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# Bits & Bytes

# GATE

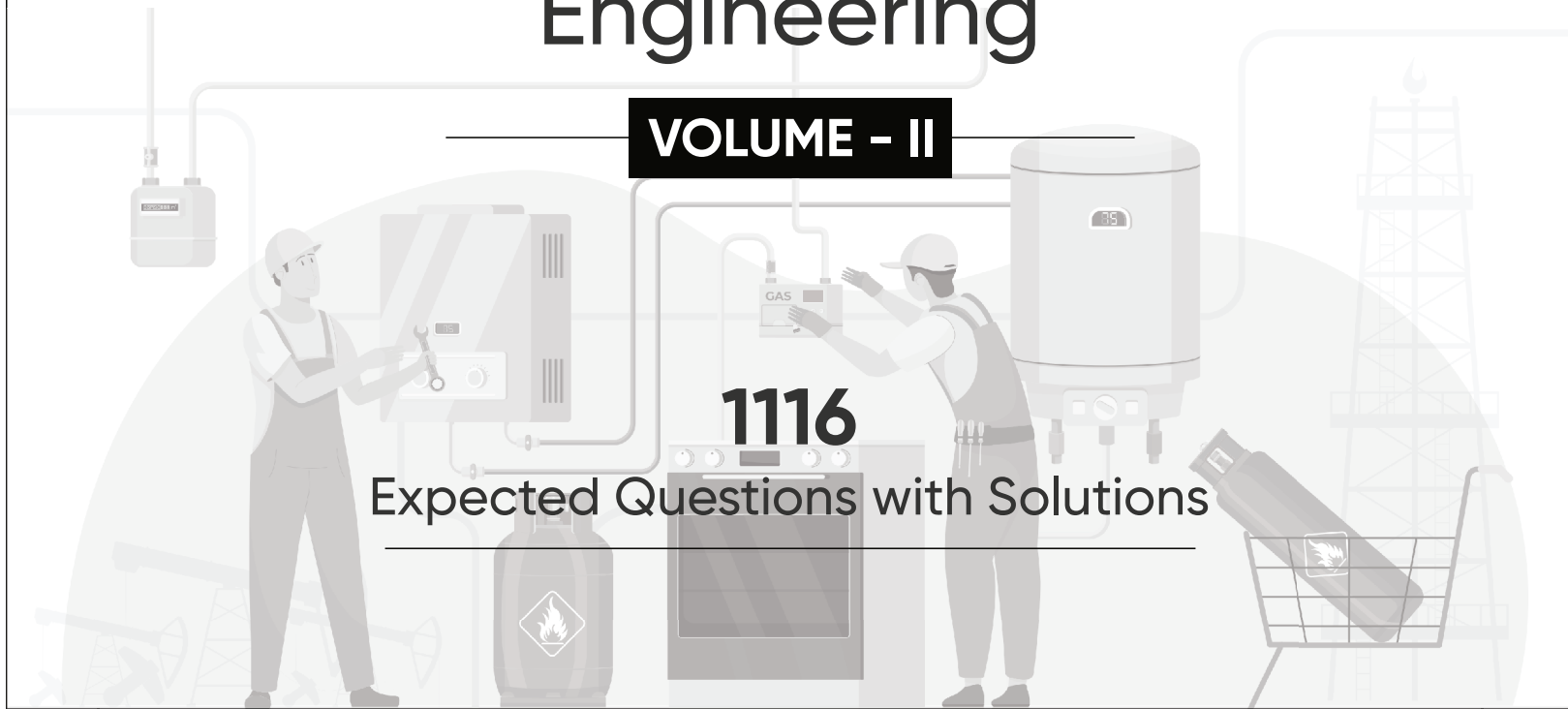
## Practice Booklet

## Instrumentation Engineering

**VOLUME - II**

**1116**

Expected Questions with Solutions



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# Foreword

Dear Students,

Solutions of all previous GATE Questions are already available. Every year about 20% of questions will have repetitive nature. However, rest of the questions are from untapped areas (never asked areas) and few from Previous Engineering Services & Civil Services Questions. Keeping this in view, possible questions are prepared in various subjects (chapter wise) along with their hints/solutions. The student is advised to practice the questions systematically so that their chances of getting high score in GATE Exam will increase.



The student is advised to solve the problems without referring to the solutions. The student has to analyze the given question carefully, identify the concept on which the question is framed, recall the relevant equations, find out the desired answer, verify the answer with the final key such as (a), (b), (c), (d), then go through the hints to clarify his answer. This will help to face numerical answer questions better. The student is advised to have a standard text book ready for reference to strengthen the related concepts, if necessary. The student is advised not to write the solution steps in the space around the question. By doing so, he loses an opportunity of effective revision.

As observed in the GATE Exam, number of sets may be possible, being online exams. Hence, don't skip any subject. All are equally important.

It is believed that this book is a Valuable aid to the students appearing for competitive exams like IES, ISRO and Other PSU's. This book can also be used by fresh Teachers in Engineering in improving their Concepts.

With best wishes to all those who wish to go through the following pages.

**Y.V. Gopala Krishna Murthy,  
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Chairman & Managing Director,  
ACE Engineering Academy,  
ACE Engineering Publications,  
Frost Interactive Service Pvt. Ltd. (ACE ONLINE).**

# Syllabus for Instrumentation Engineering

## Measurements

SI units, standards (R, L, C, voltage, current and frequency), systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression. Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C and frequency, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

## Process Control

Mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feedforward, and ratio controllers, tuning of PID controllers and sizing of control valves.

## Sensors & Industrial Instrumentation

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4-20 mA two-wire transmitter.

## Optical Instrumentation

Optical sources and detectors: LED, laser, photo-diode, light dependent resistor, square law detectors and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing. UV-VIS Spectro photometers, Mass spectrometer.

## Communication

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, quadrature amplitude, pulse shift keying for digital modulation;

## Engineering Mathematics

**Linear Algebra:** Matrix algebra, systems of linear equations, consistency and rank, Eigenvalue and Eigenvectors.

**Calculus:** Mean value theorems, theorems of integral calculus, partial derivatives, maxima and minima, multiple integrals, Fourier series, vector identities, line, surface and volume integrals, Stokes, Gauss and Green's theorems.

**Differential Equations:** First order equation (linear and nonlinear), second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, solution of partial differential equations: variable separable method.

**Analysis of Complex Variables:** Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, residue theorem, solution of integrals.

**Probability and Statistics:** Sampling theorems, conditional probability, mean, median, mode, standard deviation and variance; random variables: discrete and continuous distributions: normal, Poisson and binomial distributions.

**Numerical Methods:** Matrix inversion, solutions of non-linear algebraic equations, iterative methods for solving differential equations, numerical integration, regression and correlation analysis.

## 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.

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