008

CONSTRUCTION MANAGEMENT & ENGINEERING ECONOMICS

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Describe the principles of scientific management.
2. Explain database Management.
3. Discuss Time value of money.
4. Explainconstruction accounting.
5. Explain operation and maintenance contracts.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Discuss the major contributions of pioneers in scientific management.
7. Explain the project formulation stage of a construction project.
8. Discuss MIS effectiveness and efficiency criteria. Also, mention the failures of MIS.
9. Distinguish between break-even analysis and benefit cost analysis.
10. Explain long-term and short-term financing problems.
11. Explain commercial risk in PPP projects. Discuss the measures that can be adopted to mitigate the commercial risk.
12. With an illustration, explain the typical structure of a BOT project.

Syllabus

Module 1

Scientific Management: Concept - elements - contributions of pioneers in scientific management - basic principles of management with reference to construction industry - Construction Projects – concepts – types – life cycle of a construction project

Module 2

Management information Systems: Definition - evolution - organizational theory - systems approach - computer systems -database management - information systems for decision making - MIS effectiveness and efficiency criteria -failure of MIS.

Module 3

Engineering Economics: Definition and scope - cash flow - interest formulas and application - time value of money -bases of comparison - decision making amongst alternatives - rate of return - benefit cost analysis-incremental analysis replacement analysis - break even analysis.

Module 4

Capital budgeting - working capital management - construction accounting - long term and short term financing - problems and case studies.

Module 5

Private sector participation in Infrastructure Development Projects - PPP models - operation-maintenance, lease, concession (BOT), Private Finance Initiative - Risk identification and allocation in PPP projects - PPP structure and financing

Course Plan

No	Topic	No. of Lectures
1	**MODULE I (8 hours)**	
1.1	Scientific managementconcept - elements	1
1.2	Contributions of pioneers in scientific management	2
1.3	Basic principles of management with reference to construction industry	2
1.4	Construction Projects – concepts – types	1
1.5	Life cycle of a construction project	2
2	**MODULE II (8 hours)**	
2.1	Management information Systems Definition	1
2.2	Evolution - organizational theory	2
2.3	Systems approach -computer systems-database management	2
2.4	Information systems fordecision making	1
2.5	MIS effectiveness and efficiency criteria- Failure ofMIS.	2
3	**MODULE III (10 hours)**	
3.1	Engineering Economics- Definition and scope - Cash flow	2

3.2	Interest formulas and application- Time value of money	2
3.3	Bases of comparison -Decision making amongst alternatives- Rate of return	2
3.4	Benefit cost analysis -Incremental analysis	2
3.5	Replacement analysis - break even analysis	2
4	**MODULE IV (6 hours)**	
4.1	Capital budgeting – workingcapital management- construction accounting	2
4.2	Long-term and short-term financing	2
4.3	Problems and case studies	2
5	**MODULE V (8 hours)**	
5.1	Private sector participation in Infrastructure Development Projects – concept, benefits, limitations	1
5.2	PPP models - operation-maintenance, lease, concession, Private Finance Initiative	4
5.3	Risk identification and allocation in PPP projects	1
5.4	PPP structure and financing	2

Reference Books

1. Kumar Neeraj Jha (2015). Construction Project Management Theory & Practice, Pearson India Education Services Pvt. Ltd.
2. Leland Blank and Anthony Tarquin (2017). Engineering Economy, McGraw-Hill Education, New York.
3. Frederick E. Gould (2013). Managing the Construction Process: Estimating, Scheduling, and Project Control, Pearson.
4. Joy P.K. (1994). Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd.
5. Prasanna Chandra (2014). Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi
6. K. K. Chitkara (1998). Construction Project Management Planning Scheduling & Controlling, Tata McGraw Hill, New Delhi
7. A Guidebook on Public-Private Partnership in Infrastructure, UNESCAP (2011).
8. DinkarPagare. "Principles of Management" - Sultan Chand &Sons,New Delhi.
9. Robert G.Murdick, Joel E Ross, James R Clagget. "Information systems for ModernManagement "- PHI Learning Private Limited, New Delhi.
10. R.Paneerselvam. "Engineering Economics" - PHI Learning Private Limited, New Delhi.
11. B. L. Gupta and Amit Gupta. "Construction management and machinery" – Standardpublishers Distributors, Delhi.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
221ECE009	CONSTRUCTION CONTRACTS METHODS AND EQUIPMENT	PROGRAM ELECTIVE 2	3	0	0	3

Preamble: The course provides the basic understanding of the definition,types, elements and characteristics of contract as per Indian contract act. Students are also introduced to the laws related to dispute management, insurance and bonds as part of the project management. The course covers the construction methods and also the latest equipments used for the successful completion of modern construction projects.

Course Outcomes: After the completion of the course on Construction Contracts Methods and Equipment the student will be able to

CO 1	Describe the basic elements, types and conditions of contract.
CO 2	Explain the various steps involved in the contact documentation, claims and methods for dispute management.
CO 3	Summarise the laws related to insurance, bonds,specifications and termination of contract.
CO 4	Explain the modern construction methods, and their applications in the construction industry.
CO 5	Summarise the various types of equipment used in the construction projects andtheir capabilities.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2				
CO 2			2	1			
CO 3			2				
CO 4			2	1			
CO 5			2				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	25
Understand	35
Apply	
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE: **Reg No. :_____**

Name:_____

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

Course Code: 221ECE009

CONSTRUCTION CONTRACTS METHODS AND EQUIPMENT

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer **ALL** questions; each question carries 5 marks)

1. Explain the term 'Competency of Parties' as per Indian Contract Act.
2. State and explain the various duties assigned to an arbitrator.
3. What are the different ways by which a contract can be discharged?
4. Differentiate between 3D volumetric and tunnel form of construction.
5. Explain the operating principle of a clam shell with a neat sketch.

PART B

(Answer **anyFIVE** questions; each question carries 7 marks)

6. "All agreements are not contracts." Explain this statement as per Indian Contract Act.
7. Write notes on appointment and removal of arbitrators as per arbitration act.
8. State and explain the laws related to workmen's compensation act.
9. Explain in detail the types of specifications and standards used in construction projects.
10. Elucidate the various methods used for soil stabilisation.
11. Summarise the several types of cost-effective construction methods.
12. List the different compaction equipments with neat sketches. Briefly describe thesuitability of each equipment.

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Syllabus

Module I

Contracts

Requirement of Contract, Elements of Contracts based on Indian Contract Act (1872), Types of Contracts based on Stakeholder responsibilities, Project Delivery Models – (Turnkey, EPC and PPP Models), Standard forms of contract - (FIDIC, NHAI and CPWD), General conditions of the contract for construction.

Module 2

Contract Administration

Project Documentation, Submission and approval of documents, Permits and approvals, Construction claims and disputes, Potential major claim areas, The Bid Proposal Process and the Potential for Disputes, Modes of resolving disputes, Understanding of Arbitration and Conciliation Act 1996 with latest amendments.

Module 3

Contract Management

Discharge of contract, Breach of contract, Tendering issues, Risks in construction contract, Regulatory aspects and ethics, Intellectual property act, Law of Torts, General Construction specifications, Commercial Construction Specifications, Bonds, Types of Bonds, Insurance, Workers compensation Insurance, Commercial general liability insurance, Builders riskinsurance.

Module 4

Construction Methods

Horizontal Systems – Hand - set slab forms, Table forms, Vertical Systems – Wall forms, Column forms, Combined Horizontal and Vertical Systems – Tunnel Form Systems, TrenchSafety. Cost effective construction methods - Prestressed concrete construction - 3D printing. Precast Flat Panel System-3D Volumetric Construction-Flat Slabs-Hybrid Concrete Construction-Precast Foundations-Insulating Concrete Formwork-Soil stabilisation methods

Module 5

Construction Equipment

Dozers and graders, Scrapers, hydraulic excavators, Draglines and Clamshells.
Concreting equipment - Crushers – feeders – screening equipment – batching and mixing equipment – hauling, pouring and pumping equipment – transporters. Equipment for compaction- Pneumatic Tired Rollers, Impact Compactors, Compaction Wheels, Intelligent compaction. Trucks and Hauling Equipments - Capacities of Trucks and Hauling Equipment – Calculation of truck productivity.

Course Plan

No	Topic	No. of Lectures
1	**Contracts(9)**	
1.1	Requirements of Contract	1
1.2	Elements of Contract based on ICA	1
1.3	Types of contracts based on stakeholder responsibilities	1
1.4	Project delivery models - Turnkey model, EPC model, PPP model	3
1.5	Standard forms of contract – FIDIC, NHAI, CPWD	2
1.6	General conditions of the contract for construction	1
2	**Contract Administration (7)**	
2.1	Project Documentation, Submission and approval of documents	2
2.2	Permits and approvals, Construction claims and disputes	1
2.3	Potential major claim areas	1
2.4	The Bid Proposal Process and the Potential for Disputes, Modes of resolving disputes	2
2.5	Understanding of Arbitration and Conciliation Act 1996 with latest amendments	1
3	**Contract Management (7)**	
3.1	Discharge of contract, Breach of contract, Tendering issues	1
3.2	Risks in construction contract, Regulatory aspects and ethics, Intellectual property act, Law of Torts	1
3.3	General Construction Specifications, Commercial Construction Specifications	1
3.4	Bonds, Types of Bonds	1
3.5	Insurance, Workers compensation Insurance, Commercial general liability insurance, Builders risk insurance	3
4	**Construction Methods (9)**	
4.1	Horizontal systems-Hand-Set slab form, Table forms, Vertical Systems-Column form-Wall forms	2
4.2	Combined Horizontal and vertical Systems-Tunnel form systems, Trench safety	2
4.3	Cost effective Construction Methods-Prestressed Concrete Construction-3 D Printing	2
4.4	Precast Flat Panel System-3D Volumetric, Flat Slab, Hybrid Concrete Construction	1
4.5	Precast Foundations, Insulating Concrete Formwork	1
4.6	Soil Stabilization Methods	1
5	**Construction Equipment (8)**	
5.1	Dozers and graders, Scrapers, hydraulic excavators, Draglines and Clamshells	2
5.2	Concreting equipment - Crushers – feeders – screening equipment – batching and mixing equipment – hauling, pouring and pumping	2

	equipment – transporters	
5.3	Equipment for compaction- Pneumatic Tired Rollers, Impact Compactors, Compaction Wheels, Intelligent compaction	2
5.4	Trucks and Hauling Equipment - Capacities of Trucks and Hauling Equipment – Calculation of truck productivity	2

Reference Books

1. Indian Contract Act (1872)
2. Sidney M. Levy –"Project Management in Construction, 7th Edition", 2018 McGraw-HillEducation.
3. Richard Lambeck and John Eschemuller- "Urban Construction Project Management",2009 The McGraw-Hill Companies, Inc.
4. Donald L. Marston, J.D., P.Eng "Law for Professional Engineers: Canadian and GlobalInsights", 5th Edition.
5. David A. Madsen "Commercial Building Construction: Materials and Methods", 1st Edition.
6. Clifford J. Schexnayder, Christine M. Fiori, "Handbook for Building Construction:Administration, Materials, Systems, and Safety", 1st Edition, 2021 McGraw Hill.
7. Construction Planning, Equipment, and Methods, 9th Edition, 2018 McGraw-Hill Education
8. Robert L. Peurifoy, P.E., Clifford J. Schexnayder, P.E., Ph.D., Robert L. Schmitt, P.E., Ph.D.Aviad Shapira, D.Sc.
9. Dr. Mahesh Varma, "Construction Equipment and its Planning and Application ", Metropolitan Book Company, New Delhi
10. Mustafa Mahamid , Edwin H. Gaylord , Charles N. Gaylord, "Structural EngineeringHandbook", 5th edition.
11. Hwaiyu Geng, "Manufacturing Engineering Handbook", 2nd edition.
12. Richard L. Handy, "Foundation engineering: Geotechnical principles and practical applications", 1st edition.

