GATE ECE 2027

Deep PYQ Analysis & High-Probability Question Bank

FREE PREVIEW

GATE ECE 2027 — Deep PYQ Analysis & High-Probability Question Bank

By MD ANISH AHAMAD · First Edition 2026

This preview contains 32 real, unedited pages from the 806-page book, exactly as they appear in the full PDF. Page numbers in the running heads and on the contents pages refer to the full book.

The full book also has: all nine subject chapters, 275 practice questions with worked solutions and four confidence scores each, all ten mock tests with keys and solutions, the 78 ranked concepts, the do-not-skip checklist, the 20-week roadmap and the full last-minute sheet.

GATE ECE 2027

Deep PYQ Analysis & High-Probability Question Bank

Five GATE papers counted question by question, and 925 newly written questions built on what they show
for the GATE Electronics & Communication Engineering paper

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First Edition · 2026
For the examination of February 2027
gateguide.co.in

Contents

Preface

Every GATE book tells you what is in the syllabus. The syllabus is one page long and the organisers publish it free. This book tries to answer the question the syllabus cannot: **of the eighty-five technical marks in the GATE EC paper, where do they actually land — and how much of that can anyone honestly claim to know?**

There is a reason that question is usually answered badly. The organisers have never published a marks breakdown, so every "subject-wise weightage" table you have seen is somebody's count of a past paper. Those tables circulate, get copied, and acquire an authority they never earned. While this book was being prepared, one site's 2026 column turned out to be its own 2025 column reprinted unchanged in all nine sections. Four separate sites give four different figures for 2020, and all four descend from a single table with one subject counted twice and General Aptitude dropped. A table that says a section is worth seven marks when the paper gave it thirteen is not a small error: it is four questions a candidate decided not to prepare.

So this book does not use those tables. It counts the papers.

How this book was built

Five papers, counted question by question. GATE EC 2010, 2019, 2020, 2025 and 2026 were read one question at a time. Each question was assigned to a section of the 2027 syllabus and to a topic inside it, and every assignment was checked against that year's official answer key — 65 questions, 100 marks, General Aptitude at exactly 15. Where a question could honestly belong to two sections, both are recorded rather than one being chosen quietly.

Only those five years are cited. Not once in this book will you find a claim like "this pattern recurs in 2013, 2016 and 2021". Every historical statement names a year *and a question number*, and every one of them can be checked against a paper you can download. Four papers from 2021 to 2024 sit uncounted in the author's archive; they are named as future work and used for nothing. Five verified years, used honestly, are worth more than ten remembered ones — and a single claim a reader can disprove in ten minutes would cost this book every other number in it.

The 2027 syllabus was compared with 2026, word by word, from the two official PDFs. The changes are real and specific: FIR and IIR filter design is newly named in Networks, Signals and Systems; PID control replaces the lag/lead/lag-lead line in Control Systems; correlation and regression analysis enters Engineering Mathematics while nonlinear first-order differential equations leave it with no replacement; energy-band formation and MOSFET scaling enter Electronic Devices. Digital Circuits and Electromagnetics did not change at all.

Every question was written to that evidence, and every number in it was computed. No question is estimated, reasoned-about or remembered. Filters were designed and their responses measured; root loci were swept; Huffman trees were built; CRC divisions were run; carrier concentrations and depletion widths were evaluated with the constants stated in the question. Every incorrect option is the output of a specific mistake, and the solution names that mistake, so that a candidate who chose it learns what they did rather than merely that they were wrong.

Each chapter's format matches its own section. The GATE EC paper is not uniformly multiple-choice. Communications runs at half MCQ and Networks at three-quarters, and a bank that ignores this trains the wrong reflex — multiple-choice carries negative marking and rewards eliminating options, and numerical-answer questions reward neither. Every chapter in this book is within a few points of its own section's measured mix.

What this book refuses to do

It does not claim to know the paper. Three commitments follow:

- **Facts, analysis and predictions are labelled separately.** A statement about what happened in 2020 is marked FACT. A statement about what the data suggests is marked ANALYSIS. A statement about 2027 is marked PREDICTION. They are never blended.
- **Confidence is reported in four dimensions, not one.** Being confident that two-port networks will be examined is not the same as being confident about a particular two-port question. Every question carries Topic, Concept, Question-pattern and Exact-question confidence, and the last is capped at 35 per cent because GATE repeats concepts, not wording.
- **Absence of evidence is printed as absence of evidence.** Several topics named in the 2027 syllabus produced no question at all in five papers — optical fibre, circular waveguides, oscillators, wye–delta transformation, computer organisation. Each is said so plainly, with no history invented to fill the gap, and the questions written on syllabus authority alone say that this is what they rest on.

One thing the counting found that is worth your attention

GATE 2027 is set by IIT Madras. Exactly one of the five counted papers — 2019 — was also set by IIT Madras, and it does not look like the others. It is the flattest paper in the set: every technical section lands between nine and fourteen marks, where the other four papers each have a section above thirteen *and* a section below eight. It asked no Thevenin, no Norton, no maximum power transfer and no resonance. Its analog section contained no operational amplifier and no BJT at all — five questions, all diodes, Zeners and MOS. And it asked two FIR filter-design questions, six years before the 2027 syllabus got round to naming filter design at all.

One paper is a signal, not a law, and this book says so wherever it uses it. But a candidate budgeting for 2027 should know that the institute writing it has, once, written a paper with no peaks to aim at.

What is in it

The official 2027 syllabus with the 2026-to-2027 changes mapped from the source documents; nine subject chapters — one for each of the eight technical sections and one for General Aptitude — each with its own counted weightage, topic-level concept map with question numbers, frequency and recurrence analysis and prediction table; a bank of 275 newly written questions with full worked solutions and four confidence scores each; ten full-length mock tests in the 2027 pattern with keys and worked solutions, 650 questions more; a twenty-week study plan with an eight-week and a two-week version; and a last-minute revision sheet.

What is not in it. Four papers, 2021 to 2024, sit uncounted; they are cited nowhere and adding them is the next edition's work. And there are no printed figures: every circuit and block diagram is described in words, the way a GATE question describes one when it carries no figure.

Every one of the 925 questions is new. None is copied from a past paper. What is borrowed from the past is the pattern — and the pattern is what repeats.

A note to the reader

Read your section's counted weightage table before you read anything else in its chapter. If it disagrees with the plan you are already following, that disagreement is the most valuable thing this book can give you, and it costs nothing to check: every figure in it names the paper and the question it came from.

Section 1 — Executive Summary

This chapter is the whole book in five pages. It says what the paper is, where the marks actually landed in five counted papers, what the 2027 syllabus changed, what five counted papers cannot tell anyone, and the five things a candidate should do differently as a result. Every number in it is a count of a paper or arithmetic done on those counts in front of you. Nothing here is a weightage table copied from a website.

1.1 What the paper is

FACT. GATE Electronics and Communication Engineering is one paper of **65 questions** worth **100 marks**, written in **three hours**. Fifteen of those marks are **General Aptitude**, which is not an EC subject and is common to every GATE paper. The remaining **85 marks** are technical, and the 2027 syllabus divides them across **eight sections**: Engineering Mathematics; Networks, Signals and Systems; Electronic Devices; Analog Circuits; Digital Circuits; Control Systems; Communications; Electromagnetics.

FACT. General Aptitude was exactly 15 marks in every one of the five counted papers — 2010, 2019, 2020, 2025 and 2026 — with no exception and no drift. Across those five papers General Aptitude supplied 50 questions for 75 marks, which is 10 questions and 15 marks per paper every time.

ANALYSIS. The question count follows from the marks. Ten General Aptitude questions carrying 15 marks must be five 1-mark and five 2-mark items (5 + 5 = 10 questions, 5 + 10 = 15 marks). The 55 technical questions carrying 85 marks must then be 25 one-mark and 30 two-mark items (25 + 30 = 55, 25 + 60 = 85). So the paper as a whole is 30 one-mark and 35 two-mark questions.

Two-mark questions carry 70 of the 100 marks. A candidate who is fast but careless is trading in the wrong currency: the paper does not reward volume, it rewards the thirty-five hard ones.

1.2 Where the marks actually are

FACT. The table below is the count. Each section's mean is the average of its five counted years; `min` and `max` are the lowest and highest it reached in those five papers; `spread` is max − min; the last column expresses that spread as a percentage of the section's own mean, so that a 4-mark swing on a 17-mark section is not mistaken for a 4-mark swing on a 7-mark one. Rows are ranked by mean marks.

Rank	Section	Mean	Share	Min	Max	Spread	Spread / mean
—	General Aptitude	15.0	15.0%	15	15	0	0.0%
1	Networks, Signals and Systems	17.0	17.0%	13	21	8	47.1%
2	Engineering Mathematics	12.0	12.0%	9	15	6	50.0%
3	Analog Circuits	10.8	10.8%	9	13	4	37.0%
4	Communications	10.0	10.0%	9	12	3	30.0%
5	Digital Circuits	9.8	9.8%	6	13	7	71.4%
6	Electronic Devices	8.8	8.8%	7	11	4	45.5%
7	Control Systems	8.0	8.0%	6	10	4	50.0%
8	Electromagnetics	7.4	7.4%	6	9	3	40.5%
—	Material not in the 2027 syllabus	1.2	1.2%	0	6	6	—

The nine section means plus the residual row sum to exactly 100.0, which is the first check any weightage table should have to pass and most of the published ones do not.

FACT — the big section. Networks, Signals and Systems is the largest technical section by mean (17.0) and it was the largest technical section in four of the five counted years. Its lowest counted result, 13 marks in 2025, is still higher than the *mean* of every other technical section. It has a high floor.

FACT — the one year it was not first. In 2025, Engineering Mathematics took 15 marks and Networks took 13. That is the only counted year in which any technical section outranked Networks.

ANALYSIS — big and stable. Analog Circuits (mean 10.8, range 9–13) and Communications (mean 10.0, range 9–12) are the two most predictable substantial sections in the paper.
Communications has the smallest spread relative to its size of any technical section, 30.0%: in five papers it has never been worth fewer than 9 marks nor more than 12. If you want a section where a fixed time budget is defensible, it is this one.

ANALYSIS — small and stable. Electromagnetics (7.4, range 6–9), Control Systems (8.0, range 6–10) and Electronic Devices (8.8, range 7–11) are the three smallest technical sections. None of them has ever exceeded 11 marks and none has ever fallen below 6. Together they averaged 24.2 marks per paper — 8.8 + 8.0 + 7.4 = 24.2, or 28.5% of the 85 technical marks. That is too much to abandon and too little to build a plan around.

