

≡≡≡ GATE PREP SERIES ≡≡≡

GATE

Graduate Aptitude Test in Engineering

2025

Civil
Engineering



G. K. PUBLICATIONS (P) LTD.

Title : GATE 2025 : Civil Engineering

Language : English

Editor's Name : GKP Editorial Team

Copyright © : 2025 CLIP

No part of this book may be reproduced in a retrieval system or transmitted, in any form or by any means, electronics, mechanical, photocopying, recording, scanning and or without the written permission of the Author/Publisher.

Typeset & Published by :

Career Launcher Infrastructure (P) Ltd.

A-45, Mohan Cooperative Industrial Area, Near Mohan Estate Metro Station, New Delhi - 110044

Marketed by :

G.K. Publications (P) Ltd.

Plot No. 63, Sector-27A, Near Sector - 28 Metro Station, Faridabad, Haryana-121003

ISBN : 978-93-56817-59-3

Printer's Details : Printed in India, New Delhi.

For product information :

Visit www.gkpublications.com or email to gkp@gkpublications.com

• Preface	(xiii)
• About GATE	(xv)
• GATE Syllabus	(xxv)
• Chapter-Wise Analysis	(xxvii)

GENERAL APTITUDE

Verbal Aptitude

1. English Grammar 1.1 - 1.16

Errors in Use of Articles	1.1
Use of 'An'	1.1
Use of 'A'	1.1
Use of 'The'	1.1
Errors in Use of Nouns	1.2
Errors in Use of Pronouns	1.2
Parts of Speech	1.3
Noun	1.3
Pronoun	1.3
Verb	1.4
Adjective	1.4
Adverb	1.4
Preposition	1.4
Conjunction	1.4
Interjection	1.5
Errors in Use of Prepositions	1.5
Prepositions of Time	1.5
Prepositions of Position	1.5
Prepositions of Direction	1.5
Other Uses of Preposition	1.5
Words Followed by Prepositions	1.6
Some Special Cases	1.7
Errors in Use of Conjunctions	1.7
Errors in Subject-verb Agreement	1.8
Errors in the Use of Tenses	1.8
Gerund & Infinitive	1.9
Auxiliary Verbs	1.9

Errors in Use of Adjectives	1.10
Errors in Use of Adverbs	1.11
Some More Tips of Usage	1.11
<i>Exercise</i>	1.13
– MCQ Type Questions	1.13
<i>Answers</i>	1.15
<i>Explanations</i>	1.16

2. Sentence Completion 2.1 - 2.10

Skill of vocabulary	2.1
Skill of semantics and syntax	2.1
Skill of identifying clues	2.2
Sentence Completion Strategies	2.2
Thought Continuity Clues	2.3
Parallel Idea Clues	2.3
Thought Reversal Clues	2.3
Cause Effect Clues	2.3
Word Definition Clues	2.4
<i>Exercise</i>	2.5
– MCQ Type Questions	2.5
<i>Answers</i>	2.9
<i>Explanations</i>	2.9

3. Synonyms 3.1 - 3.12

Some Important Words With Their	
Synonyms	3.1
<i>Exercise</i>	3.4
– MCQ Type Questions	3.4
<i>Answers</i>	3.12

4. Antonyms 4.1 - 4.12

Plan to Answer Antonym Questions	4.1
<i>Exercise</i>	4.2
– MCQ Type Questions	4.2
<i>Answers</i>	4.12

5. Miscellaneous 5.1 - 5.26

Vocabulary For Reading Comprehension	5.1
Narrative Sequence	5.2
Speakers	5.4
Jargons	5.4
Phobias, Manias and Complexes	5.5
Words from Myths & Legends	5.7
Words Depicting Subjects of Study	5.8
Words from Characters of Literature	5.9
Words from People's & Place Names	5.10
Young Ones & Crises of Animals	5.11
Group Terms	5.12
Words of Foreign Origin	5.13
Word Frequency	5.15
Word Analogy	5.15
Common Types of Analogy	5.16
Odd Word Out	5.17
Idioms & Phrases	5.17
<i>Exercise</i>	5.18
– <i>MCQ Type Questions</i>	5.18
<i>Answers</i>	5.26

Analytical Aptitude

1. Logical Reasoning Ability 1.1 - 1.50

Reasoning	1.1
Verbal Reasoning	1.1
Analogy	1.6
Classification	1.11
Coding-Decoding	1.12
Blood Relations	1.13
Puzzle Test	1.15
Direction Sense	1.18
Logical Venn Diagrams	1.19
Alphabetical Quibble	1.21
Number, Ranking & Time Sequence	1.21
Mathematical Operations	1.22
Logical Sequence of Words	1.23
Decision Making	1.23
Cubes	1.25
Arrangements	1.26
Clocks	1.28
Calendars	1.30
Deductions	1.31
Data Sufficiency	1.34
<i>Exercise</i>	1.36
– <i>MCQ Type Questions</i>	1.36
– <i>Numerical Type Questions</i>	1.42
<i>Answers</i>	1.43
<i>Explanations</i>	1.44

Spatial Aptitude

1. Spatial Aptitude 1.1 - 1.40

Transformations	1.1
Geometrical Transformations	1.4
Paper Folding and Cutting	1.8
Patterns in 2 and 3 Dimensions	1.9
Shape Matching in 2D & 3D Pattern	1.13
<i>Exercise</i>	1.18
– <i>MCQ Type Questions</i>	1.18
<i>Answers</i>	1.39
<i>Explanations</i>	1.40

Quantitative Aptitude

1. Numbers, Algebra and Data Interpretation 1.1 - 1.18

Numbers	1.1
Numerical Relation	1.1
HCF and LCM	1.2
Progressions	1.3
Algebraic Formulae and Their Application	1.3
Polynomials	1.3
Inequations	1.4
Quadratic Equation with Application to Inequalities	1.4
Data Interpretation	1.4
<i>Exercise</i>	1.7
– <i>MCQ Type Questions</i>	1.7
– <i>Numerical Type Questions</i>	1.11
<i>Answers</i>	1.12
<i>Explanations</i>	1.12

2. Percentage and Its Applications 2.1 - 2.18

Percentage	2.1
Simple Interest and Compound Interest	2.3
Profit and Loss	2.4
Partnership	2.6
Stocks and Shares	2.7
<i>Exercise</i>	2.9
– <i>MCQ Type Questions</i>	2.9
– <i>Numerical Type Questions</i>	2.11
<i>Answers</i>	2.12
<i>Explanations</i>	2.13

3. Speed, Time and Work 3.1 - 3.19

Speed	3.1
Unit of Measurement	3.1
Boats and Streams	3.4
Linear and Circular Races	3.5