SEMESTER II

Discipline:CIVIL ENGINEERING

Stream : CE1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222TCE100	ADVANCED NUMERICAL METHODS	DISCIPLINE CORE 2	3	0	0	3

Preamble: For solving complex problems in mechanics and engineering, a post-graduate student must be well versed in numerical methods along with skills to apply them. This course equips the student with various numerical techniques that finds applications in civil engineering, across various streams (specialisations). Special focus is given to finite element method, explaining the relevance, versatility and fundamental concepts of this numerical tool.

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

CO 1	Obtain the solution of simultaneous Linear system of equations
CO 2	Obtain the numerical solutions of ordinary differential equations
CO 3	Obtain the numerical solutions for solving boundary value problems of partial differential equations
CO 4	Describe the terminologies, applications or procedure of finite element method
CO 5	Describe or apply the concept of finite element method

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	3			3			
CO 2	3			3			
CO 3	3			3			
CO 4	1		2	2	2	2	
CO 5	3			2	2	2	

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	5
Create	5

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern: 40 marks

Preparing a review article based on peer reviewed original publications (Minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/Data collection and interpretation : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

Note: Enough opportunity to explore the practical examples from specialization should be given to the students. One assignment/course project should be based on the coding or use of packages

End Semester Examination Pattern: 60 marks

The end semester examination will be conducted by the University. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

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

Course Code: XXXXXX

ADVANCED NUMERICAL METHODS

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain the procedure of solution of Tridiagonal systems
2. Explain single shooting method for solving Boundary value problems
3. Explain the parabolic and elliptic partial differential equations with examples
4. Explain any five practical applications of Finite element in the con
5. Explain Generalised coordinates and Natural coordinates in Finite Element analysis

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Solve the system of equations by Jacobi's iteration considering initial approximation as $[0.5, -0.5, 0.5]^T$

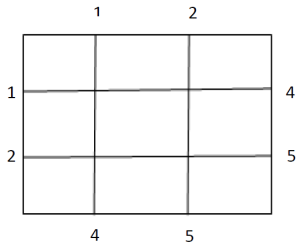
$$4x_1 + x_2 + x_3 = 2$$

$$x_1 + 5x_2 + 2x_3 = -6$$

$$x_1 + 2x_2 + 3x_3 = -4$$

7. Solve $y'=x^2+y$ for y=0.1, given that $y(0)=1$ considering h=0.05 using (i) Eulers method and (ii) Runge Kutta method

8. Solve the equation $uxx + uyy = 0$ for the square mesh with boundary value as shown in figure



9. Solve $\left(\frac{\partial u}{\partial t}\right)=\left(\frac{\partial^2 u}{\partial x^2}\right)$ subject to the conditions $u(x,0)=\sin(\pi x)$ for $0 \le x \le 1$ $u(0, t)=u(1, t)=0$. Perform the computations of two levels taking $h=1/3$ and $t=1/36$ using Crank Nicolson implicit scheme

10. Explain in detail the steps of finite element analysis

11. Explain forms of shape functions in finite element analysis

12. Explain the convergence criteria in finite element applications in detail

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Syllabus

Module 1 **(7 hours)**

Solutions of simultaneous Linear Systems of Equations- Solution of linear systems – Direct methods, Gauss-Jordan Method-Method of factorization- Solution of Tridiagonal Systems. Solution by matrix decomposition Iterative methods: Jacobi, Gauss-Siedel iteration for ordinary and sparse systems, Convergence of iterative solution schemes with examples.

Module 2 **(7 hours)**

Solving Ordinary Differential Equations- The Elementary Theory of Initial-Value Problems -Euler's Method- Higher-Order Taylor Methods. Runge-Kutta Method- Introduction to solution methods for differential algebraic equations- Single shooting method for solving ODE-BVPs.

Module 3 **(7 hours)**

Partial differential equations in two dimensions- Parabolic equations- Explicit finite difference method. Crank-Nicholson implicit method - Ellipse equations- Finite difference method-Problems with irregular boundaries.

Module 4 **(7 hours)**

Introduction to Finite Element Method – Historical Background — Mathematical Modeling of field problems in Engineering — Governing Equations — Discrete and continuous models — Boundary, Initial and Eigen Value problems– Basic concepts of the Finite Element Method- Displacement approach-Concept of Stiffness Matrix and Boundary Condition-- General procedure of FEA

Module5 **(7 hours)**

Concept of Finite Element Method- Concept of Nodes, elements, Generalised coordinates and Natural coordinates in FEA. Shape functions – Polynomials - Lagrangian and Hermitian Interpolation –- Compatibility - C0 and C1 elements - Convergence criteria - Conforming & nonconforming elements. Development of element matrices for one dimensional elements.

Text Books

1.Gupta,S.K. Numerical Methods for Engineers. Wiley Eastern, New Delhi, 1995.

2. Cook, RD. Concepts and Applications of Finite Element Analysis , Wiley.

Reference Books

1. Gilbert Strang, Linear Algebra and its Applications (4th Ed.), Wellesley Cambridge Press 2009

2. Gourdin, A. and M Boumhrat. Applied Numerical Methods.Prentice Hall India, New Delhi 2000

3. Chopra S.C. and Canale R.P. Numerical Methods for Engineers,McGraw Hill 2006

4. Krishnamoorthy C S, *Finite Element Analysis- Theory and Programming*, Tata McGraw Hill, New Delhi., 1994

5. Rao, SS. Finite Element Analysis, Elsevier Butterworth-Heinemann

6. Gerald and Wheatly, *Applied Numerical Analysis,* Pearson Education.

7. Rajasekharan S., *Numerical Methods in Science and Engineering,* S Chand & Company, 2003.

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

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CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222TCE001	ADVANCED CONCRETE TECHNOLOGY	PROGRAM CORE 3	3	0	0	3

Preamble: The course covers the properties of the ingredients of concrete and its influence on the performance of concrete. The course also focus to develop a strong understanding about the latestdevelopments in the area of concrete technology with a clear knowledge about thefundamental mechanisms.

Course Outcomes: After the completion of the course on Advanced Concrete Technology the student will be able to

CO 1	Discuss the role of various ingredients in concrete with its properties
CO 2	Describe the various mix design procedures and tests on fresh and hardened properties
CO 3	Explain the various deterioration mechanisms in concrete
CO 4	Describe the various new methods and techniques used in concrete construction
CO 5	Explain the various quality tests for concrete

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2	1		2	1			
CO 3	1		1				
CO 4			1	1			
CO 5	1		1				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	20
Analyse	5
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewedoriginal publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating totheoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION,

MONTH & YEAR

Course Code: 222TCE001

222TCE001– ADVANCED CONCRETE TECHNOLOGY

Time: 2.5 hrs. Max. Marks: 60

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1 Describe the characteristics of hydration products of cement and its influence in the properties of concrete.
2 Explain the influence of various factors affecting the workability of concrete on the rheological parameters.
3 Explain the methods to prevent corrosion of rebars in RCC.
4 Briefly describe the polymer concrete and its advantages and disadvantages.
5 How the temperature will affect the properties of concrete?

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6 What are admixtures in concrete and its classification? Briefly explain superplasticizers and its mechanism of action.
7 Mention the various steps involved in the high strength concrete mix design.
8 What are the transport mechanisms in concrete and describe any one test for each of the mechanism.
9 In a congested reinforced concrete work which type of concrete will you prefer and why? Explain its mix proportioning, properties, advantages and disadvantages.
10 The condition assessment needs to be done in a concrete water tank. Which are the tests you recommend for assessing the quality and strength of concrete. Briefly explain the tests also.
11 Why special concretes are needed and explain any three special concretes based on their application.
12 What is durability of concrete? Describe the factors affecting the durability of concrete structures.

Syllabus

Module 1 - Materials for concrete

Cement - Production, composition, hydration chemistry, Structure ofhydrated Cement,Solids in hydrated cement paste, Voids in hydratedcement paste and Water in hydrated cement paste.**Aggregates** - Geology of concrete aggregates, classification, testing ofaggregates. **Chemical Admixtures** - Different Types, Influence on the properties ofconcrete

Supplementary Cementitious Materials -Different materials,Pozzolanic reaction, Influence on the properties of concrete**Fibres** - Types, Influence on the properties of concrete, Advantages andDisadvantages

Module 2 - Concrete mix design and testing

Concrete Mix design - Methods of Concrete mix design, Highperformance and high strength concrete mixture proportioning. **Advanced topics in fresh concrete** - Rheology, pumping of concrete. **Advanced topics in hardened concrete** - Behavior under various loads,stress-strain relationships, Variability of concrete strength, creep andshrinkage.

Module 3 - Durability problems of concrete

General, Durability related clauses in IS 456, Specification for concrete – prescriptive Vs performance, Chemical attack of concrete - sulphate attack, acid attack;Corrosion of steel rebars, Carbonation and chloride induced, Freeze-thaw resistance, alkali silica reaction, Effect of temperature on the properties of concrete,Durability Tests.

Module 4 - Special Concretes

Self-compactingConcrete, Fibre reinforced Concrete, Light weightConcrete, Polymer Concrete, Heavy Weight concrete, Roller compacted concrete, Pervious/no fines concrete Coloured concrete, High strength concrete, Ultrahighstrength concrete,Bacterial concrete/Self-healing concrete, Self-cleaning Concrete

Module 5 - Modern trends in concrete

Modern trends in concrete - manufacture, placing, transportation, compaction, finishing andcuring, Non-destructive testing and quality control, White Topping, Emerging trends in replacement of conventional materials in concrete, Vacuum dewatering ofconcrete, under water concreting,Shotcreting,3D printing

Course plan

No	Topic	No. of Lectures
1	**Materials for concrete**	
1.1	**Cement** – Production, composition, hydration chemistry, Structure ofhydrated Cement, Solids in hydrated cement paste, Voids in hydratedcement paste and Water in hydrated cement paste.	3
1.2	**Aggregates** – Geology of concrete aggregates, classification, testing ofaggregates	1
1.3	**Chemical Admixtures** – Different Types, Influence on the properties ofconcrete	1
1.4	**Supplementary Cementitious Materials:-** Different materials, Pozzolanic reaction, Influence on the properties of concrete	2
1.5	**Fibres**– Types, Influence on the properties of concrete, Advantages andDisadvantages	1
2	**Concrete mix design and testing**	
2.1	**Concrete Mix design** - Methods of Concrete mix design,	2
2.2	High performance and high strength concrete mixture proportioning	2
2.3	**Advanced topics in fresh concrete** – Rheology, pumping of concrete	2
2.4	**Advanced topics in hardened concrete** – Behavior under various loads,stress-strain relationships, Variability of concrete strength, creep andshrinkage.	2
3	**Durability problems of concrete**	
3.1	Durability problems of concrete– General	1
3.2	Chemical attack of concrete	2
3.3	Corrosion of steel rebars,	1
3.4	Freeze-thaw resistance, ASR attack, Carbonation	1
3.5	Durability design of concrete	1
3.5	Durability Tests	2
4	**Special Concretes**	
4.1	Self-compacting Concrete	1
4.2	Fibre reinforced Concrete	1
4.3	Light weightConcrete	1
4.4	Polymer Concrete	1
4.5	Heavy Weight concrete, Roller compacted concrete	1
4.6	Pervious/no fines concrete, Coloured concrete	1
4.7	High strength concrete, Ultra high strength concrete	1
4.8	Bacterial concrete/Self-healing concrete, Self-cleaning Concrete	1
5	**Modern trends in concrete**	

5.1	Modern trends in concrete - manufacture, placing, transportation	1
5.2	Modern trends in concrete –compaction, finishing and curing	1
5.3	Non destructive testing and quality control	2
5.4	White Topping	1
5.5	Emerging trends in replacement of conventional materials in concrete	1
5.6	Vacuum dewatering of concrete, Under water concreting, Shotcreting	1
5.7	Effect of temperature on the propertiesof concrete	1

Reference Books

1. P. Kumar Mehta and Paulo J. M. Monteiro, Concrete: Microstructure, Properties and Materials, McGraw Hills, Newyork, 2013.
2. S. Mindess and J.F. Young, Concrete, Prentice-Hall, Englewood Cliffs, New Jersey, USA, 1981
3. A.M. Neville, Properties of Concrete, Pearson Education, Delhi, 2004.
4. A. M. Nevile, and J. J. Brookes,Concrete Technology, Pearson India Education Services Pvt. Ltd., India.
5. H.F.W. Taylor, *Cement Chemistry*, Thomas Telford Publ., London, 1997
6. *J.F. Young, S. Mindess, R.J. Gray & A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.*
7. *P.-C. Aïtcin, High-Performance Concrete, E&FN Spon, London, 1998*
8. R. Rixom and N. Mailvaganam, *Chemical Admixtures for Concrete*, E&FN Spon, London, 1999.
9. *Indian Standard IS 10262-1982, Recommended guidelines for concrete mix design, Bureau of Indian Standards, New Delhi, 2019.*

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222PCE100	MINI PROJECT	PROJECT	0	0	4	2

Mini project can help to strengthen the understanding of student's fundamentals through application of theoretical concepts and to boost their skills and widen the horizon of their thinking. The ultimate aim of an engineering student is to resolve a problem by applying theoretical knowledge. Doing more projects increases problem solving skills.

