ELECTRONICS

Digital Electronics:

1. Introduction to number systems, Logic gates OR, AND, NOT, XOR, NAND, NOR gates-Truth tables-Positive and negative logic-Logic families and their characteristics-RTL, DTL, ECL, TTL and CMOS.-Universal building blocks NAND and NOR gates. Laws of Boolean algebra De Morgan's Theorems-Boolean identities-Simplification of Boolean expressions-Karnaugh Maps- Sum of Products (SOP) and Product of sums (POS).

2. Combinational and Sequential Circuits: Multiplexer and De-Multiplexer-Decoder, Half adder, Full adder and Parallel adder circuits. Flip flops-Rs, D, JK and JK Maser-Slave (working and truth tables) – Registers, Shift registers, Serial in Serial out, Serial in –parallel out, Parallel in-Serial out and Parallel in Parallel out registers, -Synchronous and asynchronous binary counters, Up/Down counters-Decade counter(7490)-working, truth tables and timing diagrams. Semiconductor memories-RAM, ROM, PROM, EPROM, EEPROM.

3. Digital Communication:

Fourier transforms, Properties of Fourier Transform, Sampling theorem, random signals and noise, correlation and power spectrum. Analog to digital converter, digital to analog converters, amplitude modulation, pulse width modulation. Pulse code modulation, pulse phase modulation, delta modulation, adaptive delta modulation, amplitude shift keying, frequency shift keying, phase shift keying, quadrature amplitude modulation. Parity check, Hamming distance, Hamming codes, cyclic codes, Manchester code, Walsh code, NRZ coding. Paging System, global positioning system, cellular telephone, Facsimile and videotext.

Circuit Analysis and Electronic Devices:

1. AC Fundamentals: The sine wave-Average and RMS values, the Operator J, Phasor diagram-Phasor representation of sinusoidal currents and voltages, Complex impedance and admittance, Polar and rectangular forms of complex numbers, Circuit analysis using complex number representation. **2. Passive networks:** Concept of voltage and current sources-Kirchoffs Voltage Law(KVL) and Kirchoff's Current Law (KCL)-Applications to simple networks consisting of resistors with AC and DC sources-Solution of networks using node and mesh analysis**. 3. Network theorems (DC and AC):** Superposition Theorem-Thevenin's Theorem-Norton's Theorem-Maximun power transfer Theorem-Milliman's Theorem-Reciprocity Theorem-Applications to simple networks. **4. Cathode Ray Oscilloscope:** Cathode Ray Tube (CRT) and its working, electron gun, focusing, deflection sensitivity, fluorescent screen. **5. RC an RL Circuits:** Transient response of RL and RC circuits with step input-time constants. Frequency response of RC and RL Circuits- Types of Filters: Low pass filter-High pass filter-Frequency response-Passive differentiating and integrating circuits. **6. Resonance:** Series resonance and parallel resonance RLC Circuits-Resonant Frequency- Q factor-Band width-Selectivity. **7. PN Junction:** Depletion region-Junction capacitance- Diode equation (no derivation) – Effect of temperature on reverse saturation current-V-I Characteristics and simple applications of (i)junction diode (ii) Zener diode (iii) Tunnel diode and (iv) Varactor diode. **8. Bipolar Junction Transistor (BJT):** PNP and NPN transistors-current components in B**J**T-B**J**T static characteristics(Input and Output)-Early effect-CB, CC, CE configurations (cutoff, active, and saturation regions) CE configuration as two port network-h-parameters-h-parameter equivalent circuit. Determination of h-parameters from the characteristics. Load line analysis. Transistor Biasing-Fixed and self bias. **9. Field Effect Transistor (FET):** Construction and working of JFET and MOSFET- output and transfer characteristics-Determination of FET Parameters. Application of FET as voltage variable resistor and MOSFET as a switch-Advantages of FET over BJT. **10.**

Uni Junction Transistor (UJT): Construction and working of UJT – Characteristics. Application of UJT as a relaxation oscillator. **11. Sillicon Controlled Rectifier (SCR):** Construction and working of SCR. Two transistor representation, Characteristics of SCR. Application of SCR for power control. **12. Photo Electronic Devices:** Construction and characteristics of Light Dependent Resistor (LDR), Photo voltaic cell, Photo diode, Photo transistor and Light Emitting Diode (LED).