ENGINEERING MATHEMATICS

Work & Time	3.7		
Pipes and Cisterns	3.9		
<i>Exercise</i>	3.11		
– <i>MCQ Type Questions</i>	3.11		
– <i>Numerical Type Questions</i>	3.12		
<i>Answers</i>	3.14		
<i>Explanations</i>	3.14		
4. Ratio, Proportion and Mixtures			
	4.1 - 4.10		
Ratio	4.1		
Proportion	4.3		
Variation	4.3		
Mixtures and Alligations	4.4		
<i>Exercise</i>	4.6		
– <i>MCQ Type Questions</i>	4.6		
– <i>Numerical Type Questions</i>	4.7		
<i>Answers</i>	4.8		
<i>Explanations</i>	4.8		
5. Permutations-Combinations, Elementary Statistics and Probability			
	5.1 - 5.14		
Permutations-Combination	5.1		
Elementary Statistics	5.2		
Relation between A.M., G.M. and H.M.	5.5		
Probability	5.6		
<i>Exercise</i>	5.8		
– <i>MCQ Type Questions</i>	5.8		
– <i>Numerical Type Questions</i>	5.9		
<i>Answers</i>	5.10		
<i>Explanations</i>	5.10		
6. Miscellaneous			
	6.1 - 6.21		
Linear Equations	6.1		
Quadratic Equation	6.2		
Geometry and Mensuration	6.3		
Congruency of Triangles	6.4		
Similarity of Triangles	6.4		
Important Terms of Triangle	6.6		
Quadrilaterals	6.7		
Properties of A Rectangle	6.7		
Circles	6.8		
Mensuration	6.9		
Power and Exponents	6.10		
Logarithms	6.11		
<i>Exercise</i>	6.12		
– <i>MCQ Type Questions</i>	6.12		
– <i>Numerical Type Questions</i>	6.15		
<i>Answers</i>	6.16		
<i>Explanations</i>	6.16		
1. Linear Algebra		1.1 - 1.24	
Vector Spaces		1.1	
Subspaces		1.2	
Spanning Set		1.3	
Determinants		1.4	
Minor		1.4	
Co-factor		1.4	
Algebra of Matrices		1.5	
Equality of Two Matrices		1.8	
Transpose of a Matrix		1.8	
Orthogonal Matrix		1.9	
Rank of a Matrix		1.9	
Cramer's Rule		1.12	
Eigenvalues and Eigenvectors		1.13	
Cayley-Hamilton Theorem		1.13	
Solved Problems		1.15	
<i>Exercise</i>		1.17	
– <i>MCQ Type Questions</i>		1.17	
– <i>Numerical Type Questions</i>		1.19	
<i>Answers</i>		1.20	
<i>Explanations</i>		1.20	
2. Calculus		2.1 - 2.30	
Functions of Single Variable Limits		2.1	
Right Hand and Left Hand Limits		2.1	
Theorems on Limits		2.1	
Continuity and Discontinuity		2.5	
Differentiability		2.5	
Mean Value Theorems		2.5	
Computing the Derivative		2.6	
Partial Derivatives		2.6	
Taylor Series		2.8	
Some Standard Integrations		2.11	
Definite Integral		2.12	
Multiple Integrals		2.13	
Change of Order of Integration		2.14	
Triple Integrals		2.14	
Partial Derivatives		2.16	
Two Variable Case		2.16	
Rules of Partial Differentiation		2.16	
Differentials		2.17	
Line Integral		2.20	
Surfaces		2.20	

Volume Integral	2.21	Correlation	4.16
Fourier Series	2.21	Line of Regression	4.16
<i>Exercise</i>	2.22	Solved Examples	4.18
– <i>MCQ Type Questions</i>	2.22	<i>Exercise</i>	4.21
– <i>Numerical Type Questions</i>	2.24	– <i>MCQ Type Questions</i>	4.21
<i>Answers</i>	2.25	– <i>Numerical Type Questions</i>	4.25
<i>Explanations</i>	2.25	<i>Answers</i>	4.26
3. Ordinary and Partial Differential Equations	3.1 - 3.22	<i>Explanations</i>	4.26
Ordinary Differential Equation	3.1	5. Numerical Methods	5.1 - 5.15
Type I : Variable Separation Form	3.2	Accuracy and Precision	5.1
Type II : Linear Differential Equations	3.2	Error Analysis	5.1
Type III : Homogeneous Differential Equations	3.2	Algebraic Equations	5.2
Type IV : Exact Differential Equations	3.3	Polynomial Equations	5.3
Integrating Factors (I.F.)	3.3	Transcendental Equations	5.3
Particular Integral	3.5	Methods of Solving Non-Linear Equations	5.3
Method of Variation of Parameters	3.7	Newton-Raphson Method	5.4
Cauchy's Homogeneous Linear Equation	3.8	Order of Convergence	5.4
Legendre's Homogeneous Linear Equation	3.8	Secant Method	5.7
Euler-Cauchy Equations	3.8	Least Squares Approximation	5.9
Partial Differential Equations	3.11	Numerical Integration	5.11
<i>Exercise</i>	3.19	<i>Exercise</i>	5.14
– <i>MCQ Type Questions</i>	3.19	– <i>MCQ Type Questions</i>	5.14
– <i>Numerical Type Questions</i>	3.20	– <i>Numerical Type Questions</i>	5.14
<i>Answers</i>	3.21	<i>Answers</i>	5.15
<i>Explanations</i>	3.21	<i>Explanations</i>	5.15
4. Probability and Statistics	4.1 - 4.32	TECHNICAL SECTION	
Probability	4.1	1. Engineering Mechanics	1.1 - 1.80
Sampling	4.1	Introduction	1.1
Parameters	4.1	Force System	1.1
Statistics	4.1	System of Forces	1.2
Conditional Probability	4.2	Equilibrium Equations	1.2
Discrete Random Variables	4.3	Internal Forces in Structures	1.3
Elements of Probability	4.5	Varignon's Theorem	1.4
Dependent Events	4.5	Couple	1.4
Law of Total Probability	4.6	Friction	1.5
Baye's Theorem	4.6	Self Locking Mechanism	1.7
Measures of Central Tendency	4.6	Kinematics	1.7
Measures of Dispersion	4.9	Velocity and Acceleration	1.8
Random Variable	4.11	Centre of Mass	1.8
Probability Distribution	4.12	Centroid of Different Figures	1.9
Bernoulli Trials	4.13	Euler's Equation of Motion	1.10
		Impulse - Momentum	1.11

Energy Methods	1.13	3. Structural Analysis	3.1 - 3.32
Potential Energy	1.14	Structures	3.1
Concepts from Vibrations, Newton's laws	1.17	Classification of Structures Based on Their Shapes	3.1
Degree of Freedom	1.17	Classification of Structures Based on Determinacy	3.1
Classification of Vibration	1.19	Degree of Redundancy	3.2
Damping	1.32	Analysis of Structures	3.4
Forced Vibration	1.36	Force Displacement Relationships	3.8
<i>Exercise</i>	1.43	Moment Distribution Method	3.8
– <i>MCQ Type Questions</i>	1.43	Carry Over Factor (C.O.F)	3.8
– <i>Numerical Type Questions</i>	1.53	Strain Energy Method	3.11
<i>Answers</i>	1.57	Principle of Superposition	3.15
<i>Explanations</i>	1.58	Analysis of Trusses	3.15
2. Solid Mechanics	2.1 - 2.46	Analysis of Arches	3.16
Bending Moment and Shear Force	2.1	Influence Lines	3.17
Simple Stress	2.1	Matrix Method	3.18
Shearing Stress or Tangential Stress	2.1	Stiffness of Members	3.22
Stress and Strain in Two Dimensions	2.2	Nodal Degree of Freedom	3.24
Transformation of Strain Components	2.4	<i>Exercise</i>	3.25
Elastic Constants	2.5	– <i>MCQ Type Questions</i>	3.25
Theories of Failure	2.6	– <i>Numerical Type Questions</i>	3.30
Simple Bending Theory	2.8	<i>Answers</i>	3.31
Bending Stress	2.9	<i>Explanations</i>	3.31
Flexural and Shear Stresses	2.10	4. Construction Materials and Management	4.1 - 4.20
Shear Centre	2.12	Construction Material, Structural Steel	4.1
Uniform Torsion	2.13	Concrete	4.3
Compound Shafts	2.15	The Principles of Proportioning in Concrete	4.4
Columns	2.16	Short-term and Long-term Properties of Concrete	4.5
Analysis of Long Columns by Euler's Formula	2.16	Bricks and Mortar	4.5
Effective Length of Compression Members	2.17	Timber	4.8
Long Column Under Eccentric Loading	2.18	Bitumen	4.10
Combined Direct and Bending Stresses	2.18	Construction Management	4.11
Load Acting Eccentrically to One Axis	2.18	Analysis of Rates and Specifications	4.11
Load Acting Eccentrically to Both Axes	2.18	Estimate	4.11
Condition for No Tension in the Section	2.19	Project Planning	4.12
Normal and Shear Stresses on Inclined Sections	2.20	Elements of Network Diagram	4.13
Stress Elements and Plane Stress	2.22	PERT (Programme Evaluation & Review Technique)	4.14
Stresses on Inclined Sections	2.23	CPM (Critical Path Method)	4.15
Transformation Equations	2.23	Float (F)	4.16
Principal Stresses	2.24	<i>Exercise</i>	4.17
<i>Exercise</i>	2.31	– <i>MCQ Type Questions</i>	4.17
– <i>MCQ Type Questions</i>	2.31	– <i>Numerical Type Questions</i>	4.19
– <i>Numerical Type Questions</i>	2.39	<i>Answers</i>	4.19
<i>Answers</i>	2.40	<i>Explanations</i>	4.20
<i>Explanations</i>	2.41		