ANALYSIS — the swing. Digital Circuits is the most volatile section in the paper: 6 marks in 2010 and 13 marks in 2026, a spread of 7 marks on a mean of 9.8, which is 71.4% of its own size. It is also the only section whose lowest counted year is the oldest paper and whose highest is the newest. Engineering Mathematics swings almost as hard in absolute terms — 15 marks in 2025, 9 marks in 2026, a 6-mark fall between consecutive counted papers.

ANALYSIS — volatility cancels. The three largest sections behave far better together than apart.
Networks + Engineering Mathematics + Analog Circuits came to 40, 36, 41, 41 and 41 marks in 2010, 2019, 2020, 2025 and 2026 — a mean of 39.8 and a spread of 5 marks, 12.6% of the block's size, when its own members swing by up to 50%. Roughly **two of every five marks in the paper sit in that block in every counted paper**, but which of the three carries them moves year to year. Prepare the block, not the ranking inside it.

ANALYSIS — the floor. Add each section's minimum: 13 + 9 + 9 + 9 + 6 + 7 + 6 + 6 = 65 technical marks. If every section in 2027 came in at its worst counted showing, 65 of the 85 technical marks would still be accounted for. **Only about 20 technical marks are genuinely in play.** Most of the paper is not a surprise; the argument is over a fifth of it.

PREDICTION. For 2027 the honest central estimate for each section is its five-paper mean, and the honest band is its five-paper range — 17 marks for Networks with a band of 13–21, 12 for Engineering Mathematics with a band of 9–15, and so on down the table. These are not forecasts of a paper nobody has seen. They are the statement that five counted papers give a centre and a width, and that claiming more precision than the width would be dishonest.

1.3 What changed for 2027

FACT. The 2027 and 2026 official syllabus PDFs were compared word by word. Across all eight sections there are **12 phrases added and 5 removed**, and the eight section headings are identical.
The additions, by section:

- **Engineering Mathematics** — *correlation and regression analysis*, *nonhomogeneous equations*; *first order equations (linear and nonlinear)* leaves, so nonlinear first-order differential equations depart with no replacement.
- **Networks, Signals and Systems** — *FIR and IIR filter design*, *Nyquist sampling theorem*, *sampling and reconstruction*; the older *sampling theorem and applications* and *discrete-time processing of continuous-time signals* lines leave. LTI systems also moves ahead of the continuous- and discrete-time paragraphs: not one word of it changed, but it is now the topic the section is built around rather than a clause at the end.
- **Electronic Devices** — *formation of energy bands in solids*, *scaling in MOSFETs*.
- **Analog Circuits** — *dominant-pole (Miller) compensation*, *phase margin*.

- **Control Systems** — *compensators*, *PID controller*; the *lag* and *lead and lag-lead compensation* lines leave, so the named compensator family is generalised and PID is new ground.
- **Communications** — *source coding*.

FACT — and this is the honest part. Digital Circuits and Electromagnetics did not change at all.
Not a phrase added, not a phrase removed, not a reordering. Those two sections carry a combined mean of 9.8 + 7.4 = 17.2 marks, 17.2% of the paper, and for them the five counted papers are the entire story with no syllabus caveat attached to any of it.

FACT. Six marks of the 2010 paper tested material that is not in the 2027 syllabus. In 2019, 2020, 2025 and 2026 that figure is zero: every question in the four modern counted papers maps onto a section of the 2027 syllabus.

ANALYSIS. The largest single addition anywhere in the 2027 paper is FIR and IIR filter design, and the counted record behind it is one paper deep: **2019 Q39 and 2019 Q54 are the only filter-design questions in the five counted papers**, both FIR, both by zero placement or least-squares approximation, and both set by IIT Madras. The named design recipes — windowing, the bilinear transformation, impulse invariance — produced no counted question at all. So there is a precedent, but no recurrence across papers to measure and no difficulty calibration. The other genuinely new lines are thinner still. This book says so wherever it uses them, and the questions written on those topics rest on the authority of the syllabus as much as on that of the archive.

1.4 What the evidence cannot tell you

This is the section that most weightage tables do not have, and the reason to trust the rest of this one.

Five papers is five papers. Every mean in section 1.2 is an average of five numbers. A section mean of 8.8 built from 9, 11, 10, 7 and 7 is a real central tendency, but it is not a population parameter and no confidence interval printed on it would mean anything. Read the min–max column as the actual claim and the mean as its midpoint.

The counted record has holes, and they are large. The span from 2010 to 2026 contains 17 papers. Five are counted. **Twelve are not** — eight of them fall between the 2010 and 2019 columns of every table in this book, and four more sit between the 2020 and 2025 columns. Those four in particular cover exactly the stretch in which the MSQ format arrived, so the book can say when MSQ first appears in the counted record but not when it first appeared in the exam. They sit uncounted in the author's archive, they are named as the next edition's work, and they are used for nothing here. No trend line in this book is drawn through a gap.

Only one counted paper comes from the institute setting 2027. GATE 2027 is organised by IIT Madras. Of the five counted papers, exactly one — 2019 — is an IIT Madras paper. The other four come from IIT Guwahati (2010 and 2026), IIT Delhi (2020) and IIT Roorkee (2025). 2019 does not look like the others, which Section 4 quantifies. **One paper cannot establish a rule about an institute's house style**, and anywhere this book uses 2019 as evidence about 2027 it says that in the same breath.

Marks are not difficulty. This book counts what a section was worth. It does not measure how hard its questions were, how long they took, or what fraction of candidates got them right — none of that is published, and no amount of counting recovers it. A 7-mark section of brutal questions can cost more time than a 13-mark section of routine ones.

The mock tests are not calibrated. This book's mock papers are built to the counted shape — 65 questions, 100 marks, 30 one-mark and 35 two-mark items, General Aptitude at exactly 15, and the section marks of the table in 1.2. That is what makes them a fair rehearsal of the *shape* of the paper. Nobody has sat them, so no cut-off, percentile or difficulty rating can honestly be attached to a score on one. They will tell you where your preparation is thin. They cannot tell you what you would have scored.

Section 6 — Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; compensators, PID controller; State variable model and solution of state equation of LTI systems.

Section 7 — Communications

Random Processes: Autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

Information Theory: Entropy, source coding, mutual information and channel capacity theorem.

Digital Communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Section 8 — Electromagnetics

Maxwell's Equations: Differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

Plane Waves and Properties: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Transmission Lines: Equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

2.2 What changed between 2026 and 2027

FACT. The comparison below was made from the two official syllabus PDFs — the GATE 2026 EC syllabus published by IIT Guwahati and the GATE 2027 EC syllabus published by IIT Madras — on 23 September 2026, and then reviewed a second time specifically to find errors in it.

The headline numbers:

	Count
Section headings in 2026	8
Section headings in 2027	8
Phrases **added** in 2027	12
Phrases **gone** in 2027	5
Rewrites — same requirement, different words	2
Reorderings — same words, different order	1
Differences that are **not changes at all**	4

The eight section headings are identical between the two years. No section was created, deleted, renamed or merged. Everything that follows happens inside the eight sections you already know.

The twelve additions

#	Section	Added in 2027
1	Engineering Mathematics	correlation and regression analysis
2	Engineering Mathematics	nonhomogeneous equations
3	Networks, Signals and Systems	FIR and IIR filter design
4	Networks, Signals and Systems	Nyquist sampling theorem
5	Networks, Signals and Systems	sampling and reconstruction
6	Electronic Devices	formation of energy bands in solids
7	Electronic Devices	scaling in MOSFETs
8	Analog Circuits	dominant-pole (Miller) compensation
9	Analog Circuits	phase margin
10	Control Systems	compensators
11	Control Systems	PID controller
12	Communications	source coding

Four of the twelve deserve a sentence each, because they are the ones that genuinely widen the paper rather than re-labelling something you were already doing.

FIR and IIR filter design is the largest single addition anywhere in the 2027 syllabus. It is not a rephrasing of anything in the 2026 document; it is a named design skill added to Discrete-time Signals. It is also the addition with the least history behind it, and this book says so plainly in the Networks,
Signals and Systems chapter rather than manufacturing a lineage for it.

Correlation and regression analysis extends Probability and Statistics past distributions into fitting.
Nothing in the 2026 Engineering Mathematics list implied it.

Dominant-pole (Miller) compensation and phase margin turn op-amp stability from an implicit background assumption into two named, examinable items in Analog Circuits.

Scaling in MOSFETs is added directly beside MOSFET in the device list — a short phrase, but a real one:
it names short-channel behaviour and the scaling relations as examinable rather than as context.

The remaining eight additions — nonhomogeneous equations, Nyquist sampling theorem, sampling and reconstruction, formation of energy bands in solids, compensators, PID controller, source coding — are best read as the 2027 document naming explicitly what the 2026 document left implied or covered under a broader heading. They are still additions, and they are still listed above, but a candidate who prepared the 2026 syllabus thoroughly will not find them foreign.

The five removals

#	Section	Gone from 2027
1	Engineering Mathematics	first order equations (linear and nonlinear)
2	Networks, Signals and Systems	discrete-time processing of continuous-time signals
3	Networks, Signals and Systems	sampling theorem and applications
4	Control Systems	lag
5	Control Systems	lead and lag-lead compensation

Section 3 — The Organising Institute

Every GATE paper is set by one of the IITs or IISc, rotating year to year. Every year, that fact generates a great deal of confident writing about what the incoming institute "prefers", "always asks" and "never touches". Almost none of it is supported by anything.

This chapter tells you what is actually known about the institute setting GATE 2027, exactly how thin the evidence behind it is, and the one narrow planning decision it can carry. It is short because the evidence is thin. Padding it out would be the easiest place in this book to start inventing, and a reader who catches invention here has every reason to distrust the counted chapters — which are the ones that are actually worth something.

3.1 What is known

FACT. GATE 2027 is organised by **IIT Madras**. The 2027 EC syllabus reproduced in Section 2 is published on the IIT Madras GATE 2027 portal.

FACT. Of the five GATE EC papers counted question by question for this book, exactly **one** was set by IIT Madras.

Paper	Organising institute
2010	IIT Guwahati
2019	**IIT Madras**
2020	IIT Delhi
2025	IIT Roorkee
2026	IIT Guwahati

So the entire institute-specific evidence base in this book is one paper: **2019**. That is the number to keep in front of you for the rest of this chapter. Everything below is built on a sample of one.

