Jadavpur University
Instrumentation and Electronics Engg.

Syllabus for Ph.D. Entrance Examination

Paper II : Instrumentation and Electronics Engineering

Fundamental of instrumentation:
SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision, repeatability and reproducibility, propagation of errors.

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, pressure, flow (differential pressure, 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 measurement.

Signals and Systems:
Laplace, Fourier and z - transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

Control Systems:
Feedback principles, signal flow graphs, transient and steady state response analysis, Bode plot, phase and gain margins, Stability analysis using Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of system, on-off, P, P-I, P-I-D control , Control valves.

Analog Electronics:
Characteristics of operational amplifiers; applications of opamps: difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, precision rectifier, active filters.
Oscillators, signal generators

Digital Electronics:
Combinational logic circuits, minimization of Boolean functions.
Arithmetic circuits, comparators, Schmitt trigger.
Sequential circuits, flip-flops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder); Basics of number systems, 8-bit microprocessor and microcontroller (Intel 8085 and 8051): applications, memory and input-output interfacing; basics of data acquisition systems.

Reference Books:

1. Kuo, B.C, and Golnaragh, F., Automatic Control Systems, Wiley
2. D. Roy Choudhury, Modern Control Engineering, Prentice-Hall Inc., 2005.
3. M. Gopal, Control Systems: Principles and Design, Tata McGraw Hill 3rd Edn, 2008.
4. Joseph J. Distefano, Allen J. Stubberud, and I. J. Williams. 1997. Schaum's Outline of Feedback and Control Systems (2nd ed.). McGraw-Hill Professional.
5. Taub, H. and Schilling, D., Digital Integrated Citcuits, Mc Graw Hill
6. Coughlin, R.F., and Driscoll, F.F., Operational Amplifiers and Linear Integrated Circuits, Pearson
7. Manolakis, D. G., and Proakis, J. G., Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall.
8. Patranabis, D., Principles of Industrial Instrumentation, Tata McGraw Hill
9. Patranabis, D. Principles of Process Control, Tata McGraw Hill
10. D. V. S. Murthy, Transducers and Instrumentation, Prentice-Hall Inc. (2nd ed.), 2010.
11. A. K. Ghosh, Introduction to Measurements and Instrumentation, Prentice-Hall Inc. (4th ed.), 2012.
12. E. O. Doebelin, Measurement Systems: Application and Design, McGraw Hill (4th ed.), 1990.

J. P. Bentley, Principle of Measurement

Syllabus of research methodology

1. Research Ethics and Codes of Practice: Types of Ethical Issues; Plagiarism-Definition and names of popular tools.
2. Matrix algebra, systems of linear equations, Eigen values and Eigen vectors
3. Calculus: Mean value theorem, maxima and minima,
4. Fourier series and Fourier Transform
5. Differential equations: First order equation (linear)
6. Statistics: Analysis of central tendency. Mean, median, mode, standard deviation; Probability, Sampling distribution; Estimation, Hypothesis testing & application; Correlation & regression analysis; Hypothesis testing; Test of Significance, ‘p’-value, ‘t’ test, chi-square test
7. Design of experiments – Methodology selection; Data collection and quantitative analysis of patterns- Orthogonal array, ANOVA.
8. Numerical methods –
   a) Solution of algebraic equations: Newton Raphson method, Bisection method
   b) Interpolation methods: Newton’s forward and backward difference formulae.
   c) Numerical integration: Numerical integration using Trapezoidal, Simpson’s 1/3 rule
   d) Fourth order Runge-Kutta method for solving first order equations

Reference Books:

13. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
14. B. V. Ramana, Higher Engineering Mathematics, Tata Mc Graw-Hill Publishing Company Ltd.

15. R.K.Jain & S.R.K. Iyengar, Advance Engineering Mathematics, Narosa Publishing House.
16. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
17. Montgomary, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India).
18. Montgomary, Douglas C. & Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India).
19. Roig, M. Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing, (2006).
20. Vaughan, L. Statistical methods for the information professional: A practical, painless approach to understanding, using and interpreting statistics (Ed. 2), (2004) Information Today, Medord.
21. J.B.Scarborough: Numerical Mathematical Analysis.