5. Concrete Structures	5.1 - 5.36		
Analysis of Concrete Structures	5.1	Design of Semi-rigid and Rigid Connections	6.23
Working Stress Method	5.1	Riveting and Bolting	6.23
Ultimate Load Method	5.1	Welding	6.24
Whitney's Theory	5.1	Plate Girders	6.26
Limit State Design	5.2	Roof Trusses	6.29
Characteristic Strength	5.2	Plastic Analysis of Beams and Portals	6.31
Assumptions in the Limit State Design	5.3	Plastic Hinge and Mechanism	6.32
Recommendations of Indian		<i>Exercise</i>	6.34
Standard Codes	5.4	– <i>MCQ Type Questions</i>	6.34
Limit State of Collapse-Flexure	5.4	– <i>Numerical Type Questions</i>	6.46
Modes of Failure in Flexure	5.5	<i>Answers</i>	6.48
Limiting Values of Moment of Resistance	5.5	<i>Explanations</i>	6.49
Limit State of Serviceability	5.7		
Design of Beams	5.9	7. Soil Mechanics and Foundation	
Effective Depth	5.10	Engineering	7.1 - 7.73
Design of Doubly Reinforced Beams	5.13	Soil Mechanics	7.1
Design of Compression Members	5.17	Soil Classification	7.3
Short Column Under Axial Compression	5.17	Index Properties	7.5
Reinforcement	5.18	Mineral Contents of Soil	7.10
Column	5.19	Permeability	7.10
Column Footings	5.22	Seepage	7.13
Depth from B.M. Consideration	5.24	Effective Stress Principle	7.16
Depth from Punching Shear Consideration	5.24	Compaction	7.19
Check for Diagonal Tension	5.25	Compressibility and Consolidation	7.22
Pre Stressing	5.25	Shear Strength	7.25
Fully Prestressed Section	5.26	Foundation Engineering	7.31
Deflection of Prestressed Concrete Member	5.27	Soil Investigation and Exploration	7.31
<i>Exercise</i>	5.30	Earth Pressure	7.33
– <i>MCQ Type Questions</i>	5.30	Stability of Slopes	7.38
– <i>Numerical Type Questions</i>	5.35	Stress Distribution in Soils	7.41
<i>Answers</i>	5.36	Foundations Structure	7.45
<i>Explanations</i>	5.36	DEEP Foundations	7.51
		Analysis Soil Modulus	7.55
		<i>Exercise</i>	7.63
		– <i>MCQ Type Questions</i>	7.63
		– <i>Numerical Type Questions</i>	7.69
		<i>Answers</i>	7.69
		<i>Explanations</i>	7.70
6. Steel Structures	6.1 - 6.52	8. Fluid Mechanics and Hydraulics	8.1 - 8.64
Tension Member	6.1	Physical Properties of Fluids	8.1
Net Sectional Area	6.2	Water as a Fluid	8.3
Combined Axial and Bending		Variation of Static Pressure	8.3
Tensile Stresses	6.3	Hydrostatics	8.4
Slenderness Ratio (L)	6.3	Buoyancy and Flootation	8.5
Design of Axially Loaded Tension Member	6.4	Fluid Kinematics	8.6
Solved Examples	6.5	Fluid Dynamics	8.9
Compression Members	6.7	Momentum Equation	8.10
Lacings and Battens for Built-up		Viscous Flow	8.11
Compression Members	6.10	Pipe Flow	8.15
Solved Examples	6.12		
Design of Beams and Beam Columns	6.13		
Design of Connections : Column Slabs and			
Gusseted Bases	6.19		
Solved Examples	6.20		

Boundary Layer Theory	8.17	Duty (D)	10.3
Flow in Pipes	8.20	Factors Affecting Duty	10.3
Pipe Network	8.23	Water Requirement of Crops	10.4
Forces on Immersed Bodies	8.24	Consumptive Use of Water (Evapo-Transpiration)	10.6
Flow Measurement	8.27	Inflow and Outflow Studies for Large Area	10.6
Dimensional Analysis	8.28	Irrigation Efficiency	10.6
Model Analysis	8.32	Principle Crops	10.7
Velocity Triangle	8.34	Determination of Irrigation Requirement of Crops	10.8
Open Channel Flow	8.35	Design of Channels	10.8
Celerity (C)	8.38	Diversion Head Works	10.12
Steady Uniform Flow	8.39	Spillways	10.14
Critical Flow in a Channel	8.40	Design of Weirs and Barrages	10.17
Application of Specific Energy	8.43	Safety of Hydraulic Structures	10.17
Hydraulic Jump	8.43	Khosla's Theory and Concept of Flow Nets	10.18
Open Channel Surges	8.44	Irrigation Methods	10.21
Gradually Varied Flow (GVF)	8.45	I. Surface Irrigation	10.21
Basic Considerations	8.46	II. Sub-Surface Irrigation	10.24
<i>Exercise</i>	8.55	III. Sprinkler Irrigation	10.24
– MCQ Type Questions	8.55	<i>Exercise</i>	10.26
– Numerical Type Questions	8.58	– MCQ Type Questions	10.26
<i>Answers</i>	8.59	– Numerical Type Questions	10.28
<i>Explanations</i>	8.60	<i>Answers</i>	10.28
9. Hydrology	9.1 - 9.32	<i>Explanations</i>	10.29
Hydrological Cycle	9.1	11. Water Supply	11.1 - 11.34
Precipitation	9.1	Public Water Supply Scheme	11.1
Measurement of Rainfall	9.2	Water Demand	11.1
Evaporation	9.3	Per Capita Demand	11.2
Infiltration	9.6	Population Forecasts	11.3
Run-off and Rainfall-off	9.7	Sources of Water	11.6
Stage of a River	9.7	Flows in Pipe Systems	11.7
Stream Flow Measurement	9.8	Pumps for Lifting Water	11.8
Unit Hydrograph	9.11	Quality Control of Municipal and Industrial Water	11.9
Flood Estimation	9.14	Analysis of Water	11.10
Reservoirs Channel Routing	9.17	Water Quality Standards	11.15
Ground Water Flow and Yield	9.20	Water Borne Diseases and Their Control	11.16
Aquifuse, Aquitard and Aquiclude	9.22	Methods of Purification of Water	11.16
Well Hydraulics	9.22	Parts of Coagulation Sedimentation Plant	11.19
<i>Exercise</i>	9.26	Coagulant Quantities	11.20
– MCQ Type Questions	9.26	Comparison of Slow sand and Rapid sand Filters	11.22
– Numerical Type Questions	9.29	Forms in Which Chlorine Can be Applied	11.24
<i>Answers</i>	9.30	Distribution of Water	11.29
<i>Explanations</i>	9.31	<i>Exercise</i>	11.30
10. Irrigation	10.1 - 10.30	– MCQ Type Questions	11.30
Classification of Water Present in Soil	10.1	– Numerical Type Questions	11.32
Delta (Δ)	10.2	<i>Answers</i>	11.32
Base Period (B)	10.2	<i>Explanations</i>	11.33
Crop Period	10.3		