The introduction of mini projects ensures preparedness of students to undertake dissertation. Students should identify a topic of interest in consultation with PG Programme Coordinator that should lead to their dissertation/research project. Demonstrate the novelty of the project through the results and outputs.The progress of the mini project is evaluated based on three reviews, two interim reviews and a final review. A report is required at the end of the semester.

Evaluation Committee - Programme Coordinator, One Senior Professor and Guide.

Sl. No	Type of evaluations	Mark	Evaluation criteria
1	Interim evaluation 1	20	
2	Interim evaluation 2	20	
3	Final evaluation by a Committee	35	Will be evaluating the level of completion and demonstration of functionality/ specifications, clarity of presentation, oral examination, work knowledge and involvement
4	Report	15	the committee will be evaluating for the technical content, adequacy of references, templates followed and permitted plagiarism level(not more than 25%)
5	Supervisor/Guide	10	
	Total Marks	100	

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222LCE003	COMPUTATIONAL LAB	LABORATORY	0	0	2	1

Preamble: The course familiarizes the students with experimental and computational tools used in structural engineering and construction technology. The course imparts an ability to use these tools in research and solution of field problems.

Course Outcomes: After the completion of the course on Advanced Structural Engineering Lab, the student will be able to:

CO 1	Prepare computational models of structures
CO 2	Generate response of structures experimentally and/or using computational models
CO 3	Compute plot area and earthwork quantity using Total Station survey
CO 4	Analyse spatial data using GIS analysis tools
CO 5	Prepare lab reports

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		1				
CO 2	2		3	1	2		
CO 3	1		2		1		
CO 4	2		2	1	1		
CO 5		3	2				1

(1- Weak, 2-Medium, 3- strong)

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	100	–	–

Continuous Internal Evaluation Pattern:

The laboratory courses will be having only Continuous Internal Evaluation and carries 100 marks. Final assessment shall be done by two examiners; one examiner will be a senior faculty from the same department.

LIST OF EXPERIMENTS

Computational modelling for Static Analysis

Modelling and static Analysis (using Ansys or ABAQUS) of the following:

1. Modelling and analysis of Cantilever Beam
2. Modelling and analysis of Simply Supported Beam
3. Modelling and analysis of Portal Frame

Experimental and/or Computational modelling for Dynamic Analysis

Dynamic testing and/or computational modelling (using Ansys or ABAQUS) of the following:

4. Free Vibration of Cantilever beam.
5. Dynamics of simply supported beam subjected to harmonic load.
6. Dynamics of a three storied building frame subjected to harmonic base motion
7. Dynamics of a vibration absorber
8. Dynamics of a four storied building frame with and without an open ground floor
9. Dynamics of a single span and two span beams

Total station survey

10. Computation of area of a plot using Total Station survey
11. Contouring and plotting
12. Computation of earthwork from contour plot
13. Setting out of multi-level buildings
14. Setting out of a road with horizontal and vertical curves

GIS Functions

15. Digitization and Geo-referencing
16. Spatial Analysis
17. Data Output – Different types

GIS Applications

18. Environmental Applications
19. Transportation planning
20. Preparation of Maps and Layouts.

General Instructions to Faculty:

Any 8 of the 20 experiments included in the list of experiments need to be performed mandatorily.

SEMESTER II

PROGRAM ELECTIVE III

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE100	ANALYSIS AND DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: The course provides the basic principles of earthquake resistant design of structures. Students are introduced to the engineering aspects of earthquakes, their characterisation and effects. The course covers seismic design force computation, design and detailing as per Indian Standards. An introduction to seismic evaluation and retrofitting is also included.

Course Outcomes: After the completion of the course on Analysis and Design of Earthquake Resistant Structures the student will be able to

CO 1	Describe various engineering aspects of earthquakes, earthquake effects and earthquake resistant design.
CO 2	Apply IS code provisions for the analysis, design and detailing of earthquake resistant structures.
CO 3	Develop earthquake response spectrum.
CO 4	Perform response spectrum analysis of multi-storied frames.
CO 5	Analyse and design shear walls.
CO 6	Describe different strategies for seismic evaluation and seismic retrofitting.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1				
CO 2	1		3	2	2		
CO 3	2		2	1			
CO 4	1		2	2	2		
CO 5	1		2	2	2		
CO 6			1				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating totheoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: 222ECE000

ANALYSIS AND DESIGN OF EARTHQUAKE RESISTANT STRUCTURES

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Distinguish between *magnitude* and *intensity* of earthquake.
2. Explain the philosophy of earthquake resistant design.
3. Can the exact value of maximum seismic response of a multi-degree of freedom be determined using response spectrum analysis? Explain.
4. Explain the significance of ductility in earthquake resistant design.
5. What do you mean by retrofitting of structures? Explain the retrofitting methods used for RC columns.

PART B

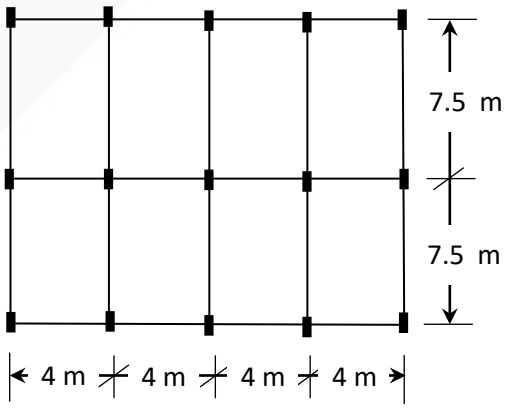
(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Figure shows the plan of a four storied RC framed structure to be constructed in Bangalore. Height of each story is 3.0 m. Calculate the seismic forces at various floor levels.

   Data given:

   Column section : 23×60 cm.
   Beam section : 23×55 cm.
   Slab Thickness : 13 cm.
   Thickness of brick wall around: 23 cm.
   Live load on floors : 4 kN/m^2
   Live load on roof : 1.5 kN/m^2
   Unit weight of concrete : 25 kN/m^3
   Unit weight of brick wall : 20 kN/m^3
   Frame type : SMRF
   Type of soil : Soft soil

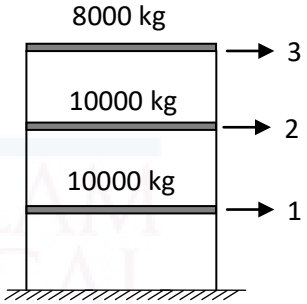
   Missing data may be suitably assumed.



7. Explain the factors which ensure proper seismic behaviour of a building.

8. The natural frequencies (in rad/s) of the three storied shear building shown below are 6.57, 16.91 and 24.67. The mass normalized modal matrix is

$$\begin{bmatrix} 0.0034 & 0.0066 & 0.0067 \\ 0.0061 & 0.0038 & -0.0069 \\ 0.0080 & -0.0072 & 0.0031 \end{bmatrix}.$$

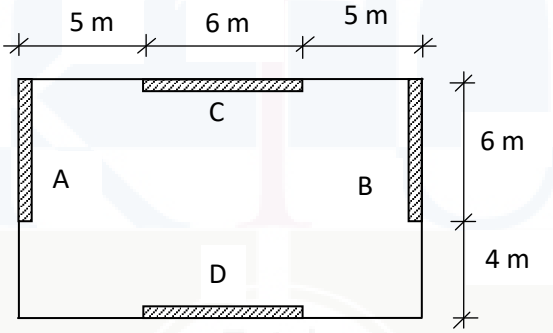


The damping may be assumed as 5% for all modes. Using response spectrum method calculate the base shear.

Assume that the building is to be constructed in Zone V and the foundation soil is Type I (hard soil). The frame may be assumed as SMRF. Take importance factor as 1.5. Use SRSS rule to combine the modal responses.

9. Explain how the ductility of RC members can be increased.

10. Plan of a single storey building having two shear walls in each direction is shown. The shear walls are 6 m long and 200 mm thick. Design shear force on the building is 120 kN in either direction. Determine the design lateral force in shear wall A using the torsion provisions of the IS code.



11. A slender shear wall of length 6 m and thickness 200 mm carries an axial load of 2700 kN. The wall is reinforced with 10# bars at 250 mm c/c in two layers. If M25 concrete and Fe415 steel are used, estimate the moment of resistance of the wall.

12. What is seismic evaluation? When is it required? Explain the different steps in seismic evaluation.

****

Syllabus

Module 1

Introduction to earthquakes and earthquake engineering, Mechanism of earthquake, seismic waves, effects of earthquakes. Measurement of earthquakes, magnitude and intensity, seismographs. Strong motion characteristics, response spectrum, Fourier spectrum. Characteristics of response spectrum, Design spectrum, construction of tripartite response spectrum.

Module 2

Effect of architectural features and structural irregularities. Damages of structures during past earthquakes, principles of earthquake resistant construction.

Philosophy of earthquake resistant design. Code provisions as per IS:1893 and IS:4326.

Module 3

Design seismic force calculation in multi storied frames. Dynamic analysis, Introduction to response spectrum analysis – theoretical aspects, Modal combination rules.

Design seismic force calculation in multi storied frames using response spectrum method.

Module 4

Ductility – Significance, Ductility factors. Ductile detailing considerations as per IS:13920. Design and detailing of structural members. Reinforcement detailing in joints.

Module 5

Torsion – code provisions, Shear walls – design force calculation, Design of shear wall, Design and detailing for earthquake resistance – Discussion of code provisions in IS 13920.

Repair and rehabilitation. Seismic evaluation and vulnerability assessment – Methods, Disaster mitigation, Response reduction techniques, Base isolation.