3.2 What the 2019 paper looks like

FACT. Marks by section across the five counted papers, with 2019 marked:

Section	2010	2019	2020	2025	2026
General Aptitude	15	**15**	15	15	15
Engineering Mathematics	10	**13**	13	15	9
Networks, Signals and Systems	21	**14**	17	13	20
Electronic Devices	9	**11**	10	7	7
Analog Circuits	9	**9**	11	13	12
Digital Circuits	6	**10**	11	9	13
Control Systems	8	**9**	6	10	7
Communications	9	**10**	9	12	10
Electromagnetics	7	**9**	8	6	7

FACT. 2019 is the flattest of the five. Every one of its eight technical sections falls between **9 and 14 marks**. Each of the other four papers has at least one technical section above 13 marks and at least one below 8:

Paper	Section(s) above 13	Section(s) below 8	Spread (lowest to highest)
2010	Networks 21	Digital 6, Electromagnetics 7	6–21
2019	**none**	**none**	**9–14**
2020	Networks 17	Control 6	6–17
2025	Engineering Mathematics 15	Electronic Devices 7, Electromagnetics 6	6–15
2026	Networks 20	Electronic Devices 7, Control 7, Electromagnetics 7	7–20

2019's spread is 5 marks. The next flattest paper's is 9, and the widest is 15. In particular, Networks, Signals and Systems — the largest section in four of the five papers, at 21, 17 and 20 marks — was 14 marks in 2019, its lowest figure in any counted paper except 2025.

FACT. By question format, 2019 was 40 MCQ and 25 NAT, with no MSQ.

(One bookkeeping note on the table: 6 marks of the 2010 paper tested content that is not in the 2027 syllabus at all. Every other counted paper has zero such marks. That affects 2010's row, not 2019's.)

3.3 What this can and cannot support

ANALYSIS. n = 1. One paper by one institute, set seven years before the paper you are sitting, by a question-setting committee whose membership is not public and will not be the same one.

What it can support — one thing. If you are deciding how much time to budget for the biggest sections, budget them **mid-range rather than at their peak**. Concretely: Networks, Signals and Systems has run as high as 21 marks, but the one IIT Madras paper in this set put it at 14. Planning your Networks preparation as though 20 marks are guaranteed, and starving Control Systems or Electromagnetics to pay for it, is a bet that the 2027 paper will look like 2010 or 2026 rather than like 2019. A flat-ish allocation across the eight sections is the cheaper mistake to make in either direction, and it is the allocation this book's chapter sizes broadly reflect.

That is a hedge, not a prediction. It is worth stating because it changes a real decision — how many hours go where — and because it is the only decision one paper can legitimately touch.

What it cannot support. Nothing else. Specifically, and none of these appears anywhere in this book:

- **No per-topic claim.** "IIT Madras favours z-transform questions", "IIT Madras likes Smith chart problems" — one paper cannot establish a topic preference. A section with 10 marks in it holds perhaps five or six questions. Whatever topics those questions covered is a sample far too small to distinguish a preference from an accident.
- **No trend.** A trend needs at least three points from the same source. There is one.
- **No negative claim.** "IIT Madras does not ask X" is the worst form of this error, because it is the one that makes a candidate skip material. The absence of a topic from one paper is close to zero evidence that it will be absent from the next. Every section of the 2027 syllabus is examinable in 2027, whoever is setting it.
- **No inference from format.** 2019 had no MSQ; the two most recent counted papers, 2025 and 2026, both have substantial MSQ counts. Question formats are set by GATE-wide policy at least as much as by the organising institute, and reading "IIT Madras will not use MSQ" off the 2019 paper would be a clear mistake.
- **No prediction of section marks.** "Networks will be about 14 marks in 2027" is not a claim this book makes. One paper gives a hedge, not a number.

ANALYSIS. There is also a reason to discount even the one usable finding slightly. 2019 sits seven years before 2027, and the syllabus itself changed between 2026 and 2027 — twelve phrases added and five removed, as Section 2 sets out. A paper set before those changes is not a preview of a paper set after them.

Section 4 — Paper Analysis

Every weightage figure in this book comes from this chapter. Five GATE Electronics and Communication papers — **2010, 2019, 2020, 2025 and 2026** — were read one question at a time, assigned to a section of the 2027 syllabus, and reconciled arithmetically against the official answer key for that year. This chapter shows the counts, shows the checks they passed, and then shows where they disagree with the tables that circulate publicly and what that disagreement costs a candidate who trusts one.

This chapter counts; it does not point. Every claim in this book about an individual question names its year *and* its question number, and those claims live in the nine subject chapters and in the ranked lists of Sections 9 and 10. None is made here, because nothing in this chapter is about a single question.

4.1 How the counting was done, and how it was checked

FACT — the method. Each paper was taken in question order. For each question: read it, assign it to one of the eight technical sections of the **2027** syllabus (not the syllabus in force in that year), assign it to a topic inside that section, and record its format — MCQ, NAT or MSQ — and its mark value. Where a question honestly belonged to two sections, both were recorded rather than one being chosen quietly. Where a question tested material that the 2027 syllabus no longer contains, it went into a separate residual row rather than being forced into a section it does not belong to.
Every assignment was then checked against that year's official answer key, which fixes both the mark value and the format of each question independently of anyone's reading of it.

FACT — the checks each year had to pass. A count that does not reconcile is not a count. Every year was required to satisfy all four of:

1. **65 questions.** Nothing dropped, nothing double-entered.
2. **100 marks.** The section column sums to exactly 100.
3. **General Aptitude exactly 15.** This is the check that catches the single most common failure in published tables — dropping General Aptitude and then normalising the technical sections to 100%, which silently inflates every technical figure by a factor of 100/85.
4. **Row-by-row agreement with the official answer key** on mark value and format.

All five columns in section 4.2 pass all four. You can verify check 2 yourself on the table: the five column sums are 100, 100, 100, 100 and 100.

ANALYSIS — the independent reconciliation. There is a second check the data supports that does not depend on trusting the first one. Across five papers there are 325 questions (65 × 5) and 500 marks (100 × 5). Every question is worth 1 mark or 2, so for any group of questions the number of
2-mark items must equal *marks minus questions*. Apply that to General Aptitude, whose structure is independently known: 50 questions, 75 marks, so 75 − 50 = 25 two-mark questions out of 50, exactly five per paper — which is what General Aptitude has. Apply it to the whole set: 500 − 325 = 175 two-mark questions, which is 35 per paper, and 325 − 175 = 150 one-mark questions, 30 per paper.
Both divide evenly by five. A count with a question misfiled or a mark misread would not produce integers that land on 35 and 30 per paper across every section simultaneously.

ANALYSIS — one seam, and it closes. The format table in section 4.3 accounts for 321 questions, not 325. The four missing questions are the 2010 questions on material now outside the 2027 syllabus:
six marks over four questions (6 − 4 = 2 two-mark and 2 one-mark items). They are excluded from the format table because it is organised by 2027 syllabus section and they have no section to sit in.
321 + 4 = 325. All four were MCQ, because in 2010 every question was.

4.2 The full marks table

FACT. Marks by section and year. The `mean` column is the average of the five years; `share` is that mean as a percentage of 100 marks.

Section	2010	2019	2020	2025	2026	Mean	Share
General Aptitude	15	15	15	15	15	15.0	15.0%
Engineering Mathematics	10	13	13	15	9	12.0	12.0%
Networks, Signals and Systems	21	14	17	13	20	17.0	17.0%
Electronic Devices	9	11	10	7	7	8.8	8.8%
Analog Circuits	9	9	11	13	12	10.8	10.8%
Digital Circuits	6	10	11	9	13	9.8	9.8%
Control Systems	8	9	6	10	7	8.0	8.0%
Communications	9	10	9	12	10	10.0	10.0%
Electromagnetics	7	9	8	6	7	7.4	7.4%
Not in the 2027 syllabus	6	0	0	0	0	1.2	1.2%
Total	**100**	**100**	**100**	**100**	**100**	**100.0**	**100%**

FACT — the residual row. Six marks of the 2010 paper tested material the 2027 syllabus does not contain. In 2019, 2020, 2025 and 2026 that figure is zero. The syllabus has, in coverage terms, been stable across the whole modern counted record; only the oldest counted paper needs reading through a filter.

ANALYSIS — the biggest section is not always the biggest. Networks, Signals and Systems tops the technical table in 2010 (21), 2019 (14), 2020 (17) and 2026 (20). In 2025 it does not: Engineering
Mathematics took 15 marks and Networks 13. That is the only inversion in the counted record, and it is a reason to treat the top of the table as a group rather than a ranking.

ANALYSIS — questions, not just marks. Dividing each section's five-paper mark total by its five-paper question total gives the average weight of a question in that section, and *marks minus questions* gives the number of 2-mark items.

Section	Questions (5 papers)	Marks (5 papers)	Questions per paper	Marks per question	2-mark share
General Aptitude	50	75	10.0	1.50	50.0%
Engineering Mathematics	41	60	8.2	1.46	46.3%
Networks, Signals and Systems	56	85	11.2	1.52	51.8%
Electronic Devices	27	44	5.4	1.63	63.0%
Analog Circuits	34	54	6.8	1.59	58.8%
Digital Circuits	32	49	6.4	1.53	53.1%
Control Systems	24	40	4.8	1.67	66.7%
Communications	32	50	6.4	1.56	56.3%
Electromagnetics	25	37	5.0	1.48	48.0%

The marks column here is the section's five-year total from the table above — for Networks,
21 + 14 + 17 + 13 + 20 = 85. The General Aptitude row is the control: 75 − 50 = 25 two-mark items over five papers is 5 per paper, which is the known structure, so the method is sound where it can be independently verified.

ANALYSIS — small sections are not cheap sections. Control Systems asks the fewest questions of any section, 4.8 per paper, but carries the heaviest questions in the paper: 1.67 marks each, with two-thirds of its items worth 2 marks. Electronic Devices is second at 1.63. At the other end,
Engineering Mathematics (1.46) and Electromagnetics (1.48) are the one-mark-heavy sections. The practical consequence is that Control Systems and Electronic Devices give you few chances and charge full price for each, while

> one-mark and 18 two-mark questions, 53 marks in total. Every numerical answer above was computed symbolically before the options or tolerances were written, and every distractor — and, in the NAT questions, every named near-miss — is the output of a specific, identified error.

5.2 Networks, Signals and Systems

Networks, Signals and Systems is the largest section of the GATE Electronics and Communication paper, and it has been the largest for as long as anyone has been counting. It is also the only section that a candidate cannot route around: its circuit-analysis half is the language in which Analog Circuits questions are posed, its LTI half is the language in which Control Systems and Communications questions are posed, and its transform machinery — Laplace, Fourier, z — is what the rest of the paper assumes you already own. A candidate who is weak here does not lose one section's marks; they lose a fraction of four.