12. Solid Waste and Waste Water**Treatment 12.1 - 12.58**

Quality of Sewage	12.1
Characteristics of Sewage	12.1
BOD by Dilution Technique	12.4
Ultimate First Stage BOD	12.4
BOD/COD Ratio	12.5
Biological Characteristics	12.6
Sewage and Sewerage Treatment	12.10
Sewer Materials	12.18
Laying of Sewers	12.18
Sewer Appurtenances	12.19
Sewage Treatment	12.20
Sewage Treatment Process	12.21
Design of Trickling Filters	12.27
Activated Sludge Plant	12.30
Sludge Volume Index (S.V.I.)	12.32
Methods of Aeration, and Aerators	12.32
Sludge Digestion Process	12.33
Aerobic and Anaerobic Biological Units	12.35
Design Criteria	12.36
Disposal of Sewage Effluents	12.36
Disposal of Solid Wastes and Refuse of a Society	12.41
Disposal of Refuse	12.41
Methods of Sludge disposal	12.42
Design of Sewer Network and Water Quality Index	12.46
Plans and Nomenclature	12.47
Precautions	12.50
Water Quality Index (WQI)	12.50
<i>Exercise</i>	12.51
– MCQ Type Questions	12.51
– Numerical Type Questions	12.56
<i>Answers</i>	12.56
<i>Explanations</i>	12.57

13. Air Pollution 13.1 - 13.12

Classification of Air Pollution	13.1
Sources of Air Pollution	13.2
Effects of Air Pollution	13.2
Air Pollution Meteorology	13.3
Inversions	13.4
Wind Velocity Profiles	13.5
Stack Plumes	13.6
Air Pollution Control	13.7
Composition of Clean and Dry Atmospheric Air	13.10
<i>Exercise</i>	13.10
– MCQ Type Questions	13.10
– Numerical Type Questions	13.12
<i>Answers</i>	13.12
<i>Explanations</i>	13.12

14. Noise Pollution 14.1 - 14.6

Characteristics of Sound and Its Measurement	14.1
Power of Sound (W)	14.2
Sound Intensity (I)	14.2
Levels of Noise	14.2
Averaging Sound Pressure Levels	14.3
Noise Rating Systems	14.3
Noise Level Standards	14.4
Sources of Noise	14.4
Noise Abatement and Control	14.5
<i>Exercise</i>	14.6
– MCQ Type Questions	14.6
– Numerical Type Questions	14.6
<i>Answers</i>	14.6
<i>Explanations</i>	14.6

15. Transportation Engineering 15.1 - 15.70

Highways	15.1
Highway Geometric Design	15.1
Sight Distance	15.4
PIEV Theory	15.5
Design of Horizontal Alignment	15.7
Design of Vertical Alignment	15.13
Highway Material	15.15
Testing and Specification of Paving Materials	15.16
Tests on Road Aggregates	15.17
Bituminous Materials	15.20
Tar	15.23
Cement	15.24
Standard Tests	15.24
Design of Highway Pavements	15.26
Design of Rigid Pavements	15.36
Traffic Parameters	15.37
Environmental Parameters	15.37
Foundation Strength	15.37
Foundation Surface Characteristics	15.38
Concrete Characteristic Pavement	15.38
Modulus of Elasticity (E) and Poisson's Ratio	15.38
Coefficient of Thermal Expansion	15.39
Design of Slab Thickness	15.39
Calculation of Stresses	15.39
Design of Joints	15.41
Design of Dowel Bars	15.42
Geometrical Design of Railway Track	15.43
Radius of Curve/Degree of Curve (D°)	15.44
Versine of Curve	15.44

Super Elevation (Cant)	15.44	V. Plane Table Survey	16.20
Equilibrium Cant (for Equilibrium Speed)	15.45	VI. Triangulation Survey	16.23
Cant Deficiency (D)	15.46	VII. Photogrammetry	16.26
Runaway Length	15.46	Geographical Positioning System (GPS)	16.33
Balanced Field Concept	15.48	<i>Exercise</i>	16.38
Taxiway	15.48	– <i>MCQ Type Questions</i>	16.38
Exit Taxiway	15.49	– <i>Numerical Type Questions</i>	16.58
Traffic Engineering	15.50	<i>Answers</i>	16.60
<i>Exercise</i>	15.57	<i>Explanations</i>	16.61
– <i>MCQ Type Questions</i>	15.57	● MSQ Question Bank	1 - 40
– <i>Numerical Type Questions</i>	15.66	Mock Tests	
<i>Answers</i>	15.67	● Mock Test 1	1 - 6
<i>Explanations</i>	15.68	● Mock Test 2	1 - 6
16. Surveying	16.1 - 16.62	● Mock Test 3	1 - 6
Basic Principles Surveying	16.1	Solved Papers	
Map	16.1	● Solved Paper 2022	1 - 22
Representative Fraction (R.F.)	16.2	● Solved Paper 2023	1 - 26
Errors	16.2	● Solved Paper 2024	1 - 25
Classification of Survey	16.3		
I. Chain Survey	16.3		
II. Compass Survey	16.6		
III. Theodolite Survey	16.16		
IV. Tacheometric Survey	16.19		

GATE

Graduate Aptitude Test in Engineering

IIT Institutes



GATE 2025 will be conducted by
Indian Institute of Technology, Roorkee



GATE 2024 conducted by
Indian Institute of Science, IISc Bangalore



Indian Institute of Technology, Kanpur



Indian Institute of Technology, Kharagpur



Indian Institute of Technology, Mumbai



Indian Institute of Technology, Delhi



Indian Institute of Technology, Chennai



Indian Institute of Technology, Guwahati

Preface

The Graduate Aptitude Test in Engineering (GATE) is an online exam conducted by the IITs for admissions to PG courses in IITs, IISc Bangalore, NITs and many state run universities as well as private universities. Also there are more than 37 PSUs that use GATE score for recruitments. A large number of corporates are also using GATE score as a tool to screen students for placements.

GK Publications is well known as the “publisher of choice” to students preparing for GATE and other technical test prep examinations in the country. We published first set of books in 1994 when GATE exam, both objective and conventional, was conducted in the paper and pencil environment, and used as a check point for entry to post graduate courses in IITs and IISCs. At that time, students had little access to technology and relied mainly on instructor led learning followed by practice with books available for these examinations.

A lot has changed since then!

Today, GATE is conducted in an online only mode with Multiple Choice Questions, Multiple Select Questions and Numerical Based Questions. The score is valid for three years and is used not only for post graduate courses but is also used by major PSUs for recruitment. Today’s students have easy access to technology and the concept of a monologue within the classroom has changed to dialogue where students come prepared with concepts and then discuss topics. They learn a lot of things on the go with their mobile devices and practice for mock tests online.

We, as a leading publisher of GATE books, have also embraced change. Today, our books are no more guides only but come with a fully supported mobile app and a web portal. The mobile App provides access to video lectures, short tests and regular updates about the exam. The web portal in addition to what is available on the App provides full length mock tests to mimic the actual exam and help you gauge your level of preparedness. The combination of practice content in print, video lectures, and short and full length tests on mobile and web makes this product a complete courseware for GATE preparation.

We also know that improvement is a never ending process and hence we welcome your suggestions and feedback or spelling and technical errors if any. Please write to us at gkp@gkpublications.com

We hope that our small effort will help you prepare well for the examination.

We wish you all the best!

GK Publications Pvt. Ltd.

About GATE

The Graduate Aptitude Test in Engineering (GATE) conducted by IISc and IITs has emerged as one of the bench mark tests for engineering and science aptitude in facilitating admissions for higher education (M.Tech./Ph.D.) in IITs, IISc and various other Institutes/Universities/Laboratories in India. With the standard and high quality of the GATE examination in 29 disciplines of engineering and science, Humanities and Social Sciences subjects, it identifies the candidate's understanding of a subject and aptitude and eligibility for higher studies. During the last few years, GATE score is also being used as one of the criteria for recruitment in Government Organizations such as Cabinet Secretariat, and National/State Public Sector Undertakings in India. Because of the importance of the GATE examination, the number of candidates taking up GATE exams has increased tremendously. GATE exams are conducted by the IITs and IISc as a computer based test having multiple choice questions and numerical answer type questions. The questions are mostly fundamental, concept based and thought provoking. From 2017 onwards GATE Exam is being held in Bangladesh, Ethiopia, Nepal, Singapore, Sri Lanka and United Arab Emirates. An Institute with various nationalities in its campus widens the horizons of an academic environment. A foreign student brings with him/her a great diversity, culture and wisdom to share. Many GATE qualified candidates are paid scholarships/assistantship, especially funded by Ministry of Human Resources Development, Government of India and by other Ministries. IIT Roorkee, is the Organizing Institute for GATE 2025.