Course Plan

No	Topic	No. of Lectures
1	**Earthquakes and Response Spectrum (9)**	
1.1	Earthquakes, Mechanism, Elastic rebound theory. Seismic waves, Effects of earthquakes	3
1.2	Size of earthquake – magnitude & intensity, moment magnitude Measurement of earthquakes – seismographs	2
1.3	Strong motion characteristics, response spectrum, Fourier spectrum	2
1.4	Characteristics of response spectrum, design spectrum, construction of tripartite response spectrum	2
2	**Earthquake Effects and Philosophy of Earthquake Resistant**	

	Construction (7)	
2.1	Structural irregularities, Effect of architectural features, Damages during past earthquakes.	2
2.2	Seismo-resistant building architecture	1
2.3	Philosophy of earthquake resistant construction. Principle of earthquake resistant construction	2
2.4	Introduction of IS codes (1893 & 4326), Code provision	2
3	**Design Seismic Force Computation (8)**	
3.1	Seismic force computation using IS code provisions	2
3.2	Response spectrum analysis – theoretical aspects, Modal combination rules	2
3.3	Seismic force computation using Response spectrum method	2
3.4	Modal combination using ABS, SRSS & CQC rules	2
4	**Ductility Aspects and Ductile Detailing (7)**	
4.1	Ductility – significance in earthquake resistant design, Ductility factors.	2
4.2	Ductile detailing considerations as per IS:13920	2
4.3	Design & detailing of structural members & joints	3
5	**Torsion and Shear Walls (9)**	
5.1	Torsion – code provisions Design eccentricity computation	1
5.2	Shear walls – design force calculation. Design of shear wall.	3
5.3	Seismic evaluation – methods	2
5.4	Repair and rehabilitation – methods	2
5.5	Response reduction techniques, Base isolation	1

Reference Books

1. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice- Hall of India, New Delhi.
2. Anil K Chopra, Dynamics of Structures, Prentice- Hall of India, New Delhi.
3. S. K. Duggal-Earthquake Resistant Design of Structures-Oxford University Press-2007
4. T.K. Datta, Seismic Analysis of Structures, John Wiley & Sons (Asia) Pte Ltd.
5. IS: 1893-2016, Indian Standard criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi
6. IS: 4326-2013, Indian Standard code for practice for Earthquake Resistant Design and Construction of Buildings, Bureau of Indian Standards, New Delhi.
7. IS: 13920-2006, Indian Standard Ductile Detailing of RCC Structures subjected to seismic forcesCode of practice, Bureau of Indian Standards, New Delhi

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE001	ADVANCED METAL STRUCTURES	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: The course focuses on design of steel and aluminium structures, in compliance with Indian and International codes. Analysis and design of bolted and welded connections, design of steel members under fire and blast loads, design of industrial structures, design of light gauge structures and design of aluminium structures are included.

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

CO 1	Design bolted and welded joints
CO 2	Design light gauge columns, beams, and tension members
CO 3	Design aluminium members under axial loads
CO 4	Design gantry girders

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			2	2	1		
CO 2			3	2	1		
CO 3			2	2	1		
CO 4			3	2	1		

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	30
Analyse	30
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: 222ECE001

ADVANCED METAL STRUCTURES

Max. Marks: 60 Duration: 2.5 hours

PART A

Answer all questions. Each question carries 5 marks

1. Why are HSFG bolts preferred in joints subjected to fatigue?What do you mean by Prying action?
2. Discuss the advantages and disadvantages of welded connections over bolted connections.
3. What is local buckling of thin elements and what do you mean by post buckling strength of light gauge steel members?
4. Compare and contrast the constitutive relationship between Structural steel and Aluminium alloys along with a plot showing the stress-strain relationships of both the materials.
5. Explain sway and non-sway frames. Include at least two examples of each type using appropriate figures.

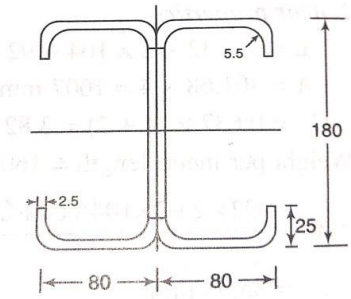
PART B

Answer any five questions. Each question carries 7 marks

6. Design a seat connection for a factored beam end reaction of 110kN. The beam section is ISMB 250 @ 36.6 kg/m connected to the flange of column section ISHB 200 @ 36.6 kg/m. Use Fe 410 grade steel and bolt 4.6 grade.

7. Design a welded stiffened seat and clip connection for an ISMB 350 @ 51.4 kg/m to transmit a factored end reaction 320 kN to a column ISHB 300 @ 57.6 kg/m. Steel Fe 410 grade and use fillet weld of required size.

8. Two channels of 180 mm x 80 mm section with bent lips as shown in figure 1 are connected with webs to act as beam. The thickness of the plate is 2.5 mm and the depth of the lip is 25mm. The beam has an effective span of 4.1 m. Determine the allowable load per m run on the beam. The dimensions in the figure 2 are in mm. Use fy = 235 N/mm^2 .



9. A light gauge rectangular box- section with overall cross-sectional dimensions of 200 mm x150 mm (out- to-out), thickness 2.5 mm and fillets of radius 2.5 mm at each of the 4 inside corners, is being employed as a column over an effective length of 3.2 m. Compute the safe load on the column is steel used is having yield stress of 2400 kg/cm^2.

10. Design a tension member using ALE H30 for carrying axial pull of 70 kN. The angles are connected back-to-back on both sides of a gusset plate using 16mm diameter bolts.

11. Explain the knees and valleys in the steel structures with neat figures.

12. A hand operated 50 kN overhead crane is provided in a workshop. The details are given below: i) Centre to centre between gantry girders = 16 m (ii) Span of the gantry girder = 6 m (iii) Weight of the crane = 40 kN Gantry (iv) Wheel spacing = 3 m (v) Weight of the crab = 10 kN (vi) Maximum edge distance = 1 m. Design a simply supported gantry girder, assuming the flange is laterally supported.

Syllabus

Module 1

Bolted connection – types, failure modes. Types of bolts. Design of seat angle, Web angle and end plate connections,Beam and column bolted splices.

Design of framed beam connection – continuous beam to beamconnection.

Module 2

Welded connection, Structure and properties of weld metal. Beam to-column connections-Angle seat,Stiffened beam seat connection,Web angle and end plate connections,Beam and column welded splices.Tubular connections -Curved weld length at intersection of tubes – SHS and RHS tubes - design parameters- Weld defects.

Module 3

Light gauge steel structures– Types of crosssections, Local and post buckling of thin elements, Stiffened and multiple stiffened compression elements, Tension members, Beams, Combined stresses and connections

Module 4

Aluminium Structures - Stress-strain relationship – Permissible stresses – Tension members, compression members, beams – Blast, impact, fire loads, Fire load calculation, Fire resistant design.

Module 5

Industrial structures, Design of members, Sway and non-sway frames, bracings, and bents.Rigid frame joints - Knees for rectangular frames and
pitched roofs - Knees with curved flanges.Valley joints - Rigid joints in multistorey buildings. Vierendeel girders, Gantry girders - Loading considerations, Design of gantry girders.

Course Plan

No	Topic	No. of Lectures
1	**Bolted Connections(8)**	
1.1	Classification (Simple, Rigid, Semi rigid); Moment rotation Characteristics - Failure modes of a joint	1
1.2	Types of bolts - Bearing and High strength bolts- Prying force. Beam to Column connections -	1
1.3	Design of seat angle - Unstiffened	1.5
1.4	Design of seat angle – Stiffened	1.5
1.5	Web angle & end plate connections,	1
1.6	Beam and column bolted splices.	1
1.7	Design of framed beam connection – continuous beam to beam connection	1
2	**Welded Connections(8)**	
2.1	Structure and properties of weld metal. Beam to-column connections-Angle seat,	1.5
2.2	Stiffened beam seat connection,	1.5
2.3	Web angle and end plate connections,	1.5
2.4	Beam and column welded splices.	1.5
2.5	Tubular connections - Parameters of an in plane joint Welds in tubular joints	1
2.6	Curved weld length at intersection of tubes – SHS and RHS	1

	tubes - design parameters- Weld defects.	
3	**Design of Light Gauge Structures(8)**	
3.1	Design of light gauge steel structures: Introduction – Types of cross sections – Materials–	1
3.2	Local and post buckling of thin elements	1
3.3	Stiffened and multiple stiffened compression elements	2
3.4	Tension members	1
3.5	Beams and deflection of beams	1.5
3.6	Combined stresses and connections	1.5
4	**Aluminium structures, Fire resistant structures(8)**	
4.1	Design of Aluminium Structures: Introduction – Stress-strain relationship – Permissible stresses –	1
4.2	Tension members and Compression members	1
4.3	Design of Aluminium Beams	1
4.4	Blast loads - impact loads-	1
4.5	Ice-infested loads on structures-	1
4.6	fire loads-	1
4.7	fire-resistant design	1
4.8	Simple problems in Fire loads calculations	1
5	**Design of Industrial buildings and Gantry girders(8)**	
5.1	Design of members subjected to lateral loads and axial loads.	1
5.2	Swayand non-sway frames, bracings, and bents.	1
5.3	Rigid frame joints - Knees for rectangular frames and pitched roofs - Knees with curved flanges.	1
5.4	Valley joints - Rigid joints in multistorey buildings - Vierendeel girders.	1
5.5	Design of gantry girders - Introduction - Loading consideration- Selection of gantry girder.	1
5.6	Position of moving load for maximum effects, profile of gantry girder, limitation on vertical deflection	1
5.7	Design of gantry girders	2

Reference Books

1. Gaylord., Design of steel structures, McGraw Hill, New York.
2. Duggal.S.K., Limit state design of steel structures, Tata McH
3. Subrahmanian.N, Design of steel structures, Oxford.
4. Wie-Wen Yu.,Cold-Formed Steel Structures, McGraw Hill Book Company.
5. Hetherington. John and Smith P. D., Blast, and ballistic loading of structures,

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE002	PROJECT PLANNING AND IMPLEMENTATION	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: The course provides different stages of planning in construction. Knowledge about productivity analysis is also included. Students are introduced with quality management and cover the details of safety measures used in construction.

Course Outcomes: After the completion of the course on Project Planning and Implementation the student will be able to

CO 1	Describe the different stages of planning, tendering and execution of works in construction industry.
CO 2	Perform work study and analyse the productivity.
CO 3	Describe concepts of quality management, system requirements and documentation.
CO 4	Describe the objectives, techniques for testing and analysis and application of tools for improvement of quality.
CO 5	Explain the fundamentals of safety management systems in construction industry and demonstrate safety management systems in construction projects.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1				
CO 2	1		2	1			
CO 3			1				
CO 4			1				
CO5			1				

(1-Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to the theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code:222ECE002

PROJECT PLANNING AND IMPLEMENTATION

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain different stages of planning by different agencies?
2. Explain different steps of work study.
3. Discuss basic elements of quality.
4. Discuss ISO standards for quality management.
5. Write notes on measurement of safety.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. Explain briefly the tendering process.
7. Discuss Motivation, Leadership and Communication.
8. Write notes on quality assurance techniques.
9. Explain how quality control can be done in an organization.
10. Explain different TQM models.
11. Enumerate the different elements for Maintaining Safety in Construction.
12. Explain human factors in construction safety.

Syllabus

Module 1

Project Planning: Objectives of planning-stages of planning by different agencies – sanctions-tendering –contracts-execution of works – measurements – disputes-arbitration

Module 2

Work and Productivity Analysis: Work study - factors influencing productivity - measurement of productivity – productivity improvement techniques - human relations - motivation leadership – communication

Module 3

Quality in Construction: Evolution of Quality-inspection, quality control and quality assurance inprojects-factors affecting quality of construction

Module 4

Quality Management: ISO standards-TQM in Construction - Principles of TQM-Different TQM models

Module 5

Safety in Construction: Importance of safety-causes of accidents-human factors in construction safety management-safety in various construction operations-safety codes-safety committee and inspection-measuring of safety-approaches to improve safety in construction

Course Plan

No	Topic	No. of Lectures
1	**MODULE I (8 hours)**	
1.1	Project Planning:Objectives of planning-stages of planning by different agencies	2
1.2	Sanctions required-tendering- contracts	2
1.3	Execution of works-measurements	2
1.4	Disputes-arbitration	2
2	**MODULE II (10 hours)**	
2.1	Work and Productivity Analysis:Work study steps-Procedure of work study	2
2.2	Factors influencing productivity	2

2.3	Measurement of productivity- productivity improvement techniques	2
2.4	Human relations-motivation	2
2.5	Leadership – communication	2
3	**MODULE III (7 hours)**	
3.1	Quality in Construction:Evolution of Quality	1
3.2	Inspection, quality control in projects	2
3.3	Quality assurance in projects	2
3.4	Factors affecting quality of construction	2
4	**MODULE IV (6 hours)**	
4.1	ISO standards	2
4.2	TQM in construction- Principles of TQM	2
4.3	Different TQM models	2
5	**MODULE V (9 hours)**	
5.1	Safety in Construction :Importance of safety-causes of accidents	2
5.2	human factors in construction safety management	1
5.3	Safety in various construction operations	2
5.4	Safety codes	1
5.5	Safety committee and inspection-measuring of safety	2
5.6	Approaches to improve safety in construction	1

Reference Books

1. Sengupta and H. Guha (1995), “Construction Management and Planning”, Tata McGrew Hill Publishing Company Pvt. Ltd. New Delhi.
2. Clarkson Oglesby, Henry Parker (1989), Gregory Howell, “Productivity improvement inconstruction”, McGraw Hill Book Company.
3. S. Seetharaman, “Construction Engineering and Management”, Umesh publications.
4. Kumar NeerajJha, “Construction Project Management- Theory and Practice”, Pearson Education India
5. R.P. Mohanty and R.R. Lakhe, “Total quality management”, Jaico publishing house
6. K.N.Vaid, “Construction Safety Management”, National Institute of ConstructionManagement and Research.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE003	CONSTRUCTION PERSONNEL MANAGEMENT	PROGRAM ELECTIVE 3	3	0	0	3

Preamble: On completion of this course the students will know various processes in manpower planning, organizational, welfare measures and various strategic approaches in construction industry.