This chapter is built on five papers that were counted question by question for this book — 2010, 2019, 2020, 2025 and 2026 — and verified against the official answer keys wherever an official key exists. Across those five papers Section 2 accounts for **56 questions and 85 marks**, more than any other section: the next largest, Engineering Mathematics, takes 60. Every claim below that carries a question number comes from that count. Every claim that comes from somebody else's published compilation is labelled as such, and the two are never averaged together.

One of those five papers matters more than the other four put together for a book aimed at 2027: **GATE 2019 was set by IIT Madras, and IIT Madras sets GATE 2027.** It was counted after the rest of this chapter was written, and every count in the chapter was redone over five papers rather than four. Beyond the arithmetic it contradicted the chapter outright in three places — the filter-design line, which this chapter had said was without history; the reciprocity line, which it had said had never been asked; and the organising-institute section, which until that count had nothing in it and said so. It also broke four regularities the chapter had highlighted — the LTI-property question in every paper, the dc-network question in every paper, the two-port question always being a parameter matrix, and phasor analysis always appearing at least twice — and those are flagged where they occur. All of these revisions are marked in place rather than quietly folded in, because a reader who wants to check this chapter should be able to see what the fifth paper moved.

FACT — official GATE 2027 syllabus, Section 2 (verbatim from the IIT Madras syllabus PDF):

> *Circuit Analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer.*
>
> *Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation.*
>
> *LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.*
>
> *Continuous-time Signals: Fourier series and Fourier transform, Nyquist sampling theorem, sampling and reconstruction. Discrete-time Signals: DTFT, DFT, z-transform, FIR and IIR filter design.*

FACT (what changed for 2027, from a direct comparison of the official 2026 and 2027 syllabus PDFs): three phrases were added to this section — *FIR and IIR filter design*, *Nyquist sampling theorem*, and *sampling and reconstruction*; two were removed — *discrete-time processing of continuous-time signals* and *sampling theorem and applications*. The paragraphs were also reordered: in 2026 the order ran Circuit Analysis → Sinusoidal steady state → Continuous-time Signals → Discrete-time Signals → LTI systems, and in 2027 it runs Circuit Analysis → Sinusoidal steady state → **LTI systems** → Continuous-time Signals → Discrete-time Signals. Not one word of the LTI paragraph changed; it simply moved from the end of the section to its middle, ahead of both signal paragraphs. FIR and IIR filter design is the single largest addition anywhere in the 2027 EC syllabus.

ANALYSIS (role in the paper): Section 2 gives up its marks in two quite different currencies. The circuit half — node analysis, Thevenin, phasors, resonance, two-ports — is *procedural*: the method is never in doubt, the work is arithmetic under a sign convention, and the failure mode is a dropped j or a peak-versus-rms slip rather than not knowing what to do. The signals half — LTI properties, ROC, sampling, Fourier coefficients — is *definitional*: the work is usually two lines long, and the failure mode is a candidate who half-remembers a property and picks the option that sounds right. The counted papers show both currencies in every year, and they show that the section's 1-mark questions are overwhelmingly definitional while its 2-mark questions are overwhelmingly procedural. Time budgeting in this section should follow that split, not the mark value.

A note used throughout this chapter, carried over from the method of the companion volume: all "prediction confidence" percentages are model-based analytical confidence, not literal probabilities that a question will appear. Every question in the bank that follows carries four separate confidence figures rather than one — Topic, Concept, Question-pattern and Exact-question — which answer, in turn, whether the topic appears at all, whether this underlying concept is the one tested, whether a question of this shape is used, and whether a question this close in wording and setup turns up; exact-question confidence is capped at 35 % because GATE rarely repeats a question verbatim.

Syllabus hierarchy

- **Section: Networks, Signals and Systems**
- **Topic: Circuit analysis**
  - Subtopic: Node and mesh analysis
  - Concept: KCL/KVL, supernode and supermesh, dependent sources in the constraint equations
  - Concept: choosing the reference node; number of independent equations (n − 1 nodes, b − n + 1 meshes)
  - Concept: power delivered or absorbed by a named source, sign of the answer under the passive sign convention
  - Subtopic: Superposition
  - Concept: one independent source at a time; voltage sources shorted, current sources opened; dependent sources never suppressed
  - Concept: superposition applies to currents and voltages, never to power
  - Subtopic: Thevenin's and Norton's theorems
  - Concept: open-circuit voltage, short-circuit current, R_th = V_oc / I_sc
  - Concept: R_th by source suppression (no dependent sources) versus by test source (dependent sources present)
  - Concept: source transformation between the two equivalents
  - Subtopic: Reciprocity
  - Concept: reciprocity holds for networks of linear bilateral passive elements only; excitation and response interchange
  - Concept: reciprocity in two-port terms — $z_{12} = z_{21}$, $y_{12} = y_{21}$, AD − BC = 1
- **Topic: Sinusoidal steady state analysis**
  - Subtopic: Phasors and impedance
  - Concept: impedance and admittance of R, L, C; series and parallel combination in the complex plane
  - Concept: phasor form of KCL/KVL; branch current and node voltage in an AC network
  - Concept: rms versus peak phasor magnitude; what an ideal voltmeter and ammeter read
  - Concept: phasor diagrams; extracting a phase condition from the geometry
  - Subtopic: Complex power
  - Concept: S = V I*, real power, reactive power, apparent power, power factor
  - Concept: average power in a reactive branch is zero; average power delivered to a load at resonance

What this chapter will not ask at all: nonlinear first-order differential equations. Exact equations, integrating factors, Bernoulli's equation, homogeneous substitutions and orthogonal trajectories left the syllabus in 2027 and there is no question on any of them in the bank.

High-probability question bank

Conventions used in every question unless a question says otherwise. **Logarithms:** log and ln both mean the natural logarithm (base e); a base-10 logarithm is written $\log_{10}$. **Complex plane:** $i = \sqrt{(-1)}$; the principal branch of the logarithm is $\mathrm{Log}\ z = \ln|z| + i\cdot\mathrm{Arg}\ z$ with $\mathrm{Arg}\ z \in (-\pi, \pi]$ and the branch cut along the negative real axis including the origin, and z^a means e^{a·Log z} on that branch; every closed contour is simple and traversed once in the **positive (counterclockwise)** sense; "residue at z_0" means the coefficient a_{-1} of $(z - z_0)^{-1}$ in the Laurent expansion valid on a punctured disc about z_0. **Transforms**, where they appear: the one-sided Laplace transform is $F(s) = \int_0^{\infty} f(t)e^{-st}\,dt$, and the Fourier transform is $F(\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t}\,dt$ with inverse $(1/2\pi)\int F(\omega)e^{j\omega t}\,d\omega$, ω in rad/s. **Vector analysis:** $(\hat{i}, \hat{j}, \hat{k})$ is a right-handed orthonormal triad; a closed surface carries the outward unit normal; the orientation in Green's and Stokes' theorems follows the right-hand rule. **Linear algebra:** all matrices are real unless stated, eigenvalues are counted in $\mathbb{C}$ with algebraic multiplicity, and $\|\cdot\|$ is the Euclidean norm. **Probability:** $X \sim N(\mu, \sigma^2)$ gives the **variance** as the second parameter; "an exponential distribution with mean μ" has density $(1/\mu)e^{-t/\mu}$ for $t \geq 0$; "without replacement" means every unordered sample of the stated size is equally likely; "correlation coefficient" means Pearson's $\rho = \mathrm{Cov}(X,Y)/(\sigma_X \sigma_Y)$; "the regression line of y on x" is the least-squares line that minimises the sum of squared **vertical** residuals; any normal-table values needed are supplied inside the question. **NAT answers** must be entered to the precision stated with the question, and the acceptance tolerance is stated with the answer. Every question below is new, written for this book, and was solved symbolically before the options were built; none reproduces a previous GATE question.

QEM.1 MCQ · 1 mark Easy–Moderate

Subject: Engineering Mathematics | **Topic:** Linear Algebra | **Subtopic:** Eigenvalues of a symmetric tridiagonal matrix
Prediction Confidence: Topic 86% | Concept 74% | Question-pattern 58% | Exact-question 14%
Based on PYQs: GATE 2010 (Q1), 2019 (Q27), 2026 (Q11) · last tested 2026 · new question on the same concept, not a reprint

QUESTION

The eigenvalues of the matrix

$$M = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

are

(A) 1, 2, 3
(B) $2 - \sqrt{2}$, 2, $2 + \sqrt{2}$
(C) $2 - \sqrt{3}$, 2, $2 + \sqrt{3}$
(D) 0, 2, 4

ANSWER (B)

Concept Tested: Characteristic polynomial of a 3×3 symmetric matrix; the checks trace = Σλ and det = Πλ; real eigenvalues of a real symmetric matrix.

Why This Question Is High Probability: Eigenvalues are the most-asked linear-algebra concept in the counted set, appearing in 2010 (Q1), 2019 (Q27) and 2026 (Q11). All three were 1-mark items answered in under a minute, which is exactly this question's size. The symmetric tridiagonal matrix is the standard vehicle when the setter wants irrational eigenvalues without an ugly cubic.

Historical Evidence: 2010 Q1 (1M, MCQ) asked for the nature of the eigenvalues of a skew-symmetric matrix; 2019 Q27 (1M, NAT) asked for the number of distinct eigenvalues of a 4×4 upper-triangular matrix; 2026 Q11 (1M, MCQ) required eigenvalues and eigenvectors to recover a matrix from a modal solution.

SOLUTION

The characteristic polynomial is

$\det(M - \lambda I) = -\lambda^3 + 6\lambda^2 - 10\lambda + 4$, i.e. $\lambda^3 - 6\lambda^2 + 10\lambda - 4 = 0$.

$\lambda = 2$ is a root ($8 - 24 + 20 - 4 = 0$). Dividing out, $\lambda^2 - 4\lambda + 2 = 0$, so $\lambda = 2 \pm \sqrt{2}$. The eigenvalues are $2 - \sqrt{2}$, 2, $2 + \sqrt{2}$.

Both consistency checks pass: the sum is 6 = trace(M), and the product is $2(2 - \sqrt{2})(2 + \sqrt{2}) = 2(4 - 2) = 4 = \det(M)$.