Why GATE?

Admission to Post Graduate and Doctoral Programmes

Admission to postgraduate programmes with MHRD and some other government scholarships/assistantships in engineering colleges/institutes is open to those who qualify through GATE. GATE qualified candidates with Bachelor's degree in Engineering/Technology/Architecture or Master's degree in any branch of Science/Mathematics/Statistics/Computer Applications are eligible for admission to Master/Doctoral programmes in Engineering/Technology/Architecture as well as for Doctoral programmes in relevant branches of Science with MHRD or other government scholarships/assistantships. Candidates with Master's degree in Engineering/Technology/Architecture may seek admission to relevant Ph.D programmes with scholarship/assistantship without appearing in the GATE examination.

Financial Assistance

A valid GATE score is essential for obtaining financial assistance during Master's programs and direct Doctoral programs in Engineering/Technology/Architecture, and Doctoral programs in relevant branches of Science in Institutes supported by the MHRD or other Government agencies. As per the directives of the MHRD, the following procedure is to be adopted for admission to the post-graduate programs (Master's and Doctoral) with MHRD scholarship/assistantship. Depending upon the norms adopted by a specific institute or department of the Institute, a candidate may be admitted directly into a course based on his/her performance in GATE only **or** based on his/her performance in GATE **and** an admission test/interview conducted by the department to which he/she has applied **and/or** the candidate's academic record. If the candidate is to be selected through test/interview for

post-graduate programs, a minimum of 70% weightage will be given to the performance in GATE and the remaining 30% weightage will be given to the candidate's performance in test/interview and/or academic record, as per MHRD guidelines. The admitting institutes could however prescribe a minimum passing percentage of marks in the test/interview. Some colleges/institutes specify GATE qualification as the mandatory requirement even for admission without MHRD scholarship/assistantship.

To avail of the financial assistance (scholarship), the candidate must first secure admission to a program in these Institutes, by a procedure that could vary from institute to institute. Qualification in GATE is also a minimum requirement to apply for various fellowships awarded by many Government organizations. Candidates are advised to seek complete details of admission procedures and availability of MHRD scholarship/assistantship from the concerned admitting institution. The criteria for postgraduate admission with scholarship/assistantship could be different for different institutions. The management of the post-graduate scholarship/assistantship is also the responsibility of the admitting institution. Similarly, reservation of seats under different categories is as per the policies and norms prevailing at the admitting institution and Government of India rules. *GATE offices will usually not entertain any enquiry about admission, reservation of seats and /or award of scholarship / assistantship.*

PSU Recruitments

As many as 37 PSUs are using GATE score for recruitment. It is likely that more number of PSUs may start doing so by next year. Below is the list of PSUs:

MDL, BPCL, GAIL, NLC LTD, CEL, Indian Oil, HPCL, NBPC, NECC, BHEL, WBSEDCL, NTPC, ONGC, Oil India, Power Grid, Cabinet Secretariat, Govt. of India, BAARC, NFL, IPR, PSPCL, PSTCL, DRDO, OPGC Ltd., THDC India Ltd., BBNL, RITES, IRCON, GHECL, NHAI, KRIBHCO, Mumbai Railway Vikas Corporation Ltd. (MRVC Ltd.), National Textile Corporation, Coal India Ltd., BNPM, AAI, NALCO, EdCIL India.

Important :

1. Admissions in IITs/IISc or other Institutes for M.Tech./Ph.D. through GATE scores shall be advertised separately by the Institutes and GATE does not take the responsibility of admissions.
2. Cabinet Secretariat has decided to recruit officers for the post of Senior Field Officer (Tele) (From GATE papers of EC, CS, PH), Senior Research Officer (Crypto) (From GATE papers of EC, CS, MA), Senior Research Officer (S&T) (From GATE papers EC, CS, CY, PH, AE, BT) in the Telecommunication Cadre, Cryptographic Cadre and Science & Technology Unit respectively of Cabinet Secretariat. The details of the scheme of recruitment shall be published in National Newspaper/Employment News by the concerned authority.
3. Some PSUs in India have expressed their interest to utilize GATE scores for their recruitment purpose. The Organizations who intend to utilize GATE scores shall make separate advertisement for this purpose in Newspapers etc.

Who Can Appear for GATE?

Eligibility for GATE

Before starting the application process, the candidate must ensure that he/she meets the eligibility criteria of GATE 2025 given in Table.

Eligibility Criteria for GATE 2025

Degree/Program	Qualifying Degree/Examination	Description of Eligible Candidates	Expected Year of Completion
B.E. / B.Tech. / B.Pharm.	Bachelor's degree in Engineering / Technology (4 years after 10+2 or 3 years after B.Sc. / Diploma in Engineering / Technology)	Currently in the 3 rd year or higher grade or already completed	2026
B. Arch.	Bachelor's degree of Architecture (5- year course) / Naval Architecture (4- year course) / Planning (4- year course)	Currently in the 3 rd year or higher grade or already completed	2027 (for 5-year program), 2026 (for 4-year program)
B.Sc. (Research) / B.S.	Bachelor's degree in Science (Post-Diploma/4 years after 10+2)	Currently in the 3 rd year or higher grade or already completed	2026
Pharm. D. (after 10+2)	6 years degree program, consisting of internship or residency training, during third year onwards	Currently in the 3 rd /4 th /5 th /6 th year or already completed	2028
M.B.B.S.	Degree holders of M.B.B.S. and those who are in the 5 th /6 th /7 th semester or higher semester of such programme.	5 th , 6 th , 7 th or higher semester or already completed	2026
M. Sc. / M.A. / MCA or equivalent	Master's degree in any branch of Arts/Science/Mathematics/Statistics/ Computer Applications or equivalent	Currently in the first year or higher or already Completed	2026
Int. M.E./ M.Tech. (Post-B.Sc.)	Post-B.Sc Integrated Master's degree programs in Engineering/ Technology (4-year program)	Currently in the 1 st / 2 nd /3 rd /4 th year or already completed	Any Year
Int. M.E./M.Tech. or Dual Degree (after Diploma or 10+2)	Integrated Master's degree program or Dual Degree program in Engineering/Technology (5-year program)	Currently in the 3 rd /4 th /5 th year or already completed	2027
B.Sc. / B.A. / B.Com.	Bachelor degree in any branch of Science / Arts / Commerce (3 years program)	Currently in the 3 rd year or already completed	2025
Int. M.Sc. / Int. B.S. / M.S.	Integrated M.Sc. or 5-year integrated B.S.-M.S. program	Currently in the 3 rd year or higher or already completed	2026
Professional Society Examinations (equivalent to B.E. / B.Tech. / B.Arch.)	B.E./B.Tech./B.Arch. equivalent examinations of Professional Societies, recognized by MoE/UPSC/AICTE (e.g. AMIE by Institution of Engineers-India, AMICE by the Institute of Civil Engineers-India and so on)	Completed Section A or equivalent of such professional courses	Enrolled upto 31 st May 2013
B.Sc (Agriculture, Horticulture, forestry)	4-year Program	Currently in the 3 rd /4 th year or already completed	2026

In case a candidate has passed one of the qualifying examinations as mentioned above in 2021 or earlier, the candidate has to submit the degree certificate / provisional certificate / course completion certificate / professional certificate / membership certificate issued by the society or institute. In case, the candidate is expected to complete one of the qualifying criteria in 2025 or later as mentioned above, he/she has to submit a certificate from Principal or a copy of marks card for section A of AMIE.