Course Outcomes: After the completion of the course on Construction Personal Management the student will be able to

CO 1	Study the various functions of human resource management such as man power planning, organizing, staffing, directing and controlling.
CO 2	Describe the organization structure and the recruitment strategies.
CO 3	Explain the team work, intergroup behaviour and conflicts in organization.
CO 4	Study the employee performance management, training and development processes
CO 5	Describe the various strategic approaches to manage human resources in construction industry.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2			1				
CO 3			1		1		
CO 4			2				1
CO 5			1				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	10
Understand	20
Apply	30
Analyse	
Evaluate	
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end

semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: 222ECE003

CONSTRUCTION PERSONNEL MANAGEMENT

Max. Marks: 60 Duration: 2.5 hours

PART A

(Answer ***ALL*** questions; each question carries 5 marks)

1. Explain with a flow chart the process of staffing in an organisation.
2. Recommend the importance of span of control in an organization.
3. Explain the conflicts in a construction organization.
4. Enumerate different performance appraisal methods and assessment.
5. Explain briefly the challenges facing the construction industry in India.

PART B

(Answer ***any FIVE*** questions; each question carries 7 marks)

6. As a personnel manager how can you direct and control employees in the field of construction and explain the functions of a supervisor in an organisation.
7. What are the different sources of recruitment in an organization? Explain the recruitment process.
8. Illustrate the role of organisation charts and explain different types of organization structures in detail.
9. Write detailed note on job description in an organization. Prepare a report containing the job description and job analysis details of an imaginary construction organisation.

10. What is 360 degree performance appraisal? Explain the significance of self appraisal for an individual in an organisation.
11. Explain in detail the total quality management and its elements.
12. Enumerate the various strategic approaches for managing human resources in construction industry.

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Syllabus

Module 1: MANPOWER PLANNING

Manpower Planning, Organizing, Staffing, directing, and controlling – Estimation of

Man power requirement – Factors influencing supply and demand of human resources – Role of HR manager – Personnel Principles.

Module 2: ORGANIZATION

Organization structure – Organization charts – Staffing Plan - Development and Operation of human resources – Recruitment – Selection strategies – Placement and Training.

Module 3: HUMAN RELATIONS AND ORGANIZATIONAL BEHAVIOUR

Basic individual psychology – Approaches to job design and job redesign – Self managing work teams – Intergroup – Conflict in organizations – Leadership-Engineer as Manager – all aspects of decision making – Significance of human relation and organizational – Individual in organization – Motivation – Group dynamics, Team working – Communication for people management.

Module 4: MANAGEMENT AND DEVELOPMENT METHODS

Compensation : Wages and Salary, Employee benefits, Employee appraisal and assessment – Employee services – Safety and Health Management – Innovative approach to designing and managing organization – Total Quality Management – Levels of change in the organizational Development – Requirements of organizational Development - New methods of training and development – Performance Management**.**

Module 5: STRATEGIC APPROACHES IN CONSTRUCTION INDUSTRY

Introduction: the challenges of managing people in construction-Strategic approaches to managing human resources in the construction industry-Employee relations-Employee participation, involvement and empowerment in construction.

Course Plan

No	Topic	No. of Lectures
1	**MANPOWER PLANNING (7)**	
1	Manpower Planning, Organizing, Staffing, directing, and controlling	2
1.2	Estimation of Man power requirement	2
1.3	Factors influencing supply and demand of human resources	1
1.4	Role of HR manager	1
1.5	Personnel Principles	1
2	**ORGANIZATION (7)**	
2.1	Organization structure	1
2.2	Organization charts	1
2.3	Staffing Plan	1
2.4	Development and Operation of human resources	1
2.5	Recruitment	1
2.6	Selection strategies	1
2.7	Placement and Training	1
3	**HUMAN RELATIONS AND ORGANIZATIONAL BEHAVIOUR (10)**	
3.1	Basic individual psychology	1
3.2	Approaches to job design and job redesign	1
3.3	Self managing work teams	1
3.4	Intergroup, Conflict in organizations	1
3.5	Leadership, Engineer as Manager, All aspects of decision making	2
3.6	Significance of human relation and organizational	1
3.7	Individual in organization, Motivation	1

3.8	Group dynamics, Team working	1
3.9	Communication for people management	1
4	**MANAGEMENT AND DEVELOPMENT METHODS (9)**	
4.1	Compensation: Wages and Salary, Employee benefits, Employee appraisal and assessment	1
4.2	Employee services	1
4.3	Safety and Health Management	1
4.4	Innovative approach to designing and managing organization	1
4.5	Total Quality Management	1
4.6	Levels of change in the organizational Development	1
4.7	Requirements of organizational Development	1
4.8	New methods of training and development	1
4.9	Performance Management	1
5	**STRATEGIC APPROACHES IN CONSTRUCTION INDUSTRY (7)**	
5.1	Introduction: the challenges of managing people in construction	2
5.2	Strategic approaches to managing human resources in the construction industry	2
5.3	Employee relations	1
5.4	Employee participation, involvement and empowerment in construction	2

Reference Books

1. Charles D Pringle, Justin Gooderi Longenecter, Management, CE Merril Publishing Co.1981.
2. Dwivedi R.S, Human Relations and Organisational Behaviour, Mac millian India Ltd.,2005.
3. Josy.J. Familaro, Handbook of Human Resources Administration, McGraw-Hill International Edition, 1987.

4. Memoria,C.B., Personnel Management, Himalaya Publishing Co., 1997.
5. Carleton Counter II and Jill Justice Coutler, The Complete Standard Handbook of Construction Personnel Management, Prentice-Hall, Inc., 1989.
6. Martin Loosemore, Andrew Dainty and Helen Lingard, Human resource management in construction projects- Strategic and operational approaches, Spon Press, Taylor & Francis Group, 2003.

SEMESTER II

PROGRAM ELECTIVE IV

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE006	ADVANCED DESIGN OF FOUNDATION	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: This course exposes the students to the various aspects of foundation analysis and design. The course covers soil exploration techniques; and, design of shallow and deep foundations. Design of machine foundation is also included in the course.

Course Outcomes: The COs shown are only indicative.

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

CO 1	Compute the geotechnical design parameters of foundation
CO 2	Design the shallow foundations
CO 3	Assess the load carrying capacity of the pile and design the pile foundation
CO 4	Identify and design the components of well foundation
CO 5	Design foundation for vibrating machines

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		2				
CO 2	2		3	2	1		
CO 3	2		3	2	1		
CO 4	2		3				
CO 5	2		3	2	1		

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	40
Analyse	20
Evaluate	-
Create	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Micro project/Course based project: 20 marks

Course based task/Seminar/Quiz: 10 marks

Test paper, 1 no.: 10 marks

The project shall be done individually. Group projects not permitted.

Test paper shall include minimum 80% of the syllabus

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: 222ECE006

ADVANCED DESIGN OF FOUNDATION

Max. Marks: 60 Duration: 2.5 Hours

PART A
Answer all questions; each question carries 5 marks

1. Write a note on split spoon sampler and scraper bucket sampler.
2. What is the effect of size on the settlement of footings on homogeneous sand deposits.
3. Discuss the different types of vertical load tests on single pile.
4. A single tube circular well foundation of 3.5 m diameter is installed to a depth of 7m below the scour level in granular soil. The corrected standard penetration value (N value) in the bearing stratum is 60. Estimate the allowable bearing pressure of the well foundation.
5. Give general requirements of machine foundations.

PART B
Answer any five questions; each question carries 7 marks

6. Explain on various geophysical methods employed in the field. Also explain their uses and limitations.
7. Design a combined footing for two columns with loads 3500kN and 4500kN.The centre to centre distance between columns is 6m.Columns are having cross sections of 500mmx 500mm.There is a restriction on projection of footing on both column sides by 0.4m from the face of the column. Take allowable soil pressure as 200kN/m^2.
8. A rectangular footing of dimensions 2.5 m X 3 m in plan is founded at a depth of 1.5 m below the ground level. The load on the footing acts at an angle of 15o to the vertical and is eccentric in the direction of the width by 10 cm. The saturated unit weight of soil is 18 kN/m^3 . C'=15 kN/m^2, $\Phi'=30^o$. Water table is at a depth of 2m below the ground surface. Use IS 6403-1981 recommendations to calculate the net ultimate bearing capacity. For $\Phi'=30^o$, Nc=30.14, Nq= 18.4, $N\gamma$=22.4

9. A precast concrete pile of size 45x45 cm is driven into stiff clay. The unconfined compressive strength of the clay is 200kN/m2.Determine the length of pile required to carry a safe working load of 400kN with F.S= 2.5
10. A group of 9 piles was driven into soft clay extending from ground level to a great depth. The diameter and length of piles were 30cm and 10m respectively. The unconfined compressive strength of clay is 50kPa.If the piles were placed 90cm centre to centre. Compute the allowable load on the pile group on the basis of shear failure criterion for F.S of 2.5
11. Explain the components of well foundations and its functions with a neat sketch. Explain different forces acting on well foundations
12. Write down the design criteria for machine foundation. Also explain the construction aspects of design of machine foundation.

Syllabus

Module I

Soil Exploration and testing: Methods of exploration-Boring, Sampling of soils, Bore log - Standard penetration Test-Field Vane shear Test-Static Cone Penetration Test - Dynamic Cone penetration tests - Field CBR test - Plate Load Test, Geophysical Methods, Soil report, Bore hole Log

Classification of Foundations - factors influencing the choice of foundations

Geotechnical design parameters- Bearing capacity – Methods by Terzaghi, Meyerhoff, Hansen and IS Code - Correlation of bearing capacity from penetration test data

Module II

Contact pressure distribution beneath rigid and flexible footings on sand and clay – modulus of subgrade reaction

Settlement of foundations-immediate settlement –consolidation settlement-Total and differential settlement-causes –permissible settlements

Proportioning of Foundations for equal settlement, loads for design- concepts of net and gross loads, depth of foundation,

Analysis of shallow foundations in clay and sand - individual and combined footings, and rafts - floating and partially compensated.

Module III

Pile foundation- Classification of pile foundation - friction piles, end bearing piles, laterally loaded piles

Evaluation of vertical stresses in soil – friction piles in clay , end bearing pile in on rock, piles driven through clay into strong strata

Estimation of pile capacity of individual piles - static formula, dynamic formulae and IS method – negative skin friction

Field test on piles – vertical load test, pull out test, lateral load test, dynamic load test, non-destructive tests

Pile groups - Consideration regarding spacing - Efficiency of pile groups – Structural design of pile and Pile Cap

Design aspects of piled raft foundation for settlement reduction and load transfer

Module IV

Caissons and well foundations – Elements of well foundations

Types of well foundation - open caissons, pneumatic caissons, floating caissons, well foundations, monoliths

Sinking stresses in well foundation

Design of well cap, well steining, well curb, cutting edge and bottom plug

Module V

Machine Foundations - Types of machines and machine foundation - Basic principles of design of machine foundation

Vibration Analysis for machine foundation - Elastic half space theory for rigid footings.

