| EI | Electronics & Instrumentation Engineering Syllabus for QT-RA |
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**Electrical Circuits:**

Voltage and current sources: independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductor and capacitor; transient analysis of RLC circuits with dc excitation.

Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems. Peak, average and rms values of ac quantities; apparent – active and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance. One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

**Analog circuits:**

Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits: clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multi-stage, , feedback, and power amplifiers. Frequency response of amplifiers.

Simple op-amp circuits: Precision rectifiers, Peak detectors, Logarithmic amplifiers, Filters. Sinusoidal oscillators. Function generators, 555 Timer & its applications, PLL(565) and its applications, Power supplies with 3 terminal regulators for positive & Negative voltages.

**Digital circuits:**

Boolean algebra, minimization of Boolean functions(K map, Q-M & MEV techniques); logic GATEs; digital IC families (TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, de-multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, DACs, ADCs(successive approximation, Dual slope, Flash, Sigma-Delta). Semiconductor memories (ROM, EPROM, EEPROM, RAM, Static & Dynamic memories)

**Sensors**

Classification, Characteristics and choice of transducers, Operating principles. 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 (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 and viscosity measurement.

**Control System**

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady -state analysis of LTI systems;

Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time -delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on -off, P, P-I, P-I-D, cascade, feedforward, and ratio controllers.

**Digital Signal processing:**

Basic operations on signals, Classification of signals, Classification of systems, Time domain representation of LTI systems. Fourier representation of signals , Z – transform representation of signals . Analysis of discrete time LTI systems : Z transform , Convolution , Correlation.

Basic elements of DSP system, concepts of frequency in Analog and Digital Signals, sampling theorem, Introduction to DFT, Properties of DFT, Circular Convolution , Filtering methods based on DFT, FFT Algorithms, DCT, Application of DCT.IIR and FIR filters

**Bio medical Instrumentation:**

Bio electric potentials, origin and propagation, ECG, EEG and EMG , Electrodes and Recording Instruments. **Thrapeutic Instruments -**Cardiac Pacemakers, Defibrillators, Diathermic Instruments, Lasers and their applications in medicine. **Medical Imaging Systems-**Imaging modalities, X-ray imaging machine, Ultrasonic imaging systems, MRI equipment. **Bio Telemetry**-Components of biotelemetry, single channel biotelemetry system, Telemedicine **Patient Safety -**Electric shock hazards, Micro shock & Macro shock, Leakage currents.