Certificate From Principal

Candidates who have to submit a certificate from their college Principal have to obtain one from his/her institution beforehand and upload the same during the online submission of the application form.

Candidates With Backlogs

Candidates, who have appeared in the final semester/year exam in 2023, but with a backlog (arrears/failed subjects) in any of the papers in their qualifying degree should upload a copy of any one of the mark sheets of the final year,

OR

obtain a declaration from their Principal along with the signature and seal beforehand and upload the same during the online submission of the application form.

GATE Structure

Structure of GATE

GATE 2025 will be conducted on 29 subjects (papers). Table below shows the list of papers and paper codes for GATE 2025. A candidate is allowed to appear in ANY ONE or UP TO TWO papers of the GATE examination. However, note that the combination of TWO papers in which a candidate can appear MUST be from the pre-defined list as given in Table. Also note that for a paper running in multiple sessions, a candidate will be mapped to appear for the examination in one of the sessions ONLY.

List of GATE Papers and Corresponding Codes

GATE Paper	Code	GATE Paper	Code
Aerospace Engineering	AE	Geology and Geophysics	GG###
Agricultural Engineering	AG	Instrumentation Engineering	IN
Architecture and Planning	AR#	Mathematics	MA
Biomedical Engineering	BM	Mechanical Engineering	ME
Biotechnology	BT	Mining Engineering	MN
Civil Engineering	CE	Metallurgical Engineering	MT
Chemical Engineering	CH	Naval Architecture and Marine Engineering	NM
Computer Science and Information Technology	CS	Petroleum Engineering	PE
Chemistry	CY	Physics	PH
Data Science and Artificial Intelligence	DA	Production and Industrial Engineering	PI
Electronics and Communication Engineering	EC	Statistics	ST
Electrical Engineering	EE	Textile Engineering and Fibre Science	TF
Environmental Science & Engineering	ES	Engineering Sciences	XE*
Ecology and Evolution	EY	Humanities & Social Sciences	XH**
Geomatics Engineering	GE##	Life Sciences	XL***

*XE Paper Sections	Code	**XH Paper Sections	Code	***XL Paper Sections	Code
Engineering Mathematics (Compulsory) (15 marks)	A	Reasoning and Comprehension (Compulsory) (25 marks)	B1	Chemistry (Compulsory) (25 marks)	P
Any TWO optional sections (2x35 = 70 marks)		Any ONE optional section (60 marks)		Any TWO optional sections (2x30 = 60 marks)	
Fluid Mechanics	B	Economics	C1	Biochemistry	Q
Materials Science	C	English	C2	Botany	R
Solid Mechanics	D	Linguistics	C3	Microbiology	S
Thermodynamics	E	Philosophy	C4	Zoology	T
Polymer Science and Engineering	F	Psychology	C5	Food Technology	U
Food Technology	G	Sociology	C6		
Atmospheric and Oceanic Sciences	H				
*AR Paper Sections		**GE Paper Sections		***GG Paper Sections	
Part-A (Compulsory)		Part-A (Compulsory)		Part-A (Compulsory)	
Part-B1 (Architecture)		Part-B1 (Surveying and Mapping)		Part-B1 (Geology)	
Part-B2 (Planning)		Part-B2 (Image Processing and Analysis)		Part-B2 (Geophysics)	

*XE (Engineering Sciences), **XH (Humanities & Social Sciences), ***XL (Life Sciences), papers are of general nature and will be comprised of Sections listed in the above table

Note: Each subject / paper is of total 100 marks. General Aptitude (GA) section of 15 marks is common for all papers. Hence remaining 85 marks are for the respective subject / paper code.

**Combination of Two Papers Allowed to Appear in GATE 2025
(subject to availability of infrastructure and schedule)**

Code of the First (Primary) Paper	Codes of Papers Allowed as the Secondary Paper	Code of the First Primary Paper	Codes of Papers Allowed as the Secondary Paper
AE	CE, ME, XE	GE	AR, CE, CS, ES, GG
AG	CE	GG	GE
AR	CE, GE	IN	BM, EC, EE, ME
BM	BT, IN	MA	CS, DA, PH, ST
BT	BM, XL	ME	AE, DA, IN, NM, PI, XE
CE	AE, AG, AR, ES, GE, NM, XE	MT	XE
CH	ES, PE, XE	NM	CE, ME
CS	DA, EC, GE, MA, PH, ST	PE	CH
CY	XE, XL	PH	CS, DA, EC, EE, MA, XE
DA	CS, EC, EE, MA, ME, PH, ST, XE	PI	ME, XE
EC	CS, DA, EE, IN, PH	ST	CS, DA, MA, XH
EE	DA, EC, IN, PH	XE	AE, CE, CH, CY, DA, ME, MT, PH, PI
ES	CE, CH, GE	XH	ST
EY	XL	XL	BT, CY, EY

General Aptitude Questions

All the papers will have a few questions that test the General Aptitude (Language and Analytical Skills), apart from the core subject of the paper.

Duration and Examination Type

All the papers of the GATE 2025 examination will be for 3 hours duration and they consist of 65 questions for a total of 100 marks. Since the examination is an ONLINE computer based test (CBT), at the end of the stipulated time (3-hours), the computer screen will automatically close the examination inhibiting any further action.

Candidates will be permitted to occupy their allotted seats 40 minutes before the scheduled start of the examination. Candidates can login and start reading the instructions 20 minutes before the start of examination. The late login time (if any) recorded by the computer system **MUST NOT** be beyond 30 minutes from the actual starting time of the examination. Under **NO** circumstances, will a candidate be permitted to login after 30 minutes from the actual examination starting time. Candidates will **NOT** be permitted to leave the examination hall before the end of the examination.

Pattern of Question Papers

GATE 2025 may contain questions of THREE different types in all the papers:

- (i) **Multiple Choice Questions (MCQ)** carrying 1 or 2 marks each, in all the papers and sections. These questions are objective in nature, and each will have choice of four answers, out of which **ONLY ONE** choice is correct.

Negative Marking for Wrong Answers: For a wrong answer chosen in a MCQ, there will be negative marking. For 1-mark MCQ, 1/3 mark will be deducted for a wrong answer. Likewise, for 2-mark MCQ, 2/3 mark will be deducted for a wrong answer.

- (ii) **Multiple Select Questions (MSQ)** carrying 1 or 2 marks each in all the papers and sections. These questions are objective in nature, and each will have choice of four answers, out of which **ONE or MORE** than **ONE** choice(s) is / are correct.

Note: There is **NO** negative marking for a wrong answer in MSQ questions. However, there is **NO** partial credit for choosing partially correct combinations of choices or any single wrong choice.

- (iii) **Numerical Answer Type (NAT)** Questions carrying 1 or 2 marks each in most of the papers and sections. For these questions, the answer is a signed real number, which needs to be entered by the candidate using the virtual numeric keypad on the monitor (keyboard of the computer will be disabled). No choices will be shown for these types of questions. The answer can be a number such as 10 or -10 (an integer only). The answer may be in decimals as well, for example, 10.1 (one decimal) or 10.01 (two decimals) or -10.001 (three decimals). These questions will be mentioned with, up to which decimal places, the candidates need to present the answer. Also, for some NAT type problems an appropriate range will be considered while evaluating these questions so that the candidate is not unduly penalized due to the usual round-off errors. Candidates are advised to do the rounding off at the end of the calculation (not in between steps). Wherever required and possible, it is better to give NAT answer up to a maximum of three decimal places.

Note: *There is NO negative marking for a wrong answer in NAT questions.*

Also, there is NO partial credit in NAT questions.