IS Code practice for design of machine foundation for reciprocating and impact type machines

Course Plan

No	Topic	No. of Lectures
1	**Module I : Total lecture hours : 8**	
1.1	Soil exploration and Testing methods	3
1.2	Interpretation of soil report	1
1.2	Classification of foundation, factors influencing choice of foundation	1
1.4	Bearing capacity by Terzagi, Meyerhoff, Hasen and IS code methods	2
1.5	Correlation of bearing capacity from penetration data	1
2	**Module II : Total lecture hours : 9**	
2.1	Contact pressure distribution beneath rigid and flexible	1

	footings on sand and clay	
2.2	Modulus of subgrade reaction	1
2.3	Settlement of foundations-immediate settlement – consolidation settlement - total and differential settlement-causes –permissible settlements	1
2.4	Proportioning of Foundations for equal settlement, loads for design - concepts of net and gross loads, depth of foundation	2
2.5	Analysis of shallow foundations in clay and sand – Individual combined footings and rafts – floating and partially compensated	4
3	**Module III : Total lecture hours : 9**	
3.1	Classification of pile foundation - friction piles, end bearing piles, laterally loaded piles	1
3.2	Evaluation of vertical stresses in soil – friction piles in clay, end bearing pile in on rock, piles driven through clay into strong strata	1
3.3	Estimation of pile capacity of individual piles - static formula, dynamic formulae and IS method – negative skin friction	1
3.4	Field test on piles – vertical load test, pull out test, lateral load test, dynamic load test, non-destructive tests	2
3.5	Pile groups - Consideration regarding spacing - Efficiency of pile groups	1
3.6	Structural design of pile and Pile Cap	2
3.7	Design aspects of piled raft foundation for settlement reduction and load transfer	1
4	**Module IV : Total lecture hours : 6**	
4.1	Introduction to well foundations – Elements of well foundations	1
4.2	Different types of well foundations	1
4.3	Sinking stresses in wells	1
4.4	Design of well cap, well steining, well curb, cutting edge and bottom plug	3
5	**Module V : Total lecture hours : 8**	
5.1	Types of machines and machine foundation	1
5.2	Basic principles of design of machine foundation	1

5.3	Vibration Analysis for machine foundation - Elastic half space theory for rigid footings	2
5.4	IS Code practice for design of machine foundation for reciprocating machines	2
5.5	IS Code practice for design of machine foundation for impact type machines	2

Reference Books

1. Varghese P.C, Foundation Engineering, Prentice Hall India,NewDelhi 2005
2. Swami Saran, Analysis and design of substructures, Oxford and IBH Publishing Company Pvt. Ltd.
3. Punmia B C, “Soil Mechanics and Foundations”, Laxmi Publications Pvt Ltd, NewDelhi
4. Joseph E. & Bowles, “Foundation Analysis & Design”, McGraw Hill
5. Kurian N P, “Design of foundation systems”, Narosa Publishing House, Madras
6. Arora K.R., “Soil Mechanics & Foundation Engineering”, StandardPublishers Distributors, New Delhi

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE007	DESIGN OF BRIDGES	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: This course provides the fundamental aspects of RC bridges. The students are exposed to the load transfer mechanisms, analysis methodologies and design principles of bridge structures and its components.

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

CO 1	Discuss the classification of bridges, codal provisions for road bridges and load acting in the bridges
CO 2	Illustrate the methods of bridge deck analysis and methods of lateral load distribution
CO 3	Design RC Slab bridges and T-Beam bridges for the given loading
CO 4	Design various Substructure elements of the RCC Bridges
CO 5	Design bridge bearings and joints

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			1	1			
CO 2			2	1			
CO 3			3	2	1		
CO 4			3	2	1		
CO 5			3	2	1		

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

original publications (minimum 10 publications shall be referred): 15 marks

Course based task/Seminar/Data collection and interpretation: 15 marks

Test paper, 1 no.: 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

QP CODE:

Reg No.:_____

Name:_____ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION, MONTH & YEAR

Course Code: 222ECE007

DESIGN OF BRIDGES

Max. Marks: 60 **Duration: 2.5 hours**

PART A

(Answer ALL questions; each question carries 5 marks)

1. Describe the different components of a bridge using neat figures
2. Explain the method of grillage analysis of bridge decks.
3. List the steps in designing RCC culverts.
4. Explain briefly the types of bridge foundations.
5. List and explain the types of bridge bearings.

PART B

(Answer any FIVE questions; each question carries 7 marks)

6. Explain the different types of bridges.
7. Explain the different types of loading on a bridge.
8. Explain briefly the method lateral load distribution using Courbon's Method.
9. Design a solid slab bridge superstructure having a clear span of 8.0 metres and carriageway of 4.5 metres with 1.2 metres wide footway on either side for a National Highway. Loading: Single lane of IRC Class AA tracked. Use M30 Concrete and Fe500 steel.
10. Design a the deck slab and outer girder of a T-Beam bridge with 9 mclear roadway and having a simply supported span of 12.0 m between centre line of bearings. The deck may consist of 3 girders spaced at 2 .45 m centres. Loading-Single lane of Class Awheeled loading. Use M30 Concrete and Fe500 steel.

11. Design pier cap for a bridge having total width of 9 m. Diameter of the pier is 2 m. Use single lane of IRC Class AA tracked loading. Use M35 Concrete and Fe500 steel.
12. Design an elastomeric bearing to suit the following data:
    Vertical load (sustained) : 300 kN
    Vertical load (dynamic): 35 kN
    Horizontal force: 50 kN
    Modulus of rigidity of elastomer : 1 MPa

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Syllabus

Module 1

Fundamentals of Bridge Design – Introduction - Bridge components

Classification of bridges –simple culverts –Solid slab bridges - simply supported beam bridges – Continuous beam bridges – arch bridges – box girder bridges- cable stayed bridges- suspension bridges

Loads - dead and imposed loads-dynamic effect-wind and seismic forces-longitudinal and centrifugal forces-hydraulic forces-earth pressure-temperature effect and secondary stresses – prestressing - General design requirements

Module 2

Bridge Deck Analysis Thin plate theory – grillage analysis – finite element analysis

Method of Lateral load Distribution-Pigeaud's Method-Effective Width Method-Courbon's Method-Hendry Jaegar method

Module 3

Design of Simple RC Bridges Design of solid slab bridge– Design of Simply Supported RC T-Beam bridge

Module 4

Bridge substructure

Piers and Pier caps – types - Design

Abutments – types – loading – seismic effect – design considerations

Introduction to Bridge Foundation – types and design considerations

Module 5

Bridge Bearings – types – Design of elastomeric bearings

Joints – uses and types

Course Plan

No	Topic	No. of Lectures
1	**Fundamentals of Bridge Design**	
1.1	Introduction - Bridge components	1
1.2	Classification of bridges – simple culverts - simply supported beam bridges – Continuous beam bridges – arch bridges – box culvert – cable stayed - suspension	3
1.3	Loads - dead and imposed loads -dynamic effect-wind and seismic forces-longitudinal and centrifugal forces-hydraulic forces-earth pressure-temperature effect and secondary stresses – prestressing - General design requirements	3
2	**Bridge Deck Analysis and Method of Lateral load Distribution**	
2.1	Bridge deck analysis - Thin plate theory – grillage analysis – finite element analysis	3
2.2	Lateral load Distribution -Pigeaud's Method-Effective Width Method- Courbon's Method- Hendry Jaegar method	3
3	**Design of Simple RC Bridges**	
3.1	Design of solid slab bridge	4
3.2	Design of Simply Supported RC T-Beam bridge	5
4	**Bridge substructure**	
4.1	Design of Pier and pier cap	5
4.2	Design of Abutments	5
4.3	Introduction to Bridge Foundation – types and design considerations	2
5	**Bridge Bearings and Joints**	
5.1	Bridge Bearings – types – Design of elastomeric bearings	4
5.2	Joints – uses and types	2

Reference Books

1. Krishna Raju, N., Design if Bridges, Oxford and IBH Publishing Company, New Delhi.

2. Jagadeesh, T. R. and Jayaram, M. A., Design of Bridge Structures, PHI Learning Private Limited, New Delhi.

3. Obrien, E. J., Keogh, D. L., O'Connor, A. J. and Lehane, B. M., Bridge Deck Analysis, CRC Press, New York.

4.Rakshit, K. S., Design and Construction of Highway Bridges, New Central Book Agency, Delhi.

5. Victor, D.J, "Essential of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi.

6. Swami Saran, "Analysis and Design of Substructures", Oxford and IBH Publishing Company, New Delhi

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE008	MAINTENANCE AND REHABILITATION OF STRUCTURES	PROGRAM ELECTIVE 4	3	0	0	3

Preamble: The course provides the basic knowledge about various distress and damage of structures.The course covers various maintenance , repair, and strengthening techniques of buildings. Also to study the durability aspects of buildings, causes and process of failure and rehabilitation methods.This course helps the students to investigate the cause of deterioration of concretestructures anddecide about different repair strategies

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

CO 1	Identify Various distress and damage of structures.
CO 2	Explain the cause of deterioration of concrete structures and methods of protection.
CO 3	Establish appropriate maintenance and repair strategy
CO 4	Explain the various repair materials and repair techniques which enable a structure to perform its designated function
CO 5	Explain the demolition sequence of buildings.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2			1				
CO 3			2				
CO 4			1				
CO 5			1		1		

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Apply	25
Analyse	25
Evaluate	10
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Micro project/Course based project: 20 marks

Course based task/Seminar/Quiz: 10 marks

Test paper, 1 no.: 10 marks

The project shall be done individually. Group projects not permitted.

Test paper shall include minimum 80% of the syllabus

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. Therewill be two parts; Part A and Part B. Part A will contain 5 numerical/short answerquestions with 1 question from each module, having 5 marks for each question(such questions shall be useful in the testing of knowledge, skills, comprehension,application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (suchquestions shall be useful in the testing of overall achievement and maturity of thestudents in a course, through long answer questions relating totheoretical/practical knowledge, derivations, problem solving and quantitativeevaluation), with minimum one question from each module of which studentshould answer any five. Each question can carry 7 marks. Total duration of the examination will be 150 minutes.

Note: The marks obtained for the ESE for an elective course shall not exceed 20%over the average ESE mark % for the core courses. ESE marks awarded to astudent for each elective course shall be normalized accordingly. For example, if theaverage end semester mark % for a core course is 40, then the maximum eligiblemark % for an elective course is 40+20 = 60 %.

Model Question Paper

Name----------
Reg:No----------

AAPJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION,MONTH & YEAR

Course Code: 222ECE008

MAINTENANCE AND REHABILITATION OF STRUCTURES

Time:2.5 hrs Max mark:60

PART A

Answer all questions; each question carries 5 marks

1. What are the needs for Rehabilitation of Structures?
2. Explain Cathodic protection.
3. Explain assessment procedure for evaluating damages in existing structures.
4. Discuss on Resin Mortar as a repair material.
5. Discuss the salient features of building demolition process.

PART B

Answer any five questions; each question carries 7 marks

6. How does concrete get affected by heat? Write in detail about thermal properties of concrete.
7. Discuss on the mechanism of corrosion in reinforcing steel.
8. Explain the various Facets of maintenance in concrete buildings.
9. Describe the properties and uses of Fibre reinforced concrete.
10. Write a note on special concrete elements used in repair works to attain early strength.
11. Describe the various underpinning methods and the circumstances with which it is provided.
12. Describe various strengthening techniques to overcome lower member strength in distressed structures.

SYLLABUS

Module 1

Influence on serviceability and durability, Need for Rehabilitation, quality assurance for concrete construction as built concrete properties- strength, permeability, thermal properties and cracking, Effects due to climate, temperature, chemicals, wear and erosion, frost action, Design and construction errors, Effects of cover thickness and cracking, concrete subjected to fire, chemical reactions responsible for the concrete deterioration, process of deterioration in structures and factors influencing.

Module 2

Corrosion control and concrete protection- Chloride, sulphate and acid attack, carbonation, Corrosion in steel- various conditions of steel in concrete, Corrosion mechanism, Concrete surface treatments, Methods of corrosion protection.