The distractors are each reachable by a specific slip. **(A)** has the right trace ($1 + 2 + 3 = 6$) but product $6 \neq 4$ — it is what you get by guessing "nice integers around the diagonal" without testing the determinant. **(C)** comes from mis-expanding the 3×3 determinant and obtaining $\lambda^2 - 4\lambda + 1$ instead of $\lambda^2 - 4\lambda + 2$, dropping the contribution of one of the two off-diagonal −1 pairs; its product is $2(4 - 3) = 2 \neq 4$. **(D)** is the answer for the *circulant* matrix with an extra −1 in the corners, and also fails the determinant check (product 0, but M is nonsingular). Testing the product against det(M) = 4 eliminates (A), (C) and (D) in ten seconds.

QEM.2 MCQ · 1 mark Easy–Moderate

Subject: Engineering Mathematics | **Topic:** Linear Algebra | **Subtopic:** Rank of a parametrised matrix
Prediction Confidence: Topic 86% | Concept 76% | Question-pattern 66% | Exact-question 16%
Based on PYQs: GATE 2020 (Q36), 2025 (Q11), 2026 (Q26) · last tested 2026 · new question on the same concept, not a reprint

QUESTION

Let α be a real parameter and

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 3 & 6 & \alpha \end{bmatrix}$$

Which one of the following statements is TRUE?

(A) rank(A) = 3 for every $\alpha \neq 9$, and rank(A) = 2 for $\alpha = 9$ (B) rank(A) = 2 for every $\alpha \neq 9$, and rank(A) = 1 for $\alpha = 9$
(C) rank(A) = 2 for every real α
(D) rank(A) = 3 for $\alpha = 9$ and rank(A) = 2 otherwise

ANSWER (B)

Concept Tested: Rank as the number of linearly independent rows; recognising proportional rows before computing anything; the fact that a determinant being zero for *all* parameter values does not fix the rank.
Why This Question Is High Probability: Three of the seven counted linear-algebra questions ask for a *condition on a parameter* rather than a number: 2020 Q36 (consistency condition), 2025 Q11 (rank for given parameter combinations) and 2026 Q26 (values of a and b making det(M) ≠ 0). The 2025 question is this question's nearest relative and was also a 1-mark MCQ.
Historical Evidence: 2025 Q11 (1M, MCQ) — rank of a triangular matrix for given parameter combinations; 2026 Q26 (1M, MSQ) — values of a and b for which det(M) is nonzero; 2020 Q36 (2M, MCQ) — consistency condition for an overdetermined system.

SOLUTION

Row 2 = 2 × Row 1 for every α, so the first two rows are always dependent and rank(A) ≤ 2 always. In particular det(A) = 0 for every α, and (A) and (D) are wrong for that reason alone.

Row 3 = (3, 6, α). Row 3 = 3 × Row 1 exactly when $\alpha = 9$. So:

- $\alpha = 9$: all three rows are multiples of (1, 2, 3), and **rank(A) = 1**.
- $\alpha \neq 9$: rows 1 and 3 are independent (the 2×2 minor formed from columns 1 and 3 of rows 1 and 3 is $1 \cdot \alpha - 3 \cdot 3 = \alpha - 9 \neq 0$), so **rank(A) = 2**.

Answer (B). **(A)** and **(D)** both come from the reflex "determinant zero ⟺ rank drops by one", applied without noticing that the determinant is identically zero here. **(C)** comes from checking only rows 1 and 2, seeing one dependency, concluding rank 2, and never testing the special value $\alpha = 9$ that collapses the third row as well.

QEM.3 MSQ · 1 mark Moderate

Subject: Engineering Mathematics | **Topic:** Linear Algebra | **Subtopic:** Span, linear independence and basis in $\mathbb{R}^4$
Prediction Confidence: Topic 86% | Concept 68% | Question-pattern 55% | Exact-question 12%
Based on PYQs: GATE 2020 (Q11), 2026 (Q26) · last tested 2026 · new question on the same concept, not a reprint

QUESTION

In $\mathbb{R}^4$, let

$v_1 = (1, 0, 1, 0)$, $v_2 = (0, 1, 0, 1)$, $v_3 = (1, 1, 1, 1)$, $v_4 = (1, -1, 1, -1)$, $v_5 = (2, 1, 2, 1)$,

and let $W = \text{span}\{v_1, v_2, v_3, v_4, v_5\}$. Which of the following statements is/are TRUE?

(A) $\dim(W) = 2$
(B) $\{v_1, v_2\}$ is a basis of W
(C) $\{v_3, v_4\}$ is a basis of W
(D) $\{v_1, v_3, v_5\}$ is linearly independent

ANSWER (A), (B), (C)

Concept Tested: Dimension of a span; a spanning set of five vectors need not have rank five; several different bases of the same subspace; a set of three vectors inside a 2-dimensional subspace can never be independent.
Why This Question Is High Probability: 2020 Q11 posed exactly this situation — six vectors in $\mathbb{R}^4$, asked about span, linear independence and basis — as a 1-mark MCQ. The 2025 and 2026 papers moved this kind of multi-statement classification into the MSQ format (2025 Q25, Q51, Q52; 2026 Q26), and an MSQ is the natural 2027 home for it.
Historical Evidence: 2020 Q11 (1M, MCQ) — six vectors in $\mathbb{R}^4$, span, linear independence and basis; 2026 Q26 (1M, MSQ) — parameter values keeping a determinant nonzero, the first linear-algebra MSQ in the counted set.

SOLUTION

Observe the three relations directly:

$v_3 = v_1 + v_2$, $v_4 = v_1 - v_2$, $v_5 = 2v_1 + v_2$.

So every one of the five vectors lies in $\text{span}\{v_1, v_2\}$, and $W = \text{span}\{v_1, v_2\}$. Since v_1 and v_2 are not proportional, **$\dim(W) = 2$** — (A) is true — and **$\{v_1, v_2\}$ is a basis** — (B) is true.

For (C): v_3 and v_4 are two vectors in the 2-dimensional space W, and they are independent because $a(v_1 + v_2) + b(v_1 - v_2) = 0$ forces $a + b = 0$ and $a - b = 0$, hence $a = b = 0$. Two independent vectors in a 2-dimensional space form a basis, so **(C) is true**. This is the statement most often rejected: a basis of W need not consist of the vectors that were listed first.

For (D): any three vectors inside a 2-dimensional subspace are dependent. Explicitly $v_5 = v_1 + v_3$, since $v_1 + v_3 = v_1 + (v_1 + v_2) = 2v_1 + v_2 = v_5$. **(D) is false.** The error that makes (D) look true is checking only that no *pair* among v_1, v_3, v_5 is proportional — pairwise non-proportionality is not independence for three or more vectors.

QEM.4 MCQ · 2 marks Moderate

Subject: Engineering Mathematics | **Topic:** Linear Algebra | **Subtopic:** Existence and uniqueness for a parametrised linear system
Prediction Confidence: Topic 86% | Concept 77% | Question-pattern 68% | Exact-question 17%
Based on PYQs: GATE 2020 (Q36), 2025 (Q11), 2026 (Q26) · last tested 2026 · new question on the same concept, not a reprint

QUESTION

Consider the system of linear equations in the unknowns x, y, z, where λ is a real parameter:

Section 9 — The Seventy-Eight Concepts That Recur, Ranked

Eight chapters of this book each rank their own section. This one merges them into a single order for the whole paper, so that a candidate with four weeks left can start at the top and work down.

Three things have to be said before the list, because they decide whether the list is worth anything.

The first is the **count**. Books like this one usually promise a hundred concepts. The evidence here supports **78** — those appearing in two or more of the five counted papers — and the list stops there. Padding the tail with concepts asked once in five years would make the bottom of the list indistinguishable from guesswork, which is the failure this whole book is written against.

The second is that **the eight chapters do not score on the same scale**, and merging their printed numbers directly would have produced a ranking that measured which chapter you were reading rather than what the papers contain. What was wrong and what was done about it is set out below, before the table, because a reader is entitled to check it.

The third is that **every row can be checked**. Each entry names the counted papers it appears in and the question numbers behind it. Only 2010, 2019, 2020, 2025 and 2026 are cited, here and anywhere else in this book.

Do the eight chapters' scores agree? (ANALYSIS)

> ***FACT — the eight prediction-scoring schemes, as printed in the chapters.***

Section	Scheme as printed	Output range	Items scored	Top / bottom
1 Engineering Mathematics	No per-topic score table. Confidence bands only: 5-of-5 areas 82–88 %, 4-of-5 areas 70–76 %	0–100 (bands)	6 areas	—
2 Networks, Signals and Systems	Eight factors F1–F8, each 0–10, weights 20/20/15/15/10/5/5/10, scaled to 0–100	0–100	18 subtopics	92.0 / 34.0
3 Electronic Devices	Frequency 40 + recency 25 + institute fit 20 + syllabus 15	0–100	7 topics	88 / 46
4 Analog Circuits	40·F + 30·M + 20·R + 10·I, F/M/R fractions, I binary	0–100	10 buckets	80.0 / 14.0
5 Digital Circuits	0.30·freq + 0.30·marks + 0.25·recency + 0.15·IITM, each input 0–10	**0–10**	11 topics	8.2 / 0.0
6 Control Systems	0.40·marks-share + 0.30·papers + 0.20·recency + 0.10·IITM 2019	0–100	10 bands	94.0 / 36.0
7 Communications	0.40·F + 0.30·M_n + 0.20·R + 0.10·S	**0–1**	5 topics	0.760 / 0.450
8 Electromagnetics	0.35·Freq + 0.30·Rec + 0.20·Madras + 0.15·Gen, each 0–10, rescaled	0–100 (%)	9 topics	89 % / 8 %

> ***ANALYSIS.*** *The method is the same everywhere: a weighted composite of frequency across the five counted papers, marks share, recency, and the IIT Madras 2019 signal, with a syllabus term in three chapters. That is genuine common ground, and it is why a merge is possible at all. But the printed numbers are not comparable, for five specific reasons.*

1. Two chapters print on a different scale entirely. Digital Circuits scores 0–10 and Communications scores 0–1. Multiplying by ten and by a hundred fixes the units and nothing else.

2. Every chapter normalises marks share to its own section's largest bucket. In Control Systems, "marks share = 100" means the state-variable band's 8 counted marks. In Communications, the equivalent means Digital Communications' 20 counted marks. Merging raw would systematically inflate the small sections and deflate the large ones — the exact opposite of what a whole-paper ranking is for.

3. Granularity differs by a factor of three or more. Networks scores eighteen subtopics; Communications scores five whole topics. A score attached to "Digital Communications" (12 counted questions, 20 marks, five papers) sits in the same column as a score attached to "wye-delta transformation" (zero counted questions). These are not the same kind of object and cannot be sorted against each other.