Pattern of Examination

Paper Code	General Aptitude (GA) Marks	Subject Marks	Total Marks	Total Time (Minutes)*
AE, AG, BM, BT, CE, CH, CS, CY, EC, EE, ES, EY, IN, MA, ME, MN, MT, NM, PE, PH, PI, ST, TF	15	85	100	180
AR [Part A + Part B1 or B2] (B1: Architecture or B2: Planning)	15	60 + 25	100	180
GE [Part A + Part B1 or B2] (B1: Surveying and Mapping or B2: Image Processing and Analysis)	15	55 + 30	100	180
GG [Part A + Part B] (Section 1: Geology or Section 2: Geophysics)	15	25 + 60	100	180
XE (Section A + Any TWO Sections)	15	15 + (2 x 35)	100	180
XH (Section B1 + Any ONE Section)	15	25 + 60	100	180
XL (Section P + Any TWO Sections)	15	25 + (2 x 30)	100	180

*PwD candidates with benchmark disability are eligible for the compensatory time of 20 minutes per hour. Thus, they will get one hour extra for a three hours examination

Marking Scheme - Distribution of Marks and Questions

General Aptitude (GA) Questions

In all papers, GA questions carry a total of 15 marks. The GA section includes 5 questions carrying 1-mark each (sub-total 5 marks) and 5 questions carrying 2-marks each (sub-total 10 marks).

Question Papers other than AR, GE, GG, XE, XH and XL

These papers would contain 25 questions carrying 1-mark each (sub-total 25 marks) and 30 questions carrying 2-marks each (sub-total 60 marks) consisting of some MCQ type questions, while the remaining may be MSQ and / or NAT questions.

AR (Architecture and Planning) Paper

Apart from the General Aptitude (GA) section, the question paper consists of two parts: Part A (60 marks) and Part B (25 marks). Part A is compulsory for all the candidates. Part B contains two parts: Part B1 (Architecture) and Part B2 (Planning). Candidates will have to attempt questions in Part A and questions in either Part B1 or Part B2 of Part B. The choice of Part B1 OR Part B2 can be made during examination.

Part A consists of 39 questions carrying a total of 60 marks: 18 questions carrying 1-mark each (sub- total 18 marks) and 21 questions carrying 2-marks each (sub-total 42 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions. Either section of Part B [Part B1 (Architecture) and Part B2 (Planning)] consists of 16 questions carrying a total of 25 marks: 7 questions carrying 1-mark each (sub-total 7 marks) and 9 questions carrying 2-marks each (sub-total 18 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.

GE (Geomatics Engineering) Paper

Apart from the General Aptitude (GA) section, the question paper consists of two parts: Part A (55 marks) and Part B (30 marks). Part A - Engineering Mathematics and Basic Geomatics is

compulsory for all the candidates. Part B contains two sections: Section I - Surveying and Mapping and Section II - Image Processing and Analysis. Candidates will have to attempt questions in Part A and questions in either Section I or Section II of Part B. The choice of Section I OR Section II of Part B can be made during examination.

Part A consists of 36 questions carrying a total of 55 marks: 17 questions carrying 1-mark each (sub- total 17 marks) and 19 questions carrying 2-marks each (sub-total 38 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions. Either section of Part B [Section I (Surveying and Mapping) or Section II (Image Processing and Analysis)] consists of 19 questions carrying a total of 30 marks: 8 questions carrying 1-mark each (sub-total 8 marks) and 11 questions carrying 2-marks each (sub-total 22 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.

GG (Geology and Geophysics) Paper

Apart from the General Aptitude (GA) section, the GG question paper consists of two parts: Part A and Part B. Part A is compulsory for all the candidates. Part B contains two sections: Section 1 (Geology) and Section 2 (Geophysics). Candidates will have to attempt questions in Part A and questions in either Section 1 or Section 2 of Part B. The choice of Section 1 OR Section 2 of Part B has to be made **at the time of filling online application form**. At the examination hall, candidate cannot request for change of section.

Part A consists of 16 questions carrying a total of 25 marks: 7 questions carrying 1-mark each (sub-total 7 marks) and 9 questions carrying 2-marks each (sub-total 18 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions. Either section of Part B (Section 1: Geology and Section 2: Geophysics) consists of 39 questions carrying a total of 60 marks: 18 questions carrying 1-mark each (sub-total 18 marks) and 21 questions carrying 2-marks each (sub-total 42 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.

XE Paper (Engineering Sciences)

A candidate appearing in the XE paper has to answer the following:

- **GA - General Aptitude** carrying a total of 15 marks.
- **Section A - Engineering Mathematics (Compulsory):** This section contains 11 questions carrying a total of 15 marks: 7 questions carrying 1-mark each (sub-total 7 marks), and 4 questions carrying 2-marks each (sub-total 8 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.
- **Any two of XE Sections B to H:** The choice of two sections from B to H can be made during the examination after viewing the questions. Only TWO optional sections can be answered at a time. A candidate wishing to change midway of the examination to another optional section must first choose to deselect one of the previously chosen optional sections (B to H). Each of the optional sections of the XE paper (Sections B through H) contains 22 questions carrying a total of 35 marks: 9 questions carrying 1-mark each (sub-total 9 marks) and 13 questions carrying 2-marks each (sub-total 26 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.

XH Paper (Humanities and Social Sciences)

A candidate appearing in the XH paper has to answer the following:

- **GA - General Aptitude** carrying a total of 15 marks
- **Section B1 - Reasoning and Comprehension (Compulsory):** This section contains 15 questions carrying a total of 25 marks: 7 questions carrying 1-mark each (sub-total 7 marks) and 9 questions carrying 2-marks each (sub-total 18 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.
- **Any ONE of XH Sections C1 to C6:** The ONE choice of section from C1 to C6 has to be made **at the time of filling online application form**. Candidate cannot request for change of section at the examination hall. Each of the optional sections of the XH paper (Sections C1 through C6) contains 39 questions carrying a total of 60 marks: 18 questions carrying 1-mark each (sub-total 18 marks) and 21 questions carrying 2-marks each (sub-total 42 marks). Some are MCQ type questions, while the remaining may be MSQ and / or NAT questions.

XL Paper (Life Sciences)

A candidate appearing in the XL paper has to answer the following:

- **GA – General Aptitude** carrying a total of 15 marks.
- **Section P–Chemistry (Compulsory):** This section contains 17 questions carrying a total of 25 marks: 9 questions carrying 1-mark each (sub-total 9 marks) and 8 questions carrying 2-marks each (sub-total 16 marks). Some questions will be of MSQ and/or numerical answer type while remaining questions will be MCQ type.
- **Any two of XL Sections Q to U:** The choice of two sections from Q to U can be made during the examination after viewing the questions. Only TWO optional sections can be answered at a time. A candidate wishing to change midway of the examination to another optional section must first choose to deselect one of the previously chosen optional sections (Q to U). Each of the optional sections of the XL paper (Sections Q through U) contains 19 questions carrying a total of 30 marks: 8 questions carrying 1-mark each (sub-total 8 marks) and 11 questions carrying 2-marks each (sub-total 22 marks). Some questions will be of MSQ and/or numerical answer type while remaining questions will be MCQ type.

GATE Score

After the evaluation of the answers, the actual (raw) marks obtained by a candidate will be considered for computing the GATE Score. For multi-session papers (subjects), raw marks obtained by the candidates in different sessions will be converted to Normalized marks for that particular subject. Thus, raw marks (for single session papers) or normalized marks (for multi-session papers) will be used for computing the GATE Score, based on the qualifying marks.

Calculation of Normalized Marks for Multi-Session Papers

In GATE 2025 examination, some papers may be conducted in multi-sessions. Hence, for these papers, a suitable normalization is applied to take into account any variation in the difficulty levels of the question papers across different sessions. The normalization is done based on the fundamental assumption that "in all multi-session GATE papers, the distribution of abilities of candidates is the same across all the sessions". This assumption is justified since the number of candidates appearing in multi-session papers in GATE 2025 is large and the procedure for allocation of session to candidates is random. Further, it is also ensured that for the same multi-session paper, the number of candidates allotted in each session is of the same order of magnitude.

Based on the above, and considering various normalization methods, the committee arrived at the following formula for calculating the normalized marks for the multi-session papers.

