



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Civil and Infrastructure Engineering**  
**Subject Code: 3144002**  
**Semester – IV**  
**Subject Name: Fundamentals of Structural Analysis**

**Type of course:** Core Subject in Civil and infrastructure engineering

**Prerequisite:** Mechanics of Solids

**Rationale:** This subject is conceptual applications of principles of mechanics of rigid and deformable bodies in Engineering.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

### Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>Analysis of Trusses:</b> Internal forces in members of statically determinate pin jointed trusses.	04	10
2	<b>Analysis of Statically Determinate Beams:</b> Static and Kinematic indeterminacy of a system, concept stability and redundancy, principle of superposition, principle of virtual work, Method of Strain energy for analysis of beams, Minimum complementary energy, Castigliano's theorems, determination of deflection.	08	20
3	<b>Displacement of Determinate Beams:</b> Differential equation of elastic curve, relation between moment, slope and deflection, Macaulay's method, Moment Area Method.	08	10
4	<b>Moment Distribution Method:</b> Analysis of determinate and indeterminate beams, settlement of supports. Analysis of determinate portal frames.	06	15
5	<b>Slope Deflection Method:</b> Analysis of determinate and indeterminate beams for various loading including settlement/rotation of support.	06	15
6	<b>Arches, Cables and Suspension Bridges:</b> Analysis of three hinge arches with circular and parabolic shapes subjected to various types of loading, Analysis of two hinged arches. Analysis of forces in cables.	06	15



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7	<b>Influence Lines for Determinate Beams:</b> Influence lines under a train of concentrated loads, and under moving uniformly distributed loads.	06	15
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### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers.

The actual distribution of marks in the question paper may vary slightly from above table

### Reference Books:

1. Junarkar S.B. & Shah H.J.; Mechanics of Structures Vol-I; Charotar publishing house, Anand
2. Wang C. K.; Intermediate Structural Analysis; Tata McGraw Hill book Company, New Delhi
3. Popov E.P.; Engineering Mechanics of Solids; Prentice Hall of India, New Delhi
4. Ryder G.H.; Strength of Materials; Mc Millan
5. Gere & Timoshenko; Mechanics of Materials; CBS Publishers & Distributors, Delhi
6. Hibbler R C; Mechanics of Materials; Pearson Education
7. Hibbler R C; Structural Analysis; Pearson Education

### Course Outcomes:

S. No.	Course Outcome Statement	Marks % weightage
CO-1	Apply principles of statics (equilibrium, compatibility and constitutive relationships) to determine response of statically determinate members/beams.	20 %
CO-2	Determine displacements of statically determinate structures, using the principle of virtual work and strain energy stored in the system.	20 %
CO-3	Use classical and iterative methods for determination of internal forces and displacements in determinate and indeterminate beams.	20 %
CO-4	Draw influence lines for statically determinate beams under moving loads (concentrated and uniformly distributed)	20 %
CO-5	Determine the forces in three hinged and two hinged arches, and to determine the forces in cables.	20%

### Term-Work:

1. The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Practical examinations shall consist of oral based on term work and above course.

### List of Open Source Software/learning website:

[www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Civil and Infrastructure Engineering**  
**Subject Code: 3144004**

**Semester – IV**  
**Subject Name: Concrete Technology**

**Type of course:** Professional Core Course

**Prerequisite:** Material Science

**Rationale:** Concrete is the most widely used as a construction material in the world. It plays an important role in Infrastructure and building construction. This subject is intended for gaining useful knowledge with respect to facts, concepts and procedures related to manufacturing of concrete with consideration of strength and severability criteria, because it is heterogeneous material and has complex microstructure. Understanding the basic behaviour of concrete is very important for civil engineering students to become efficient civil engineering professionals. It will help the students to explore the material, its properties, intrinsic nature and application & also the recent advances in field of concrete technology.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs
1	<b>Introduction:</b> Introduction of concrete, Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.	2
2	<b>Concrete Making Materials:</b> Cement: Manufacturing process of cement, Chemical composition, Hydration reaction of cement, Tests on cement, Types and properties of pozzolonic materials used for partial cement replacement in concrete. Types of special cement. Aggregates: Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified grading, Testing of aggregates. Water – General requirements & limiting values of impurities and water reducing chemical admixtures.	6
3	<b>Microstructure of Hydrated Cement Paste:</b> Hydration of portland cement, Heat of hydration, Microstructure of Hydrated Cement, Transition Zone, Effect of Cement Characteristics on Strength and Heat of Hydration, Water Requirements for Hydration, Alkali Aggregate Reaction	6