4. "Recency" is four different quantities. Analog Circuits defines R as the fraction of a bucket's *own* marks that fell in 2025–2026, which mechanically penalises a topic for having been asked steadily since 2010 — its diode-network row scores R = 0.40 despite being the section's most frequent item. Control Systems defines recency as a lookup on the last year tested (2026 → 100, 2010 → 25). Electromagnetics defines it as weight in 2025–2026. Electronic Devices scores it as a judgement out of 25. Averaging these four would be averaging four different measurements.

5. The floors are far apart. Electronic Devices' lowest printed score is 46 and Communications' is 45; Digital Circuits' is 0 and Electromagnetics' is 8. On a raw merge, every topic in two chapters would outrank most topics in two others for reasons that have nothing to do with the papers.

Systematic level differences, stated plainly. Converting all eight to 0–100 gives top scores of 94 (Control), 92 (Networks), 89 (Electromagnetics), 88 (Electronic Devices), 82 (Digital), 80 (Analog), 76 (Communications) and, by implication from its confidence bands, about 88 (Engineering Mathematics). The spread of the tops is 18 points and the spread of the bottoms is 46. Communications runs low at the top and high at the bottom; Analog runs low throughout; Control runs high at the top.
A merged list built by rescaling these numbers would be worse than no list.

What was done instead (ANALYSIS)

The merge does not rescale the chapters' scores. It rebuilds one score from the two primitives that **every** chapter reports in the same way and that a reader can check line by line against a concept map:

- **P** — how many of the five counted papers contain the concept, 0 to 5.
- **Q** — how many counted questions, with the question numbers printed.

Two small adjustments are added, both declared:

- **R — recency.** +8 if the concept appears in **both** 2025 and 2026; +5 if in one of them; 0 if in neither. This is one definition, applied identically to all eight sections, replacing the four incompatible ones.
- **Y — syllabus and institute.** +4 if the 2027 syllabus newly names or renames the concept; +2 if IIT Madras asked it more than once in 2019, the one counted paper that institute set. Otherwise 0.

> ***The formula.***
>
> ***Score = 12 · P + 4 · Q_eff + R + Y****, where* ***Q_eff = min(Q, 2P)****, and the maximum is 100.*

The **Q_eff cap** is the one non-obvious ingredient and it exists for a named reason. Static CMOS has six counted questions but five of them are in the 2019 paper alone; the named filter-design line has two questions and both are in 2019. Without a cap, one paper's enthusiasm outranks a pattern spread across four papers. Capping the question credit at two per paper present means a concept is rewarded for **recurring**, not for having had one good year.

Section 11 — Ten Full-Length GATE ECE 2027 Mock Tests

11.1 What these papers are, and what they are not

A mock test is not a question bank with a clock on it. It is a forgery of the real paper, and every bit of its value comes from how closely the forgery matches. A paper that gives Networks eight marks and Electromagnetics sixteen will teach a candidate to budget their three hours for an exam that does not exist, and it will do that damage quietly, because nothing about taking it feels wrong.

So these ten were not written and then measured. The shape was solved for first — how many marks to each section, how many questions of each type, how many at one mark and how many at two — and the questions were written to fit the shape. **No question anywhere in Section 11 was reclassified to make a total close.**

Three things these papers never do, and each is a rule the book is written to:

- **They never reuse a question from the subject chapters.** A candidate has already worked those 275 questions; a mock that repeats them measures memory, not readiness.
- **They never copy a past GATE question**, from any year, from any source. Every one of the 650 was written for this book.
- **No mock question names a year as its evidence.** The subject chapters cite: every historical claim there names a year *and* a question number out of the five counted papers. The mocks predict. Where a mock question needs to explain itself it does so in its solution, in terms of the pattern, not a citation. The one place a year appears in this section is the opening of Mock 9, which is a paper about the 2026-to-2027 syllabus change and has to name the two documents it is built on. No question in it, or anywhere else here, rests on a past paper.

11.2 The pattern every test follows

> ***FACT.*** *From all five counted papers — GATE EC 2010, 2019, 2020, 2025 and 2026 — without a single exception.*

Element	Every counted paper	Every test in this section
Questions	65	65
Marks	100	100
One-mark questions	30	30
Two-mark questions	35	35
General Aptitude	exactly 15 marks, all MCQ	Q1–Q5 at one mark, Q6–Q10 at two, all MCQ
Technical	85 marks	Q11–Q35 at one mark, Q36–Q65 at two
Duration	180 minutes	180 minutes

Question numbering follows the real paper, which is why the mark value of a question is decided by its position: Q1–Q10 are General Aptitude, Q11–Q65 technical, and a question's number tells you what it is worth before you read a word of it.

Marking. MCQ: exactly one option is correct; a wrong answer costs one third of the question's marks, an unattempted one costs nothing. MSQ: one or more options are correct; no negative marking and no partial credit, so a mark is scored only when every correct option and no incorrect one is selected. NAT: type the value; no negative marking, and any value inside the printed acceptance band earns full marks.

11.3 How the 85 technical marks are spread

> ***ANALYSIS.*** *The counted means, which is what a real paper does on average. Section 4 shows the year-by-year spread these come from.*

Section	Mean marks, five counted papers	In a mock test
Networks, Signals and Systems	17.0	17
Engineering Mathematics	12.0	12
Analog Circuits	10.8	11
Communications	10.0	10
Digital Circuits	9.8	10
Electronic Devices	8.8	9
Control Systems	8.0	8
Electromagnetics	7.4	8
Technical total	**84.6**	**85**

Individual tests vary by a mark or two, the way real papers do — the five counted papers put Networks anywhere between 13 and 21 marks — but no test in this section moves a section far from its mean without saying, in its own opening paragraph, why.

11.4 The format mix, and why it is not the five-year average

The paper's shape changed twice inside the counted record:

> ***FACT.*** *2010: 65 MCQ, no NAT, no MSQ. 2019 and 2020: NAT arrives, 25 and 23 questions. 2025 and 2026: MSQ arrives, 14 and 10 questions.*

A mock built on the five-year average would therefore model a paper that has not been set since 2020. These ten model the **current** paper instead: roughly 60 to 65 per cent MCQ, 20 to 25 per cent NAT and 10 to 15 per cent MSQ, which is where 2025 and 2026 sit. Within that, each section leans on its own measured mix, because the sections differ sharply from one another — Communications ran at 50.0 per cent MCQ across the five papers and Networks at 76.8 — and General Aptitude is all MCQ.

This matters more than it looks. MCQ carries negative marking and rewards eliminating options; NAT rewards neither and punishes nothing; MSQ is all-or-nothing. A paper with the wrong mix trains the wrong reflex about when to guess, and guessing policy is decided in seconds under pressure by whatever habit you arrived with.

11.5 The ten tests, and what each one is for

> ***PREDICTION-driven design.*** *Every test closes on the same 65 / 100 / 30 / 35 / 15, and every one is inside a mark or two of the section table above. What differs is where each test puts its weight and its difficulty.*

Test	What it is for	Difficulty
1	First sitting. Section marks on the means, format mix on the 2025–2026 average, hardest two-markers in Networks and Control. The paper to find out where you are.	Moderate
2	The same ground approached from the other side: nodal analysis where Test 1 asked Thevenin, the inverse z-transform where it asked convolution, single-sideband where it asked amplitude modulation.	Moderate

Mock Test 01

Duration: 180 minutes | Maximum marks: 100 | 65 questions

This paper is a forgery of the GATE Electronics and Communication Engineering pattern for 2027: Q1-Q5 General Aptitude at 1 mark, Q6-Q10 General Aptitude at 2 marks, Q11-Q35 technical at 1 mark, Q36-Q65 technical at 2 marks. Every question here was written for this book. None is taken from a past paper and none reproduces one, so no question carries a year as a source.

Marking. MCQ (exactly one correct option): full marks for the correct option, negative marking of one-third of the question's marks for a wrong option. MSQ (one or more correct options): full marks only if every correct option and no incorrect option is chosen; no negative marking and no partial credit. NAT (numerical answer): type the value; no negative marking. Any value inside the printed acceptance band earns full marks.

Conventions used throughout this paper. Passive sign convention. All sources are ideal and all op-amps are ideal unless a question says otherwise. Capacitors are uncharged and inductors are de-energised at t = 0- unless a question says otherwise. Angular frequency omega is in rad/s and frequency f is in Hz, and every question states which it means. All ac voltages and currents are rms unless a question says peak. "log" is base 10, "ln" is natural and "log2" is base 2. The DTFT and the z-transform use the usual e^(-j*omega*n) and z^(-n) conventions; the DFT is unnormalised on the forward transform. "Stable" means BIBO stable. The thermal voltage kT/q is stated inside every question that needs it. Every decibel figure is labelled as a power ratio or a voltage ratio inside the question that uses it.

Q1 - Q5 carry ONE mark each.

Q1 MCQ · 1 mark

Select the option that is most nearly OPPOSITE in meaning to the word shown in bold.

The board's assessment of the proposal was unusually **terse**.

(A) verbose
(B) blunt
(C) inaccurate
(D) reluctant

General Aptitude — antonyms in context

Q2 MCQ · 1 mark

Choose the pair that correctly fills the two blanks.

Neither the technician nor the two engineers ___ able to explain why the meter ___ a negative reading during the calibration run.

(A) was / showed
(B) were / showed
(C) was / show
(D) were / show

General Aptitude — subject-verb agreement with neither/nor

Q3 MCQ · 1 mark

The price of a component is first reduced by 20%. By what percentage must the reduced price now be increased so that it returns exactly to its original value?

(A) 20%
(B) 25%
(C) 16.67%
(D) 22.5%

General Aptitude — percentage change and the moving base

Q4 MCQ · 1 mark

In a laboratory:

- every calibrated meter is a digital meter;
- some digital meters are battery powered.

Which one of the following necessarily follows?

(A) Some calibrated meters are battery powered.
(B) Every battery-powered meter is calibrated.
(C) Nothing necessarily follows about whether any calibrated meter is battery powered.
(D) Every digital meter is calibrated.

General Aptitude — categorical syllogism and illicit conversion

Q5 MCQ · 1 mark

Find the next term of the sequence.

3, 7, 16, 35, 74, ____

(A) 149
(B) 153
(C) 156
(D) 163

General Aptitude — number series with a growing increment

Q6 - Q10 carry TWO marks each.

Q6 MCQ · 2 marks

Five examination centres reported the following numbers for one session.