Normalization mark of j^{th} candidate in the i^{th} session \widehat{M}_{ij} is given by

$$\widehat{M}_{ij} = \frac{\bar{M}_t^g - M_q^g}{\bar{M}_{ti} - M_{iq}} (M_{ij} - M_{iq}) + M_q^g$$

where

M_{ij} : is the actual marks obtained by the j^{th} candidate in i^{th} session

\bar{M}_t^g : is the average marks of the top 0.1% of the candidates considering all sessions

M_q^g : is the sum of mean and standard deviation marks of the candidates in the paper considering all sessions

\bar{M}_{ti} : is the average marks of the top 0.1% of the candidates in the i^{th} session

M_{iq} : is the sum of the mean marks and standard deviation of the i^{th} session

Calculation of GATE Score for All Papers

For all papers for which there is only one session, actual marks obtained by the candidates will be used for calculating the GATE 2025 Score. For papers in multi-sessions, normalized marks will be calculated corresponding to the raw marks obtained by a candidate and the GATE 2025 Score will be calculated based on the normalized marks.

The GATE 2025 score will be computed using the formula given below.

$$\text{GATE Score} = S_q + (S_t - S_q) \frac{(M - M_q)}{(\bar{M}_t - M_q)}$$

where

M : marks obtained by the candidate (actual marks for single session papers and normalized marks for multi-session papers)

M_q : is the qualifying marks for general category candidate in the paper

\bar{M}_t : is the mean of marks of top 0.1% or top 10 (whichever is larger) of the candidates who appeared in the paper (in case of multi-session papers including all sessions)

S_q : 350, is the score assigned to M_q

S_t : 900, is the score assigned to \bar{M}_t

In the GATE 2025 the qualifying marks (M_q) for general category student in each subject will be 25 marks (out of 100) or $\mu + \sigma$, whichever is larger. Here μ is the mean and σ is the standard deviation of marks of all the candidates who appeared in the paper.

After the declaration of results, GATE Scorecards can be downloaded by the GATE qualified candidates ONLY.

The GATE 2025 Committee has the authority to decide the qualifying mark/score for each GATE paper. In case of any claim or dispute with respect to GATE 2025 examination or score, the Courts and Tribunals in Mumbai alone will have the exclusive jurisdiction to entertain and settle them.

GATE Syllabus

GENERAL APTITUDE

Verbal Aptitude

Basic English Grammar: tenses, articles, adjectives, prepositions, conjunctions, verb-noun agreement, and other parts of speech.

Basic Vocabulary: words, idioms, and phrases in context, Reading and comprehension, Narrative sequencing.

Quantitative Aptitude

Data Interpretation: data graphs (bar graphs, pie charts, and other graphs representing data), 2-and 3-dimensional plots, maps, and tables.

Numerical Computation and Estimation: ratios, percentages, powers, exponents and logarithms, permutations and combinations, and series, Mensuration and geometry, Elementary statistics and probability.

Analytical Aptitude

Logic: Deduction and induction, Analogy, Numerical relations and reasoning.

Spatial Aptitude

Transformation of shapes: translation, rotation, scaling, mirroring, assembling, and grouping Paper folding, cutting, and patterns in 2 and 3 dimensions.

Section 1: Engineering Mathematics

Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima; Taylor series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities; Directional derivatives; Line, Surface and Volume integrals.

Ordinary Differential Equation (ODE): First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; initial and boundary value problems.

Partial Differential Equation (PDE): Fourier series; separation of variables; solutions of one- dimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation.

Probability and Statistics: Sampling theorems; Conditional probability; Descriptive statistics – Mean, median, mode and standard deviation; Random Variables – Discrete and Continuous, Poisson and Normal Distribution; Linear regression.

Numerical Methods: Error analysis. Numerical solutions of linear and non-linear algebraic equations; Newton's and Lagrange polynomials; numerical differentiation; Integration by trapezoidal and Simpson's rule; Single and multi-step methods for first order differential equations.

Section 2: Structural Engineering

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management

Construction Materials: Structural Steel – Composition, material properties and behaviour; Concrete - Constituents, mix design, short-term and long-term properties. Construction.

Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis -beams and frames.

Section 3: Geotechnical Engineering

Soil Mechanics: Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One- dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

Foundation Engineering: Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Section 4: Water Resources Engineering

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

Section 5: Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Sewerage system design, quantity of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

Section 6: Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments.

Geometric design of railway Track – Speed and Cant.

Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.

Section 7: Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS.

Chapter-Wise Analysis

GATE PAPERS (Civil Engineering)

Subject	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1. Engineering Mathematics											
1 Mark Question	3	3	4	6	3	3	5	5	3	5	3
2 Marks Question	4	5	5	4	4	4	4	4	5	4	5
Total Marks	11	13	14	14	11	11	13	13	13	13	13
2. Engineering Mechanics											
1 Mark Question			1	1	0	2	1	0	0	0	0
2 Marks Question	–	–	0	1	2	0	0	1	0	1	1
Total Marks				1	3	4	2	1	2	2	2
3. Solid Mechanics											
1 Mark Question	2	2	0	2	2	2	0	2	1	1	2
2 Marks Question	2	1	2	3	1	1	1	2	1	0	1
Total Marks	6	4	4	8	4	4	2	6	3	1	4
4. Structural Analysis											
1 Mark Question	2	2	1	0	1	0	1	1	0	1	2
2 Marks Question	3	1	4	2	3	3	3	1	3	3	1
Total Marks	8	4	9	4	7	6	7	3	6	7	4
5. Constructional Material & Management											
1 Mark Question			2	0	0	0	2	1	2	1	1
2 Marks Question	–	–	1	1	0	1	0	2	1	0	1
Total Marks			4	2	0	2	2	5	4	1	3
6. Concrete Structure											
1 Mark Question	4	4	1	1	4	3	0	1	2	2	2
2 Marks Question	3	3	0	1	3	4	2	1	3	1	1
Total Marks	10	10	1	3	10	11	4	3	8	4	4
7. Steel Structure											
1 Mark Question	0	0	0	0	1	1	1	0	0	1	1
2 Marks Question	3	2	2	1	1	1	1	1	1	0	0
Total Marks	6	4	4	2	3	3	3	2	2	1	1
8. Soil Mechanics and Foundation Engineering											
1 Mark Question	4	3	5	5	5	4	4	3	5	4	3
2 Marks Question	3	6	6	5	5	5	5	5	3	6	6
Total Marks	10	15	17	15	15	14	14	13	11	16	15

Subject	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
9. Fluid Mechanics and Hydraulics											
1 Mark Question	2	3	1	2	4	2	2	2	2	1	2
2 Marks Question	2	3	3	3	2	3	2	3	3	3	3
Total Marks	6	9	7	8	8	8	6	8	8	7	8
10. Hydrology & Irrigation											
1 Mark Question	2	0	0	1	1	1	3	2	1	1	1
2 Marks Question	3	3	1	3	3	3	2	2	2	4	2
Total Marks	8	6	2	7	7	7	7	6	5	9	5
11. Environmental Engineering											
1 Mark Question	3	3	4	3	2	2	3	3	5	4	4
2 Marks Question	3	2	3	3	2	3	4	4	3	4	3
Total Marks	9	7	10	9	6	8	11	11	11	12	10
12. Transportation Engineering											
1 Mark Question	2	2	3	2	1	2	3	4	2	2	2
2 Marks Question	3	3	2	1	2	1	4	3	3	2	3
Total Marks	8	8	6	4	5	4	11	10	8	6	8
13. Surveying											
1 Mark Question	1	3	3	2	1	3	0	1	2	2	2
2 Marks Question	1	1	1	2	2	1	2	1	2	2	3
Total Marks	3	5	5	6	5	5	4	3	6	6	8
14. General Aptitude											
1 Mark Question	5	5	5	5	5	5	5	5	5	5	5
2 Marks Question	5	5	5	5	5	5	5	5	5	5	5
Total Marks	15	15	15	15	15	15	15	15	15	15	15