Module 3

Maintenance and Repair strategies- Objectives of maintenance, Facets, Factors influencing, benefits of good maintenance operation, Causes of deterioration in various materials, testing techniques, Inspection of property and reports, Maintenance budget estimation, Assessment procedure for evaluating a damaged structure, Purpose of investigating defects- aspects to be investigated.

Module 4

Materials for repair- Special concrete and mortar, polymer concrete, sulphur infiltrated concrete, resin mortar, Expansive cement, Concrete chemicals, Ferrocement- casting techniques, application, Fibre reinforced concrete.

Module 5

Techniques for repair- Rust eliminators and polymer coating for rebars, foamed concrete, mortar, dry pack, vacuum concrete, pre-packed aggregate, Gunite and Shotcrete, epoxy injection, stitching, mortar repair for cracks, shoring and underpinning, Repairs to overcome low member strength, Concrete removal and preparation for repair, Case studies.

Demolition of Buildings – Planning, Precautions and Protective measures indemolition Work-Sequence Of Operations.

COURSE PLAN

	Topic	No. of Lectures
1	**Influence on serviceability and durability**	
1.1	Introduction- Need for Rehabilitation, classification of buildings and structures, classification of loads acting on a structure, quality assurance for concrete construction as built concrete properties- strength, permeability, thermal properties and cracking	2
1.2	Effects due to climate, temperature, chemicals, wear and erosion, frost action, Design and construction errors, Effects of cover thickness and cracking, Effects of fire	3
1.3	Chemical reactions responsible for the concrete deterioration, Process of deterioration in structures and factors influencing	3
2	**Corrosion control and concrete protection**	
2.1	Chloride, sulphate and acid attack, carbonation, Corrosion in steel- various conditions of steel in concrete, Corrosion mechanism	3
2.2	Concrete surface treatments- liquid surface coatings, coatings on concrete to resist salt and water, resisting carbonation, Application of coatings, Corrosion inhibitors	3
2.3	Methods of corrosion protection- coatings to reinforcement, corrosion resistant steel, cathodic protection	2
3	**Maintenance and Repair strategies**	
3.1	Objectives of maintenance, Facets, Factors influencing, benefits of good maintenance operation	2
3.2	Causes of deterioration in various materials, testing techniques	3
3.3	Inspection of property and reports, Maintenance budget estimation, Assessment procedure for evaluating a damaged structure, Purpose of investigating defects, aspects to be investigated	3
4	**Materials for repair**	
4.1	Special concrete and mortar, polymer concrete, sulphur infiltrated concrete, resin mortar, Expansive cement	3
4.2	Concrete chemicals, special elements for accelerated strength gain	2
4.3	Ferrocement- casting techniques, application, Fibre reinforced concrete- fibres used, factors effecting the properties	2
5	**Techniques for repair**	
5.1	Rust eliminators and polymer coating for rebars during repair, foamed concrete, mortar, dry pack, vacuum concrete, Pre-packed aggregate, Gunite and Shotcrete Epoxy injection, Stitching, Mortar repair for cracks, shoring and underpinning.	3
5.2	Repairs to overcome low member strength, deflection, cracking, chemical disruption, weathering wear, fire, leakage, Concrete removal and preparation for repair	3

5.3	Case studies	2
5.4	Demolition of buildings – sequence of operations, protective measures.	1

Reference Books

1. Denison Campbell, Allen and Harold Roper, Concrete Structures, Materials,Maintenance and Repair, Longman Scientific and Technical UK, 1991.
2. M.S. Shetty, Concrete Technology – Theory and Practice,S. Chand and Company, New Delhi, 1992.
3. R.T. Allen and S.C. Edwards, Repair of Concrete Structures,Blakie and Sons, UK,1987.
4. R. D. Woodson, Concrete Structures- Protection, Repair and Rehabilitation, Butterworth-Heinemann, UK, 2009.
5. P. S. Gahlot, S. Sharma, Building Repair and Maintenance Management, CBS publishers, New Delhi, 2013
6. Forensic Structural Engineering Handbook, Second Edition,Robert T. Ratay
7. Structural Renovation of Buildings: Methods, Details, and Design Examples, Second Edition - Alexander Newman, P.E., MBA, F.ASCE.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE009	PRESTRESSED CONCRETE DESIGN	PROGRAM ELECTIVE 4	3	0	0	3

Permeable: This course provides the basic principles of Prestressed concrete design of structures. Students are introduced to the engineering aspects of prestressed concrete design, principles, and losses in prestressed concrete. This course covers the basic principles, design of flexural, compression, and tension members as per IS standards. This course also includes design of composite members.

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

CO 1	Describe the basic aspects of prestressed concrete structures
CO 2	Compute the losses of prestressing
CO 3	Analyse and design a prestressed concrete structural members and sections subjected to axial load and flexure
CO 4	Analyse and design a prestressed concrete structural members subjected to shear and torsion
CO 5	Design prestressed concrete structural members.
CO 6	Estimate crack width and deflection in prestressed concretemembers.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	1		1				
CO 2	1		1				
CO 3	1		3	2			
CO 4	1	1	3	2			
CO 5	1	1	3	2			
CO 6	1	1	2				

(1- Weak, 2-Medium, 3- strong)

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	20
Apply	25
Analyse	
Evaluate	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed
Original Publication (minimum 10 publications shall be referred) : 15 marks
Course based task/Seminar/Data collection andinterpretation:15 marks
Test Paper 1 No : 10 marks

Test paper shall include minimum 80% of the syllabus

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students).

Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question paper

QP CODE: **Name:**

Reg. No.:

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SECOND SEMESTER M.TECH. DEGREE EXAMINATION,MONTH & YEAR

Course Code: 222ECE009

PRESTRESSED CONCRETE DESIGN

Max. Marks: 60 Duration: 2.5Hours

Use of relevant codes are permitted

Assume suitable data with justification

Limit the answers to the required points

PARTA

Answer AllQuestions

Each question carries 5marks

1. Discuss the basic assumptions in analysis of prestressed Concrete.
2. Write notes on anchorage reinforcement.
3. List out the methods to achieve continuity in beams.
4. Mention the advantages of composite sections.
5. Mention the difference in the design of prestressed concrete slab from the prestressed concrete beam.

PART-B

6. A rectangular prestressed beam 150 mm x 300 mm, have an effective span of 10m. The cable with zero eccentricity at the supports and linearly varying to 50 mm at the centre, carries an effective prestressing force of 500kN. Find the magnitude of concentrated load Q located at the centre of the span if the load counteracts the bending effects of the prestressing force (neglecting self-weight of the beam).

7. The support section of prestressed concrete beam, 100mm x 250mm, is required to support an ultimate shear force of 60kN. The compressive prestress at the centroidal axis is $5N/mm^2$. The characteristic cube strength and characteristic strength of steel in stirrups are 40MPa and 250MPa respectively. Design suitable reinforcements at the section using the IS:1343 recommendations.

8. A continuous prestressed concrete beam ABC (AB=BC=10m) has an uniform rectangular section of 100mm x 300mm. The cable carrying an effective prestresseing force of 360kN is parallel to the axis of the beam and located at 100mm from the soffit.
    a. Determine the secondary and resultant moment at the central support

b. Locate the resultant line of thrust.

9. A composite T-girder of span 5m is made up of a pre-tensioned rib, 100mm wide by 200mm depth, with an in-situ cast slab, 400mm wide 40mm thick. The rib is prestressed by a straight cable having an eccentricity of 33.33mm and carrying initial force of, 150kN. The loss of prestress is 15%. Check the composite T-beam for the limit state of deflection if its supports an imposed load of 3.2kN/m for (i) unpropped (ii) propped. Assume modulus of elasticity of 35kN/mm^2 for both precast and in situ cast elements.

10. Design a prestressed concrete pipe of internal dia 900mm to withstand the internal pressure of 0.8Mpa. the max. Permissible compressive stress in concrete is 18 MPa and no tensile stress is to be permitted. Modular ratio between steel and concrete is 5.8. adopt 5mm diameter high tensile wires which can be stressed to 1100MPa.
11. Briefly explain the various steps involved in the design of continuous prestressed concrete beams.
12. Recall the design procedure for prestressed circular water tank.

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Syllabus

Module 1

Basic Concept of prestressing-Historical overview of prestressing–Advantages and disadvantages – Materials required – Systems and methods of prestressing–Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensilestresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation ofdeflections – Short term and long-term deflections - Losses of prestress – Estimation of crack width.

Module 2

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different types of sections - Design of sections of Type I and Type II post-tensioned and pre tensioned beams – Check forflexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wiresin pre-tensioned beams – Design for shear based on I.S. 1343 Code.

Module 3

Analysis and design of continuous beams, Methods of achieving continuity, Concept of linear transformations, concordant cable profile and gap cables, Analysis and design of cantilever beams

Module 4

Composite Sections – Types – Advantages, Analysis of stresses for composite sections, applications, Composite beams Analysis and design of Flexural and shear strength, Partial prestressing - its advantages and applications.

Module 5

Role of prestressing in members subjected to Tensile forces and compressive forces - Design of tension andcompression members – Tanks, pipes and poles – Design of prestressed concrete slab.

Course Plan

No	Topic	No. of Lectures
1	**PRINCIPLES OF PRESTRESSING (8)**	
1.1	Basic Concept of prestressing, Brief History, Advantages	1
1.2	Types of Prestressing and System ofPrestressing	1
1.3	Analysis of sections	1
1.4	Stress concept, Strength concept, Load balancing concept	2
1.5	Prestressing Devices , Need for High Strength materials	1
1.6	Estimation of deflection and crack width (Briefly)	1
1.7	Losses of Prestress	1
2	**DESIGN OF FLEXURAL MEMBERS (8)**	
2.1	Behaviour of flexural members	1
2.2	Design of sections as per code for pre-tensioned and post-tensioned rectangular beams- Various Codal provisions	1
2.3	Design for ultimate and serviceability limit states for flexure	2
2.4	Analysis and Design for shear and torsion.	2
2.5	Design of anchorage zone reinforcement (end block)	2
3	**DESIGN OF CONTINUOUS AND CANTILEVER BEAMS (8)**	
3.1	Analysis and design of continuous beams	2
3.2	Methods of achieving continuity	2
3.3	Concept of linear transformations, concordant cable profile and gap cables	2
3.4	Analysis and design of cantilever beams	2
4	**ANALYSIS &DESIGN OF COMPOSITE MEMBERS (8)**	
4.1	Composite Sections – Types – Advantages	2
4.2	Analysis of stresses for composite sections, applications.	2
4.3	Composite beams Analysis and design of Flexural and shear strength	2
4.4	Partial prestressing - its advantages and applications.	2
5	**DESIGN OF TENSION AND COMPRESSION MEMBERS (8)**	
5.1	Design of concrete pipes - Circular tanks, poles –Prestressed concrete slabs	3
5.2	Design of compression members with and without flexure	3
5.3	Its application in the design piles, flag masts and similar structures.	2

Reference Books

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company ,New Delhi, 2012
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2012
3. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2002.
4. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013
5. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
6. IS 1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012
7. IS 3370- Part 3 (1967) (Reaffirmed – 2008) Indian standard Code of practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi, 2008
8. IS 3370- Part 4 (2008) Indian standard Code of practice for concrete structures for the storage of liquid- Design tables, Bureau of Indian standards, New Delhi

SEMESTER II

INTERDISCIPLINARY ELECTIVE

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE097	MECHANICS OF COMPOSITE MATERIALS	INTERDISCIPLINARY ELECTIVE	3	0	0	3

Preamble: Fibre reinforced plastic composite materials are finding wide range of applications in the field of aerospace structures, automobile engineering, offshore structures, maritime structures, ships and civil engineering structures presently due to its outstanding material capabilities such as High strength, low weight, high corrosion resistance, high fatigue strength and faster assembly. The everyday applications of composites in the commercial markets and hence the job opportunities in this field are drastically increasing nowadays. This course will equip the students with the specialist knowledge and skills required by the leading employers in aerospace, marine, automobile, construction and renewable energy industries to design and develop next generation environmental-friendly and structural-efficient advanced lightweight composite materials and components.

