Syllabus for M.S./ Ph.D. Written Tests in EE at IIT Tirupati, 2018

I. Common areas of test **Marks: 30**

1. Signals & Systems (Classification of Signals & Systems and their properties, Fourier series, Fourier Transform, Laplace Transform, LCCDE)
2. Basic Electronics (Diodes, Transistors, OP-AMPs, Digital Electronics, Flip flops)
3. Electrical Circuits (RLC circuits, Transient Analysis, First order and Second order circuits, AC Circuits, Application of Laplace Transform)
4. Basic Mathematics (Linear Algebra, Calculus, Plotting functions, Finding Maxima & Minima, Probability)

II. Specific areas **Marks: 70**

Stream 1: Signal & Image Processing, Computer Vision & Machine Learning, Medical Image Analysis

1. **Signals and Systems & Signal Processing:** Continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT: Definitions and properties of Laplace transform, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Deterministic & Random (a-periodic & Periodic) Signal transmission through LTI systems. FIR & IIR Filter design. Basics of Multi-rate signal processing.
2. **Linear Algebra, Probability & Random Variables** : Matrix Algebra, Systems of linear equations, Eigen values and Eigen vectors; Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Normal and Binomial distribution, Correlation and Independence, Transformation of random variables.

[1] A. V. Oppenheim, R. W. Schafer and J. R. Buck, Discrete Signal Processing, Prentice-Hall Inc., 2009.
[2] A. V. Oppenheim and A. S. Willsky, Signals and Systems, Pearson Education, 2013.
[3] K. Hoffman and R. Kunze, Linear Algebra, Prentice-Hall Inc., 2005.
[4] R. Sheldon, A first course in probability. Pearson Education India, 2002.

Stream 2: Microelectronics

Crystals and Electronic grade materials; Formation of energy bands in solids; Concept of holes, Density of states and Fermi level; Intrinsic and extrinsic semiconductors; Equilibrium carrier concentration; Direct and indirect semiconductors; Recombination and generation of carriers, carrier transport; Drift and Diffusion; Equations of state; Continuity and Poisson equation; generation-recombination mechanism; pn junction; energy band diagram, static and dynamic characteristics; physics and characteristics of MOS capacitors; MOSFET-physics, characteristics and modelling; Hetero junctions; light-matter interactions; photo detectors; solar cells.

Stream 3: Control & Robotics

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady -state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis in Time and Frequency domain, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space models, State transition matrix; Linear Systems, Eigen values/vectors, basics of non-linear systems and Lyapunov Analysis.

Stream 4: Communication and Networking

Probability: Axioms of probability, conditional probability, independence, Baye's rule, random variables, distribution functions, expectation and variance, multivariate normal distributions, transformations of random variables, sum of random variables, Chebychev's inequality, law of large Numbers, central limit theorem.

Signals and Systems: Continuous and discrete time signals, signal energy and power, periodicity, even and odd signals, unit impulse and unit step signals, properties of systems (linearity, time-invariance, causality, stability, invertibility), LTI systems, convolution, Fourier Series and Fourier Transforms, Parseval's identity.

Communication Systems: Baseband and passband signals, up-conversion and down-conversion, sampling theorem, signal constellations (QAM, PSK, QPSK, PAM, etc), Jointly Gaussian random variables, probability of error, SNR, ML and MAP rules.

References:
[1] R. Sheldon, A first course in probability. Pearson Education India, 2002.
[2] A. V. Oppenheim and A. S. Willsky, Signals and Systems, Pearson Education, 2013.
[3] U. Madhow, Introduction to Communication Systems, Cambridge University Press, 2014.

Stream 5: Measurements & Instrumentation
Analog and digital circuits :- BJT and FET's, filters, amplifiers, log amplifiers, AD/DA converters. Principles of electric and magnetic measurements.

Reference books:

1. M. Mano, Digital Design, 3rd Ed, Prentice-Hall, 2001
2. Cooper, H., and Albert D. Helfrick. Modern Electronic Instrumentation and Measurement Techniques, 2005.
3. Northrop, Robert B. Introduction to Instrumentation and Measurements. CRC Press, 2005.
4. Franco, Sergio. Design with Operational Amplifiers and Analog Integrated Circuits. McGraw-Hill, 2001.
5. Sedra and Smith, Micro Electronic Circuits, 7th edition, Oxford, 2017.