Centre	Registered	Present
P	480	432
Q	520	442
R	350	322
S	600	510
T	450	396

Which centre had the highest attendance rate, and what was the overall attendance rate taken over all five centres together?

(A) P, and 87.58%
(B) R, and 88.00%
(C) R, and 87.58%
(D) S, and 85.00%

General Aptitude — data interpretation, pooled versus averaged ratios

Q7 MCQ · 2 marks

At present the senior technician in a calibration laboratory is three times as old as the apprentice. Seven years ago the technician was five times as old as the apprentice was then. What will the sum of their two ages be seven years from now?

(A) 49 years
(B) 56 years
(C) 63 years
(D) 70 years

General Aptitude — ages from two linear conditions

One or more options are correct. Mark every correct option and no other.

Electromagnetics — uniform plane wave in a lossless dielectric

Q65 MCQ · 2 marks

Coherent binary phase shift keying is used over an additive white Gaussian noise channel with a matched-filter receiver and equally likely symbols. The ratio E_b/N_0 is 9.00 dB (a power ratio, expressed as 10 log10). Using P_e = Q(sqrt(2 E_b/N_0)), where Q is the Gaussian tail function, the bit error probability is closest to

(A) 1.1 x 10^-5
(B) 3.4 x 10^-5
(C) 2.4 x 10^-3
(D) 2.3 x 10^-2

Communications — bit error probability of coherent BPSK

Answer key — Mock Test 01

Attempt the whole paper before reading this page. Score with the official scheme: a correct 1-mark question gives +1 and a correct 2-mark question +2; a wrong MCQ costs 1/3 of a mark (1-mark) or 2/3 of a mark (2-mark); MSQ and NAT carry no negative marking, and an MSQ scores only if every correct option is selected and no incorrect one is. NAT answers are given to the precision stated in each question.

This paper contains 41 MCQ, 9 MSQ and 15 NAT questions (30 one-mark and 35 two-mark, 100 marks).

Q	Answer	Type	Q	Answer	Type	Q	Answer	Type
1	A	MCQ	23	0.812 (range 0.800-0.822)	NAT	45	6.2832 (range 6.20-6.35)	NAT
2	B	MCQ	24	C	MCQ	46	1061 (range 1040-1085)	NAT
3	B	MCQ	25	0.655 (range 0.645-0.668)	NAT	47	A, C, D	MSQ
4	C	MCQ	26	B	MCQ	48	A	MCQ
5	B	MCQ	27	19.53 (range 19.3-19.7)	NAT	49	A	MCQ
6	C	MCQ	28	1.75 (range 1.73-1.77)	NAT	50	26.63 (range 26.2-27.1)	NAT
7	D	MCQ	29	B	MCQ	51	C	MCQ
8	C	MCQ	30	A	MCQ	52	4.152 (range 4.05-4.26)	NAT
9	B	MCQ	31	A	MCQ	53	0.1590 (range 0.154-0.164)	NAT
10	B	MCQ	32	B	MCQ	54	11.28 (range 11.0-11.6)	NAT
11	B	MCQ	33	A	MCQ	55	A	MCQ
12	B	MCQ	34	A, B, D	MSQ	56	B, C	MSQ
13	B	MCQ	35	C	MCQ	57	B	MCQ
14	B	MCQ	36	B	MCQ	58	A	MCQ
15	B	MCQ	37	C	MCQ	59	A	MCQ
16	B	MCQ	38	0.327 (range 0.320-0.336)	NAT	60	A, B, D	MSQ
17	C	MCQ	39	C	MCQ	61	A	MCQ
18	4.5 (range 4.45-4.55)	NAT	40	D	MCQ	62	A, B, D	MSQ
19	A	MCQ	41	B	MCQ	63	A, B, C	MSQ
20	A, B, D	MSQ	42	A, C	MSQ	64	A, B	MSQ
21	43.07 (range 42.0-44.0)	NAT	43	16.30 (range 15.8-16.8)	NAT	65	B	MCQ
22	A	MCQ	44	6.562 (range 6.48-6.64)	NAT			

Detailed solutions for this test: Section 13, under the heading "Mock Test 01".
Each solution there works the question through in full, names the specific mistake behind every wrong option, and ends with two figures: how confident this book is in the pattern the question tests, and how confident it is in this exact question. The second is always the smaller of the two.

Consolidated keys for all 10 tests: Section 12.

Section 13 — Detailed Mock Test Solutions

Each test's solutions follow, in question order. Attempt and score the paper (Section 12) before reading these.

Mock Test 01

Q1 ANSWER **A**

General Aptitude — antonyms in context — 1 mark — MCQ

Terse means using few words. Its opposite is *verbose*, using many.

- **(B) blunt** is the trap for a candidate who reads *terse* as "curt" and then picks a near-synonym instead of an antonym. Blunt and terse both describe plain speech.
- **(C) inaccurate** comes from confusing *terse* with *vague*. Terseness says nothing about correctness.
- **(D) reluctant** comes from reading brevity as unwillingness to speak, which is a motive, not a length.

Confidence: Pattern 90% | Exact-question 25%

Q2 ANSWER **B**

General Aptitude — subject-verb agreement with neither/nor — 1 mark — MCQ

With *neither ... nor*, the verb agrees with the nearer subject. The nearer subject is *the two engineers*, so the verb is plural: **were**. The second blank is a past-tense narrative clause parallel to *was able*, so **showed**.

- **(A)** applies the proximity rule to the far subject (*the technician*) instead of the near one.
- **(C)** makes both mistakes: wrong agreement and a tense shift to the present.
- **(D)** gets the agreement right but shifts the subordinate clause into the present.

Confidence: Pattern 90% | Exact-question 25%

Q3 ANSWER **B**

General Aptitude — percentage change and the moving base — 1 mark — MCQ

Let the original price be 100. After the 20% cut the price is 80. To return to 100 the increase is (100 - 80)/80 = 20/80 = 0.25, that is **25%**.

- **(A) 20%** assumes a percentage change is reversible by the same percentage. It is not, because the base changed from 100 to 80.
- **(C) 16.67%** is the answer to the mirror-image question (a 20% *rise* is undone by a 16.67% fall): it divides the 20 by 120 instead of by 80.
- **(D) 22.5%** is the average of 20 and 25, picked by a candidate who senses the answer is above 20 but does not do the division.

Confidence: Pattern 92% | Exact-question 30%

Q4 ANSWER **C**

General Aptitude — categorical syllogism and illicit conversion — 1 mark — MCQ

Calibrated meters form a subset of digital meters. The battery-powered ones form some other, unspecified subset of digital meters. The two subsets may overlap or may be disjoint, so nothing about their intersection is forced.

- **(A)** converts *some digital meters are battery powered* into a statement about the calibrated subset. "Some A are B" plus "all C are A" says nothing about C and B.
- **(B)** reverses the first premise, treating "all calibrated are digital" as if it were "all digital are calibrated".
- **(D)** is that same illicit conversion stated openly.

Confidence: Pattern 88% | Exact-question 22%

Q5 **ANSWER B**

General Aptitude — number series with a growing increment — 1 mark — MCQ

Each term is twice the previous term plus an increasing integer:
3x2+1 = 7, 7x2+2 = 16, 16x2+3 = 35, 35x2+4 = 74, so the next is 74x2+5 = **153**.

- **(A) 149** is 74x2+1: the added constant frozen at its first value instead of counting on to 5.
- **(C) 156** is 74x2+8: the added constant *doubled* from the 4 used at the previous step instead of advanced by one to 5.
- **(D) 163** is 74x2+15, where 15 = 1+2+3+4+5 is the running total of all the added constants. It is the answer of a candidate who accumulates the constants instead of using only the next one.

Confidence: Pattern 85% | Exact-question 20%

Q6 **ANSWER C**

General Aptitude — data interpretation, pooled versus averaged ratios — 2 marks — MCQ

Centre-wise attendance: P = 432/480 = 90.00%, Q = 442/520 = 85.00%, R = 322/350 = **92.00%**, S = 510/600 = 85.00%, T = 396/450 = 88.00%. The highest is R.

Overall = total present / total registered = 2102/2400 = **87.58%**.

- **(B) 88.00%** is the unweighted mean of the five centre percentages, (90+85+92+85+88)/5 = 88.00. Averaging ratios instead of pooling the raw counts is the single most common error in this question shape; the centres have different sizes, so the pooled figure is 87.58%, not 88.00%.
- **(A)** has the pooled 87.58% right but names P as the best centre. 432/480 = 90.00% is the first round figure in the table and a candidate who stops at it never divides 322/350 = 92.00%; the smallest centre wins here, which is exactly what makes it easy to skip.
- **(D)** picks the largest centre and quotes its own rate as the overall rate.

Confidence: Pattern 90% | Exact-question 25%

Q7 **ANSWER D**

General Aptitude — ages from two linear conditions — 2 marks — MCQ

Let the apprentice's present age be a and the technician's be t. The two statements give

```
t = 3a                  (at present)
t - 7 = 5(a - 7)        (seven years ago)
```

Substituting the first into the second, 3a - 7 = 5a - 35, so 2a = 28 and **a = 14**, hence **t = 42**. Check both conditions: 42 = 3 x 14, and seven years ago the ages were 35 and 7, with 35 = 5 x 7.

Seven years from now the two ages are 49 and 21, so their sum is **70 years**.

The step the question is built on is the second condition: *both* ages move back by seven, not just one. Writing t - 7 = 5a instead gives 3a - 7 = 5a and a negative age, which is the signal to go back and subtract the seven on both sides of the comparison.

Section 15 — The Last Fortnight

Formulas, conditions and traps. No derivations, no motivation, no worked examples. Every entry is a concept Section 9 ranked, with its counted question numbers so it can be checked. Sections run in counted-marks order — Networks 17.0, Engineering Mathematics 12.0, Analog 10.8, Communications 10.0, Digital 9.8, Electronic Devices 8.8, Control 8.0, Electromagnetics 7.4 — and inside each section the Tier 1 concepts come first.

Conventions, once: ω in rad/s and f in Hz; rms unless "peak" is written; log is base 10, ln natural, $\log_2$ where the unit is bits; passive sign convention; op-amps and sources ideal unless stated.