Course Outcomes: The COs shown are only indicative. For each course, there can be 4 to 6 COs.

After the completion of the Advanced Composite Structures course the student will be able to

CO 1	Identify the properties of fibre and matrix materials used in commercial composites, as well as some common manufacturing techniques.
CO 2	Explain linear elasticity with emphasis on the difference between layered composite materials and isotropic materials.
CO 3	Apply constitutive equations of composite materials and understand the mechanical behaviour at micro and macro levels.
CO 4	Predict the failure mode and strength of laminated composite structures.
CO 5	Apply the ideas developed in the analysis of composites towards using composites in various fields of engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1			3	3	2		
CO 2			3	3	2		
CO 3			3	3	2		
CO 4			3	3	2		
CO 5			3	3	2		

Assessment Pattern

Bloom's Category	End Semester Examination
Remember	15
Understand	15
Apply	25
Analyse	5
Evaluate	-
Create	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed original publications (minimum 10 publications shall be referred): 15 marks
Course based task/Seminar/Data collection and interpretation: 15 marks
Test paper, 1 no.: 10 marks
Test paper shall include minimum 70% of the syllabus.

End Semester Examination Pattern:
The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks.

Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example, if the

average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40 + 20 = 60 %.

Model Question paper

PART A

Answer **all** questions.

All Questions carry **equal** marks

1. How is the mechanical advantage of a composite measured?
2. Write the number of independent elastic constants for three dimensional anisotropic, orthotropic, transversely isotropic and isotropic materials.
3. What is Classical Lamination Theory? Explain its significance in composite analysis.
4. The weight fraction of glass in a glass epoxy composite is 0.8. If the specific gravity of glass and epoxy are 2.5 and 1.2 respectively, find (i) fibre and matrix volume fractions (ii) density of composite?
5. Explain briefly the progressive failure analysis in a composite laminate.

PART B

Answer any **FIVE** questions only

6. Briefly explain the Hooke's law for Anisotropic materials. Derive the stress-strain relation for a material with three planes of reflection and one 90◦ rotation symmetry
7. (a) Explain any two methods of manufacturing of composite in detail.
   (b) Derive the relations connecting the engineering constants and the elements of stiffness and compliance matrices for a specially orthotropic lamina.
8. (a) Calculate the longitudinal modulus and tensile strength of a unidirectional composite containing 60% by volume of carbon fibres (E_{1f} = 294 GPa and σ_{1fu} = 5.6 Gpa) in a toughened epoxy matrix (E_m = 3.6 GPa and σ_{mu} = 105 Gpa). Compare these values with the experimentally determined values of E_1 = 162 GPa and σ_{1u} = 2.94 GPa. What fraction of load is carried by fibres in the composite?
   (b) Explain how to calculate the effective modului of a composite lamina in terms of its constituent properties.
9. (a) Explain the free edge effects and interlaminar stresses in composite laminates
   (b) Explain how to determine the laminae stresses and strains from the analysis of a laminate?
10. Calculate the A, B , D matrices for a [0/90°] laminate each layer of which is of 0.125 mm thickness. The lamina properties are given by E_1 = 140 GPa, E_2 = 10 GPa, G_{12} = 5 GPa, υ_{12} = 0.3
11. (a) Explain the effect of interlaminar stresses in composite laminate in detail
    (b) Explain the importance of the sign of shear stress on strength of composites.

12. Find the maximum value of S>0 if a stress of σ_x = 2S, σ_y = -3S, and τ_{xy} = 4S is applied to a 60° Graphite/epoxy Lamina. Use Tsai-Hill Failure theory.
Given $(\sigma_1^t)_{ult} = 1500MPa, (\sigma_1^C)_{ult} = 1500MPa, (\sigma_2^t)_{ult} = 40MPa, \ (\sigma_2^C)_{ult} = 246MPa,$
$(\tau_{21})_{ult} = 68MPa$

Syllabus and Course Plan

No	Topic	No. of Lectures
1	**Introduction to Composite Materials (6)**	
1.1	Definition of composites, Objectives, constituents and Classification of composites.	2
1.2	Basic terminology used in fibre reinforced composite materials- Lamina, Laminates ,General Characteristics of reinforcement and classifications, Characteristics of matrix- Polymer matrix, Thermoplastics and thermosetting resins, Glass transition temperature , Prepregs	2
1.3	Structural applications of Composite Materials	1
1.4	Processing of Composites	1
2	**Macro mechanical behaviour of a composite lamina (9)**	
2.1	Review of Basic Equations of Mechanics and Materials, Hooke's law for different types of materials- Anisotropic, orthotropic, isotropic, monoclinic and Transversely isotropic materials.	2
2.2	Stress-Strain relations for a Two dimensional unidirectional and orthotropic lamina, lamina of arbitrary orientation, Transformations of stress and strain	3
2.3	Relationship of Compliance and stiffness matrix to elastic constants of a lamina	1
2.4	Strength and Failure theories of Continuous Fibre-reinforced orthotropic Lamina- Failure envelopes, Maximum stress/strain criteria, Tsai-Hill and Tsai-Wu criterion.	2
2.5	Hygrothermal stresses and strains in a lamina –unidirectional and angle lamina	1
3	**Micromechanical Behaviour of a Lamina (6)**	
3.1	Volume and Mass fractions, density and void content	1
3.2	Effective Moduli of a continuous fibre-reinforced lamina – Models based on mechanics of materials, theory of elasticity and experimental methods, Mechanics of materials approach to strength, Numerical Examples	2
3.3	Ultimate Strengths of unidirectional Lamina- longitudinal and transverse tensile and compressive strengths	2
3.4	Coefficients of moisture and thermal expansion	1
4	**Macro mechanical behaviour of Laminates (10)**	

4.1	Classical Lamination Theory-Laminae Stress-strain behaviour, In-plane forces, stress-strain variation in a laminate, resultant laminate stresses and strains,	3
4.2	Special cases of laminate stiffnesses-symmetric and antisymmetric laminates, cross ply and angle ply laminates, quasi-isotropic laminates	3
4.3	Inplane and flexural modulus of a laminate	1
4.4	Effects of stacking sequence-Laminate code	1
4.5	Free-Edge Interlaminar Effects, Hygro-thermal effects and warpage in a laminate	2
5	**Strength and Design of Laminates (9)**	
5.1	Determination of laminae stresses and strains, numerical examples	2
5.2	Laminate strength analysis procedure, Failure envelopes	3
5.3	Analysis of laminates after initial failures, Progressive failure Analysis. Numerical Examples	2
5.4	Composite mechanical design issues-Long-term environmental effects, impact resistance, fracture resistance, fatigue resistance	2

Text Books

1. Jones M. Roberts, Mechanics of Composite Materials, Taylor and Francis,1998
2. Reddy, J.N , Mechanics of Laminated Composite Plates: Theory and Analysis, CRC Press, 2003

Reference Books

1. Calcote, L. R., Analysis of Laminated Composite structures, Van Nostrand, 1969
2. Vinson, J. R. and Chou P, C., Composite materials and their use in Structures, Applied Science Publishers, Ltd. London, 1975
3. Agarwal, B.D. and Broutman, L. J., Analysis and performance of Fibre composites. 3rdEdn.

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
222ECE098	PROJECT EVALUATION AND MANAGEMENT	INTERDISCIPLINARY ELECTIVE	3	0	0	3

Preamble: Objective of the course is to enable the students to understand the management aspects of project idea formulations, feasibility studies and report preparation, costing of project, project appraisal and project funding.

Course Outcomes: The COs shown are only indicative. For each course, there can be 4 to 6 COs.

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

CO 1	To develop project ideas
CO 2	To do the feasibility analysis of projects
CO 3	To plan and arrive at Project Costs
CO 4	To carry out project appraisals
CO 5	To identify the various funding sources and select the apt source

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	2		3	2		2	
CO 2	2		2				
CO 3	3	2		3			
CO 4	2		2	2	2		
CO 5	2		2	1			

Assessment Pattern

Bloom's Category	End Semester Examination
Understand	20
Apply	10
Analyse	10
Evaluate	20
Create	

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	40	60	2.5 hours

Continuous Internal Evaluation Pattern:

Preparing a review article based on peer reviewed

Original publications (minimum 10 publications shall be referred) : 15 marks

Course based task/Seminar/Data collection and interpretation : 15 marks

Test paper, 1 no. : 10 marks

Test paper shall include minimum 80% of the syllabus.

End Semester Examination Pattern:

The end semester examination will be conducted by the respective College. There will be two parts; Part A and Part B. Part A will contain 5 numerical/short answer questions with 1 question from each module, having 5 marks for each question (such questions shall be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students). Students should answer all questions. Part B will contain 7 questions (such questions shall be useful in the testing of overall achievement and maturity of the students in a course, through long answer questions relating to theoretical/practical knowledge, derivations, problem solving and quantitative evaluation), with minimum one question from each module of which student should answer any five. Each question can carry 7 marks. Note: The marks obtained for the ESE for an elective course shall not exceed 20% over the average ESE mark % for the core courses. ESE marks awarded to a student for each elective course shall be normalized accordingly. For example if the average end semester mark % for a core course is 40, then the maximum eligible mark % for an elective course is 40+20 = 60 %.

Model Question Paper

Model Question paper

Course Code & Name:

Project Evaluation and Management

Max. Marks: 60
Duration: 2.5 hours

PART A

(Answer all Questions: Each question carries 5 marks)

1. Discuss the need for project idea generation ?
2. Why feasibility studies are essential?
3. What do you understand by Present value of a single amount?
4. Explain the international practice of Project Appraisal.
5. Discuss the means of Project Financing.

PART B

(Answer any *five* questions: Each carries 7 marks)

6. Describe the various steps involved in Project Identification.
7. How will you assess the technical feasibility of a project?
8. Explain cash flow and what are the benefits of cash flow statement..
9. Discuss the various methods of Risk Analysis
10. Bluebell Enterprises had invested Rs.2,00,00,000 for the purpose of replacing some of its machinery components. This renovation is expected to result in incremental benefits of Rs.5000000 in 1st year, Rs.3000000 in 2nd year and Rs. 4000000 in 3rd year. Calculate the benefit-cost ratio of the replacement project if the applicable discounting rate is 5%..
11. Discuss the role of various institutions for project financing
12. Discuss the Private Sector Participation on Infrastructure Projects in India

Syllabus and Corse Plan (For 3 credit courses, the content can be for 40 hrs and for 2 credit courses, the content can be for 26 hrs. The audit course in third semester can have content for 30 hours).

No	Topic	No. of Lectures
1	Project formulation	
1.1	Concepts of Project, Capital Investments	2
1.2	Purpose and need for Project Identification	2
1.3	Methodology for Project Identification	2
1.4	Steps in Project Identification	2
2	Project Feasibility	
2.1	Introduction to feasibility Studies, need for feasibility studies	2
2.2	Components of Feasibility Analysis - Market, Technical, Financial, Economic	4
2.3	Feasibility Reports and approvals	2
3	Project Costing	
3.1	Time Value of Money - Future value of single amount, Present value of single amount, Future value of an annuity, Present value of an annuity, Simple interest-Compound interest	3
3.2	Project Cash Flows	3
3.3	Cost of capital	2
4	Project Appraisal	
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Reference Books

1 Project Planning Analysis selection financing Implementation and Review- Tata Mc Graw Hill Publication, 7th edition 2010, Prasana Chandra

2 United Nations Industrial Development Organization (UNIDO) Manual for the preparation of Industrial Feasibility Studies, (IDSI Reproduction), Bombay, 2007.

3 A Systems Approach to Planning, Scheduling, and Controlling Project Management Harold Kerzner (2013), Wiley India, New Delhi

4 Project planning scheduling & control, James P.Lawis, Meo Publishing Company 2001

5 Project planning analysis selection implementation & review Prasanna Chandra, ISBNO-07-462049-5 2002.