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4	<b>Fresh Concrete:</b> Properties of fresh concrete, Definition and Measurement methods of workability as per IS and ASTM standards, factors affecting workability, Segregation & Bleeding, Slump loss, Re-tempering, Site preparations for concreting, mixing, conveying, placing, compaction, finishing of concrete, methods of curing.	6
5	<b>Hardened Concrete:</b> Strengths of hardened concrete (Tensile & Compressive strength, Flexural & Bond strength), standard test methods as per IS and ASTM, Failure mechanism under compression & tension, Stress-strain behaviour of concrete, Overview of Modulus of elasticity, Dimensional stability – Creep & Shrinkage	6
6	<b>Durability &amp; Permeability of concrete:</b> Causes of deterioration in concrete and durability problems, Factors affecting durability, Transport mechanism of gases & fluids in concrete, Cracking & causes of cracking, Carbonation induced & corrosion induced cracking, Alkali-Silica Reaction, Degradation by freeze & thaw, Sulphate attack, Durability under sea-water (marine environment).	5
7	<b>Mix design of Concrete:</b> Principles of concrete mix design, Parameters and factors influencing mix design, Indian Standard methods of mix design, Acceptability criteria, variability of results, Various provisions of IS code for sound concrete.	5
8	<b>Special concrete and Concreting methods:</b> Advanced cement based composites, Fibre reinforced concrete, Polymer modified concrete, Self-compacting concrete, Light weight concrete, High strength concrete, Lightweight & heavy weight concrete, High volume fly ash concrete. Special concreting methods: Pumped concrete, Ready mix concrete, Under-water concreting, Hot & cold weather concreting, Precast concrete.	4
9	<b>Miscellaneous Topics:</b> Destructive, semi-destructive & Non-destructive testing types and its methodology. Problems faced during test evaluation, Various Test methods and procedure like Core cutting test, Rebound Hammer test, Ultra-sonic pulse velocity, Penetration tests, Pull out tests etc.	4

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
R Level	U Level	A Level	N Level	E Level
35	35	20	05	05

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.



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### Texts/ Reference Books:

- Gupta.B.L., Amit Gupta, “Concrete Technology”, Jain Book Agency, 2010.
- Shetty,M.S, “Concrete Technology”, S.Chand and Company Ltd, New Delhi, 2003
- Santhakumar,A.R; “Concrete Technology” , Oxford University Press, New Delhi, 2007
- Neville, A.M; “Properties of Concrete”, Pitman Publishing Limited, London,1995
- P. Kumar Mehta, Paulo J.M. Monteiro “Concrete: Microstructure, Properties, and Materials”, 4<sup>th</sup> Edition, Tata McGraw Hill Publishing Co Ltd.
- Gambir, M.L; “Concrete Technology”, 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi.
- Properties of Concrete by A. M. Neville, Pearson Education Limited.
- IS 10262-1982 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998

**Course Outcomes:** After successful completion of the course the students shall be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Components of cement and advantages of concrete over other materials. Explain types, properties and testing procedure of concrete making materials.	25 %
CO-2	Elucidate facts, concepts, and properties of hydrated cement microstructure, which influence over all quality of concrete. Describe properties of fresh concrete and factors affecting workability of concrete during its early stage and testing of fresh concrete as per codal provision.	30 %
CO-3	Illuminate strengths of hardened concrete and failure mechanism under loading conditions. Explicate creep and shrinkage of concrete. Elucidate durability and permeability of concrete, as harden concrete is having complex structure, which affect overall performance of the concrete over a period of design life.	25 %
CO-4	Prepare and develop concrete mix design based on material characteristics and design mix principles of manufacturing of concrete as per IS code. Describe special concrete and concreting methods and miscellaneous topics on advanced concrete technology.	20 %



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## **List of Experiments and term works:**

- Testing of Cement
- Testing of Aggregates
- Testing of Water
- Testing of Admixture dose.
- Technical assignments:
  - [1]. One site visits and technical report on the visit of any on-going Construction Site (visit report should contain: details of the project, stage of construction, standard practice of concrete making, placing, transporting and compaction. Detailing of Concrete Mix Design adopted, Ready Mix Concrete (RMC) plant functional and operation requirement or any modern advanced concrete technology adopted on site.)
  - [2]. Visit to a construction material related exhibition.