1. Networks, Signals and Systems — 17.0 marks a paper

Tier 1

Phasor analysis of an AC network — 5 of 5 (2010 Q33; 2019 Q40; 2020 Q26, Q38; 2025 Q20, Q39; 2026 Q39)

- Z_L = jωL, Z_C = 1/(jωC) = −j/(ωC). **Trap:** ω = 2πf. A 50 Hz source is ω = 314 rad/s, not 50.
- P_avg = V_rms I_rms cos θ, θ = ∠Z. **Trap:** cos θ is the impedance angle, not the phase of V or I alone.
- **Trap, and it is the recent one:** an ideal voltmeter or ammeter reads **rms**; a source written v(t) = V_m cos ωt is **peak**. V_rms = V_m/√2. The 2025 and 2026 questions are framed through meter readings.

z-transform: ROC, poles, zeros, causality, stability — 5 of 5 (2010 Q14, Q42; 2019 Q13; 2020 Q24, Q63; 2025 Q27; 2026 Q16)

- Right-sided → ROC |z| > |p|_max. Left-sided → |z| < |p|_min. Two-sided → an annulus.
- Causal **and** stable ⟺ all poles strictly inside the unit circle. Stable ⟺ ROC contains |z| = 1.
- **Trap:** the ROC never contains a pole. A finite-length sequence has the whole plane except possibly z = 0 or z = ∞.
- **Trap:** a pole–zero cancellation written into H(z) does not stabilise anything. One H(z), many ROCs — the question is which sequence, not which formula.

Two-port network — 5 of 5, exactly one per paper (2010 Q4; 2019 Q14; 2020 Q25; 2025 Q40; 2026 Q51)

- Reciprocal: $z_{12} = z_{21}$, $y_{12} = y_{21}$, AD − BC = 1, $\mathbf{h_{12} = -h_{21}}$.
- Symmetric: $z_{11} = z_{22}$, $y_{11} = y_{22}$, A = D.
- **Trap:** the h-parameter reciprocity carries a minus sign and the others do not.
- **Trap:** the parameter set rotates — y (2010), z (2020), Z (2025), ABCD (2026) — and 2019 named no set at all, stating reciprocity as excitation and response interchanged. Expect a two-port; do not assume a matrix.

LTI properties — 4 of 5 (2010 Q42; 2020 Q15; 2025 Q17, Q27; 2026 Q16, Q47)

- Linear ⟺ additive and homogeneous. $y = x^2$ is not; y = x + c is not unless c = 0; $y(t) = x(t)\cos \omega_0 t$ **is** linear and is not time-invariant.
- Causal ⟺ h(t) = 0 for t < 0. BIBO stable ⟺ $\int |h|\, dt < \infty$ ($\Sigma |h[n]| < \infty$).
- **Trap:** a cascade or parallel interconnection is LTI only if **every** block is. One nonlinearity anywhere kills it. This interconnection form appeared in 2025 and again in 2026.
- **Trap:** time scaling, y(t) = x(2t), is linear and time-**varying**.

Fourier series — 4 of 5 (2010 Q2; 2019 Q31; 2025 Q55; 2026 Q37)

- Half-wave symmetry, x(t) = −x(t ± T/2) → **even harmonics vanish**.
- Even symmetry → **sine terms vanish** ($b_n = 0$). Odd symmetry → cosine terms and a_0 vanish.

- **Trap:** swapping those two rules lands exactly on a printed distractor. Half-wave kills *harmonics*; even/odd kills *terms*.
- x(at): coefficients unchanged, period T/a, fundamental frequency ×a.

dc / resistive network analysis — 4 of 5 (2010 Q34; 2020 Q19; 2025 Q19; 2026 Q30)

- V_th = open-circuit voltage. R_th: deactivate independent sources (V → short, I → open).
- **Trap:** dependent sources are **never** deactivated. Apply a 1 V or 1 A test source and take the ratio.
- **Trap:** superposition applies to voltage and current, never to power.

Tier 2

Sampling (2010 Q43; 2025 Q38; 2026 Q15) — $f_s > 2f_{max}$. Alias sits at $|f - k f_s|$.
Trap: Nyquist *rate* = $2f_{max}$; Nyquist *frequency* = $f_s/2$. Squaring a signal doubles its bandwidth.

Frequency response at one frequency; all-pass (2010 Q18; 2019 Q13; 2020 Q24, Q59, Q63) — $y = |H(j\omega_0)| \cdot A \cdot \cos(\omega_0 t + \varphi + \angle H(j\omega_0))$. All-pass: $|H| = 1$ for all ω, poles and zeros mirrored about the jω axis (about the unit circle, discrete-time).
Trap: $|H| = 1$ does not mean no distortion — the phase is not flat.

Transients in RL/RC (2010 Q32; 2019 Q51; 2026 Q23) — $\tau = RC$ or L/R;
$x(t) = x(\infty) + [x(0^+) - x(\infty)]e^{-t/\tau}$.
Trap: v_C and i_L are continuous *unless* the switching creates a capacitor loop or an inductor cut-set; then conserve charge or flux, not the variable.

Convolution and interconnection (2010 Q15; 2020 Q15; 2026 Q13) — cascade $h_1 * h_2$, parallel $h_1 + h_2$. Lengths N and M convolve to $N + M - 1$.
Trap: linear convolution ≠ circular convolution; circular of length N aliases the tail back.

Laplace, and the final-value theorem (2010 Q31; 2019 Q15; 2026 Q13) — $\lim_{t\to\infty} f(t) = \lim_{s\to 0} sF(s)$.
Trap: valid only if every pole of sF(s) is in the open left half-plane. Applied to an oscillatory or unstable F(s) it returns a clean, wrong number.

DFT (2010 Q16; 2019 Q38; 2020 Q39) — $X[k] = \Sigma\, x[n]e^{-j2\pi kn/N}$, unnormalised forward.
Trap: a cosine gives exactly two non-zero bins, k_0 and $N - k_0$, **only** when N is an integer number of periods. Otherwise leakage puts energy in every bin.

Tier 3, one line each

- **Parseval / energy** (2020 Q62; 2026 Q43, Q46): $E = \int|x|^2dt = (1/2\pi)\int|X(j\omega)|^2d\omega$. **Trap:** the $1/2\pi$ is present in ω and absent in f. x(at) has energy $E/|a|$.
- **Resonance** (2010 Q5; 2026 Q31): $\omega_0 = 1/\sqrt{(LC)}$, $BW = \omega_0/Q$. Series $Q = \omega_0 L/R$; **parallel $Q = R/(\omega_0 L) = R\sqrt{(C/L)}$ — the reciprocal.** Trap:** using the series form on a parallel circuit.
- **DTFT existence** (2019 Q54; 2025 Q27): exists ⟺ $\Sigma|x[n]| < \infty$ ⟺ ROC contains the unit circle.
  Trap: a z-transform can exist where the DTFT does not.

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2. Engineering Mathematics — 12.0 marks a paper

Tier 1

Multiple integrals — 4 of 5 (2019 Q29; 2020 Q61; 2025 Q49; 2026 Q61)

- Polar $dA = \mathbf{r}\, dr\, d\theta$. Cylindrical $\mathbf{r}\, dr\, d\theta\, dz$. Spherical $\boldsymbol{\rho^2 \sin\varphi}\, d\rho\, d\varphi\, d\theta$.
- Change of variables: multiply by $|J| = |\partial(x,y)/\partial(u,v)|$.

Section 16 — Sources, and How to Check This Book

Every number in this book is a count of a document you can download. This section lists those documents, gives the address each one came from and the date it was fetched, states plainly the one place where the sourcing is weaker than the rest, and sets out the procedure for checking any single claim in the book against the paper it came from.

A claim nobody checks is a claim nobody should trust. This section exists so that checking is a ten-minute job rather than a research project.

16.1 The official documents (FACT)

> ***FACT.*** *Every file listed below was downloaded from a GATE organising-institute host — `*.iit*.ac.in` or `*.iisc.ac.in`. No coaching site, aggregator, blog or question repository was used, with the single exception stated in 16.3.*

Where a year's own organising institute still publishes its paper, that host is used. Where it does not — and for several years it does not, because the sites are gone — the file is taken from the official GATE archive that the current organising institute maintains. The same archive is served from three official hosts:

- `https://gate2026.iitg.ac.in/download.html` (IIT Guwahati)
- `https://gate2025.iitr.ac.in/download.html` (IIT Roorkee)
- `https://gate2027.iitm.ac.in/download` (IIT Madras)

They carry the same files. If a link in the tables below has moved by the time you read this, try the same path on one of the other two hosts before concluding the document is gone.

The syllabus documents

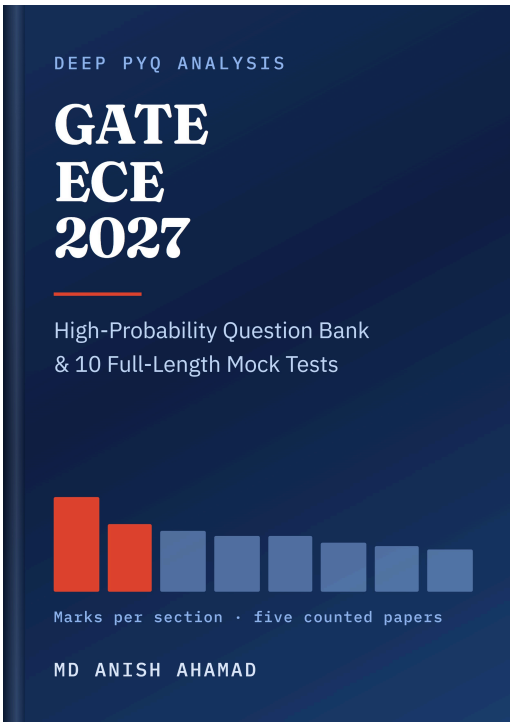
Document	Institute and host	Retrieved	Bytes
GATE 2027 EC syllabus (PDF)	IIT Madras, `gate2027.iitm.ac.in`	23 September 2026	148,208
GATE 2026 EC syllabus (PDF)	IIT Guwahati, `gate2026.iitg.ac.in`	23 September 2026	542,326

These two documents are the entire basis of Section 2's change list. The 2027 file is the syllabus
GATE 2027 will be set from; the 2026 file is the one it replaced, and the comparison between them is word-by-word from these PDFs and nothing else.

One honesty note about this row, because it is the one gap in the chain: the two syllabus PDFs were fetched from the two institute hosts named above, but the **exact document path within each host was not written down in the source log at the time of download**, only the host and the institute. The files themselves are the official ones and their byte counts are printed above so that a downloaded copy can be compared against them; but this book cannot print a direct link for these two documents the way it can for every paper below, and it will not invent one. Both hosts publish the EC syllabus from their front page under "Syllabus".

The counted years — question papers and answer keys

These are the five papers the book's numbers are built from.



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