Stream wise syllabus for Recruitment Exam for the Post of Scientific Assistant

# (Electronics and Communication)

## 1. Engineering Mathematics

**Linear Algebra**: Matrix Algebra, Systems of linear equations, Eigen values and Eigen vectors.

**Calculus**: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and Minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Strokes, Gauss and Green's theorems.

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

**Complex variables**: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent' series, Residue theorems, solution integrals

**Probability & statistics**: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distributions, Correlation and regression analysis.

**Numerical Methods**: Solutions of non-linear algebraic equations, single and multi-step methods for differential equations.

**Transform Theory**: Fourier transform, Laplace transform, Z-transform.

## 2. Electronics and Communication

**Electronics Devices**: Energy band in silicon, intrinsic and extrinsic semiconductors. Carrier transport in semiconductors, diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers, p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-i-n and avalanche photo diode, basics of LASERs, Device technology, integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

**Analog Circuits**: Small Signal Equivalent circuit of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifier. Amplifiers: single-and-multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters,

Sinusoidal oscillators, criterion for oscillation, single transistor and op-amp configurations. Function generators and wave-shaping circuits, 555 Timers. Power supplies.

**Digital Circuits**: Boolean algebra, minimization of Boolean functions, logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits: arithmetic circuits, code converters, multiplexers, decoders. ROM, PROMS, Sequential circuits, latches and flipflops, counters and shift registers, Sample and hold circuits, ADCs, DACs, Semiconductor memories.

**Signals and Systems**: Definitions and properties of Laplace transform continuous-time and discrete-time Fourier series. Continuous-time and discrete-time Fourier transform, DFT and FFT, z-transform, Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeroes, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

**Communications**: Random signals and noise; probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem.

**Digital Communication Systems**: pulse code modulation (PCM), Differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matches filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA, CDMA and GSM. Wireless Communication.

**Control Systems**: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems, transient and study state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis, root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integra-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

**Electromagnetics**: Elements of vector calculus; divergence and curl: Gauss and Stokes theorems, Maxwell's equations: differential and integral forms. Wave equations, Poynting vector. Plane wave: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristics and impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides : modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relation. Basics of propagation in dielectric waveguide and optical fibres. Basics of Antennas: Dipole antennas: radiation pattern; antenna gain.

**Networks**: Network graphs: Matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solutions methods: nodal and mesh analysis. Network theorems: superposition, Thevenin's and Norton's maximum power transfer, Star-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits. Solution of Network equations using Laplace transform, frequency domain analysis of RLC circuits, 2-port network parameters; driving point and transfer functions. State equations for networks.

**Microprocessors & Micro controllers**: Introduction to microprocessors and microcomputers: Function, architecture, programming of 8086 microprocessor , interfacing of RAM and EPROM, I/O addressing, I/O mapped I/O, and memory mapped I/O schemes, instruction execution, fetch/execute cycle, instruction timings and operation status.

Memory organization, program memory, data memory, direct & indirect addressing area, addressing modes, instruction set – arithmetic, logical and data transfer instructions. Machine cycles – interrupts, interrupt handling, single step operation, port bit latches and buffers, port structures and operation, accessing external memory. Timers, serial interface, I/O ports, timing,

Microcontroller 8051 – Architecture, configurations, internal block schematic, program protection modes. I/O interfaces with microcontroller, Real Time Control Issues, Embedded

Processing – Evolution, Issues and Challenges, Von Neumann, Harvard and their variants, Memory Architecture and Devices, Input, Output Devices and Mechanisms, PLA, PAL,PLDs.

**Computer Architecture And Organization**: Basics of Digital Electronics, Register Transfer and Micro operations, Basic Computer Organization, Control Unit, Central Processing Unit, Computer Arithmetic, Input-Output Organization, Memory Unit, Introduction to Parallel Processing