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# GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Civil and Infrastructure Engineering

Subject Code: 3144005

Semester – IV

Subject Name: Water Resource Engineering & Hydrology

Type of Course: Core

Prerequisite: NIL

## Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

## Contents:

Sr.No.	Topics	Hrs.	% Weight age
1	<p><b>Hydrology</b>  <b>Surface Water Hydrology:</b> Hydrologic cycle, water budget, precipitation and Abstractions; Evaporation and Evapotranspiration. Runoff and Hydrographs: Rainfall runoff relations, time area concept, flow duration curve, mass curve, flow hydrograph, Unit Hydrograph (UH), its analysis, S-curve hydrograph,            Discharge Measurement: Stream gauging, Flow rating curve, Use of current meters for velocity measurement, Estimation of discharge.</p> <p><b>Ground Water Hydrology:</b> Types of aquifers and properties (storage coefficient, coefficient of transmissibility), confined and unconfined aquifer, Tube wells and Open wells. Yield from an open well. Water logging, land drainage, benefits, classification of drains, surface drains, subsurface drains, design principles and maintenance of drainage systems.</p>	8	22%
2	<p><b>Basics of Irrigation Engineering:</b> Crop water requirements, Irrigation methods, necessity of Irrigation in India, advantages and disadvantages, techniques of irrigation water, quality of irrigation water, crop water requirements, consumptive use, Irrigation requirements, estimation of consumptive use of water by climatic approaches, Irrigation efficiencies, Soil moisture-irrigation relationship.</p>	3	9%
3	<p><b>Canal Irrigation:</b> Classification of canals, Canal losses, alignment of canals, Design of Irrigation Canals, Design of stable channels using Kennedy's and Lacey's theory, Cross section of irrigation canals, Lining of Irrigation Canals, Design of lined canals.</p> <p>Types of Cross-Drainage Works, Canal Falls, Weirs and Barrages, Layout of a diversion head work, Design of weirs and barrages: Bligh's creep theory, Design of weir using theory, Lane's weighted creep theory, Khosla's theory, Khosla's method of independent variables, Exit gradient</p>	8	22%
	<p><b>Dams:</b> Various forces acting on gravity dam, Combination of forces for design, modes of failure and criteria for structural stability, High and low gravity dam, Design of high dam, Earth and Rock fill Dams: Types, Causes of</p>		



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4	failure, Stability analysis of earthen and gravity dam, Seepage control in earth dams, Spillways: Descriptive study of various types of spillways Reclamation of Water Logged and Saline Soils: Causes and control of water logging. Reclamation of saline and alkaline land.	8	22%
5	<b>Reservoir planning</b> - Investigations - zones of storage in a reservoir, determination of storage capacity and yield, reservoir sedimentation Floods, Routing and Drought management, Concepts of return period, flood frequency analysis, Hydrologic storage routing, Flood forecasting - Flood routing, water harvesting, check dams.	9	25%
	<b>Total</b>	<b>36</b>	<b>100</b>

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N	E Level	C
10	15	20	20	25	10

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

### Reference Books:

1. SK Garg ,Irrigation engineering and hydraulic structures,, Khanna Publishers
2. BC Punamia, Pandey BB Lal, Irrigation and water power engineering, Standard Publishers
3. SK Sharma,Principles and practice of irrigation engineering, S Chand and Company
4. Punmia, B.C., Irrigation and Water Power Engineering, Standard Publishers, 2001.Ragunath. H.M., Hydrology, Willey Eastern Limited, New Delhi, 2000.
5. K.Subramanya (2004), Engineering Hydrology, Tata-McGraw Hill, New Delhi.
6. Asawa, G.L. (2005). Irrigation and Water Resources Engineering, New Age International Ltd.
7. Elizabeth M Shaw ,Hydrology in practice
8. M.H.Ali, Fundamentals of irrigation and on-farm water management volume - 1
9. M.H.Ali, Practices of irrigation and on-farm water management volume - 2
10. Irrigation Engg. By Birdie and Das, Dhanpat Rai, New Delhi
11. Irrigation Engg. By Sharma and Sharma, S. Chanda and Company, New Delhi
12. Todd D.K., "Groundwater Hydrology", John Wiley & Sons, Inc, New York,
13. Bear J., "Hydraulics of Groundwater", McGraw-Hill, New York,
14. Irrigation, Water Resources and water power engineering-P. N. Modi ,Standard Book House,
15. Srivastava, R. (2008). Flow through Open Channels, Oxford University Press,
16. Ven Te Chow, David Maidment and Larry Mays (2001), Applied Hydrology, Tata McGraw Hill, New Delhi, India,
17. Hill, New Delhi, India,
18. C.S.P. Ojha, R, Berndtsson and P. Bhunya, Engineering Hydrology, Oxford University Press, New Delhi,
19. R.A. Wurbs and W.P. James, Water Resources Engineering, Prentice Hall of India, New Delhi,
20. R.K. Sharma and T.K. Sharma, Hydrology and Water Resources Engineering, Dhanpat Rai Publications, New Delhi,
21. R.K. Linsley, J.B. Franzini, D.L. Freyberg and G. Tchobanoglous, Water Resources





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Subject Code: 3144005

Engineering, McGraw Hill Singapore,

22. V.P. Singh, Elementary Hydrology, Prentice Hall, Englewood Cliffs, New Jersey.

## Course Outcome:

Sr.No.	Course Outcome	% weightage
CO(1)	Conceptual understanding of Irrigation engineering	20
CO(2)	Compute reservoir capacity using mass curve	20
CO(3)	Compute the capacity of well	20
CO(4)	Measures of water conservation to battle drought	20
CO(5)	Estimation of design flood for the design of hydraulic structure	20

## List of Tutorials:

1. To determine rate of infiltration and infiltration capacity using double ring infiltrometer.
2. Measurement of rainfall
3. Estimation of flood using unit hydrograph
4. Computation of rate of infiltration using infiltrometer
5. Computation of live and dead storage capacity of reservoir
6. Flood routing of reservoir and channel
7. Calculation of dependable flow.
8. Determination of capacity of well.
9. Calculation of power of a hydro-power plant

List of Open Source Software/learning website: <http://en.wikipedia.org/wiki/Hydrology>  
<http://nptel.ac.in/courses/105104103/>



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# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3144006**

**Semester – IV**

**Subject Name: Environmental Sustainability**

**Type of course:** Humanities and Social Science

**Prerequisite:** Environmental Science subject of First Year. Preliminary knowledge of sustainability.

**Rationale:** Environmental sustainability is desperately essential to protect environmental resources for the future generations. This subject helps to reveal the students about need of preserving planet using renewable resources, cleaner and green production. It is also necessary to aware the students regarding policies for environmental sustainability in order to reduce the pollution level of environment.

### Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	0	3	70	30	0	0	100

### Content:

Sr. No.	Content	Total Hrs
1	Principles of Sustainable development: Introduction. Pillars of sustainability-Social, Environmental and Economy. Sub domain of sustainability-cultural, technological and political. Socio-ecological process. Ways of sustainable living. Introduction to Concepts of Green chemistry.	8
2	Ecosystem: Health of ecosystem. Protecting the long-term productivity and health of resources to meet future economic and social needs, protecting food supplies, farm land and fishing stocks.	6
3	Pollution control: Types of Pollutants. Effects of Pollutants. Avoiding excess Pollution	4
4	Renewable resources: Introduction. Shift to Renewable resources. Use of solar, wind, hydro, tidal, geo-thermal energy. Renewable vs Non-Renewable resources. Semi-Renewable resources.	6
5	Concept of Cleaner Production, Definition of Cleaner Production, Cleaner Production, Good House Keeping checklist, tools.	6
6	Green Productivity concepts, methodology & techniques, Guidelines of APO on Green Productivity, CEPI Index	6
7	Policies to promote environmental sustainability: Carbon Tax. Government regulation. Subsidizing. Environmental consequences.	6



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Bachelor of Engineering  
Subject Code: 3144006

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	30	20	10	5	5

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

- 1) An Introduction to Green Chemistry Matlack A.S., Marcel Dekker, 2001
- 2) Green Chemistry: Theory and Practice, Anastas P.T. and Wavner J.C.;Oxford University Press, 1998
- 3) An Introductory Text on Green Chemistry, Lancaster M., Royal Society of Chemistry, Cambridge, 2002
- 4) Handbook of Green Chemistry and Technology, Clark J.H. and Macquaries, Blackwell Publishers, 2002
- 5) Cleaner Production and its implementation in Industries, Dr Bharat Jain, GCPC
- 6) Renewable energy sources and emerging technologies, D.P.Kothari and K.C.Singal, PHI 2011.
- 7) Global Environment problems and policies, K.R.Gupta and Prasenjit Maiti, Atlantic 2009.

**Note: Apart from above references one can use some other books and material if required.**

### Course Outcomes:

Sr. No.	CO statement	Marks % weightage
CO-1	Understand the different principles of sustainable development and green chemistry.	25
CO-2	Understand the health of eco system and pollution control.	12
CO-3	Be aware of use of renewable resources for better environment.	18
CO-4	Empathize the concepts of cleaner technologies	15
CO-5	Know about practical applications of green productivity and emerging technologies.	20
CO-6	Apprehend the policies to promote environmental sustainability.	10



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**List of Experiments: Nil**

**Major Equipment: Nil**

**List of Open Source Software/learning website:**

- 1) <https://www.economicshelp.org>
- 2) <https://www.rsc.org>
- 3) <https://www.nptel.ac.in>

GTUQuestionPapers.com



**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**Bachelor of Civil and Infrastructure Engineering**  
**Subject Code: 3144006**

**Semester – IV**  
**Subject Name: Numerical and Statistical Methods**

**Type of course:** Basic Science Course

**Prerequisite:** The students are required to have a reasonable understanding of Calculus, Differential equations and Linear algebra and introductory knowledge of probability and statistics.

**Rationale:**

There is different kind of systems which requires through mathematical analysis tools. The type of systems which requires such tools are linear systems, nonlinear systems and dynamical systems. Apart from them, it requires systematic study of uncertainty (randomness) by probability - statistics and curve fitting. The different methods like numerical methods are required to be studied.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	2	0	5	70	30	0	0	100

**Content:**

Sr. No.	Content	Total Hours	% Weightage
<b>Numerical Methods</b>			
01	<b>Numerical Solutions:</b> Roots of Algebraic and Transcendental Equations: Bisection, false position, Secant and Newton-Raphson methods.	3	7%
02	<b>Interpolation:</b> Finite Differences, Newton's Forward and Backward interpolation, Newton's divided formulae and Lagrange's interpolation formulae for unequal intervals.	3	7%
03	<b>Numerical Integration:</b> Newton-Cotes formula, Trapezoidal and Simpson's formulae, Gaussian quadrature formulae.	3	7%
04	<b>Numerical solution of ODE:</b> Taylor's series method, Euler methods and Runge - Kutta methods.	3	7%
<b>Statistical Methods</b>			
05	<b>Probability:</b> Classical & Set theoretic approach, Conditional probability, Bayes' theorem, Probability distribution, probability mass function, probability density function, Expectation, Poisson distribution, Normal distribution.	10	24%
06	<b>Basic Statistics:</b> Measures of central tendency, dispersion, Moments, skewness, kurtosis, Correlation and Regression.	7	17%
07	<b>Curve fitting:</b> Curve fitting by of method of least squares, fitting of straight lines, second degree parabola and more general curves.	3	07%



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<b>08</b>	<b>Applied Statistics:</b> Sampling and Estimation: Formation of Hypothesis, Test of significance: Large sample test for single mean & proportion, Difference of means & proportions. Test of significance for Small samples: t- test for single mean, difference of means, t-test for correlation coefficients, F- test for ratio of variances, Chi-square test for goodness of fit and independence of attributes.	10	24%
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**Suggested Specification table with Marks (Theory):**

<b>Distribution of Theory Marks</b>					
R Level	U Level	A Level	N Level	E Level	C Level
<b>10</b>	<b>30</b>	<b>30</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

- (1) E. Kreyszig, Advanced Engineering Mathematics, John Wiley (1999)
- (2) J. L. Devore, Probability and Statistics for Engineering and the Sciences, Cengage Learning
- (3) Chapra S.C, Canale, R P, Numerical Methods for Engineers, Tata McGraw Hill, 2003.
- (4) Gerald C. F. and Wheatley P.O., Applied Numerical Analysis (5th Edition), Addison-Wesley, Singapore, 1998
- (5) P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
- (6) S. Ross, A First Course in Probability, 6th Ed., Pearson Education India.
- (7) W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley.
- (8) D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.

**Course Outcomes:**

After learning the course, the students should be able to:

<b>Sr. No.</b>	<b>CO statement</b>
CO-1	solve algebraic equation related to civil and infrastructure engineering problem by using numerical and understand convergent of it
CO-2	find unknown value of given data by using various interpolation methods and calculate integration and solve differential equations by using numerical methods
CO-3	understand the terminologies of basic probability and analyze the behavior of various discrete and continuous probability distributions.
CO-4	understand the central tendency, correlation, regression and curve fitting.
CO-5	apply the statistics for testing the significance of the given large and small sample data by using z-test, t- test, F- test and Chi-square test.

**List of Open Source Software/learning website:**

- E-materials available at the website of NPTEL- <http://nptel.ac.in/>