Analog Circuits and Communications:

1. Power Supplies: Rectifiers-Halfwave, fullwave and bridge rectifiers-Efficiency-Ripple factor-Regulation – Harmonic components in rectified output – Types of filters- Choke input (inductor) filter- Shunt capacitor filter-L section and π section filters- Block diagram of regulated power supply – Series and shunt regulated power supplies – Three terminal regulators (78XX and 79XX) – Principle and working of switch mode power supply (SMPS). **2. RC Coupled Amplifier:** Analysis and frequency response of single stage RC coupled CE amplifier. **3. Feedback:** Positive and negative feedback – Effect of feedback on gain, band width, noise, input and output impedances. **4. Operational Amplifiers:** Differential amplifier Block diagram of Op-Amp-Ideal characteristics of Op-Amp- Op- Amp parameters- Input resistance- Output resistance- Common mode rejection ratio (CMMR)-Slew rate- Offset voltages-Input bias current-Basic Op-Amp circuits- Inverting Op-Amp- Virtual ground-Non-inverting Op-Amp-Frequency response of Op-Amp. Interpretation of Op-Amp data Sheets. **5. Applications of Op-Amps:** Summing amplifier-subtractor- Voltage follower- Integrator-Differentiator – Comparator- Logarithmic amplifier- Sine wave [Wein Bridge] and square wave [Astable] generators- Triangular wave generator- Monostable multivibrator- Solving simple second order differential equation. Basic Op-Amp series regulator and shunt regulator – IC 555 Timer [Block diagram and its working] – IC 555 as monostable and astable multivibrators. **6. Communications:** Need for modulation-Types of modulation-Amplitude, Frequency and Phase modulation. Amplitude modulation-side bands-modulation index- square law diode modulator- Demodulation- diode detector. Frequency modulation working of simple frequency modulator- Ratio detection of FM waves- Advantages of frequency modulation. AM and FM radio receivers [block diagram approach].

Instrumentation Engineering

Electricity and Magnetism

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations

Electrical Circuits and Machines

Voltage and current sources: independent, dependent, ideal and practical; V-I relationships of resistor, inductor, mutual inductance and capacitor; transient analysis of RLC circuits with DC excitation

Kirchoff's laws, Mesh and Nodal analysis, Superposition, Thevenin's Norton's, 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, Locus diagrams, Realization of basic filters with R, L and C elements. transient analysis of RLC circuits with AC excitation.

One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

Single phase transformer: Equivalent circuit, Phasor diagram, Open circuit and Short circuit tests, Regulation and efficiency; Three phase induction motors: Principle of operation, Types, performance, Torque-speed characteristics,No-load and blocked rotor tests, Equivalent circuit, Starting and speed control; Types of losses and efficiency calculations of electric machines.

Transducers, Mechanical Measurement and Industrial Instrumentation: Resistive, Capacitive, Inductive and Piezoelectric Transducers, Hall effect sensors and their Signal Conditioning. Measurement of Displacement, Velocity and Acceleration (Translational and Rotational), Force, Torque, Vibration and Shock. Measurement of Pressure, Flow, Temperature and Liquid Level. Measurement of Ph, Conductivity, Viscosity and Humidity.

Analog Electronics: Characteristics of Diode, BJT, JFET and MOSFET. Diode Circuits. Transistors at Low and High Frequencies, Amplifiers: Single and Multi-Stage, Feedback Amplifiers. Operational Amplifiers, Characteristics and Circuit Configurations. Instrumentation Amplifier. Precision Rectifier. V-To-I and I-To-V Converter. OP-Amp Based Active Filters. Oscillators and Signal Generators.

Digital Electronics: Combinational Logic Circuits, Minimization of Boolean Functions, IC Families, TTL, MOS and CMOS. Arithmetic Circuits. Comparators, Schmitt Trigger, Timers and Mono-Stable Multi- Vibrator, Sequential Circuits, Flip-Flops, Counters, Shift Registers. Multiplexer, S/H Circuit. Analog to-Digital and Digital- to-Analog Converters. Basics of Number System. Microprocessor Applications, Memory and Input-Output Interfacing, Microcontrollers.

Signals, Systems and Communications: Periodic and Aperiodic Signals, Impulse Response, Transfer Function and Frequency Response of First- and Second Order Systems, Fourier Transform, Laplace Transform, Sampling Theorem, Z-Transform, Convolution, Correlation and Characteristics of Linear Time Invariant Systems. Discrete Time System, Impulse and Frequency Response. Pulse Transfer Function, Ideal filters: LPF, HPF, BPF, BSF, Amplitude and Frequency Modulation and Demodulation. Pulse Code Modulation. Frequency and Time Division Multiplexing. Amplitude Shift Keying, Frequency Shift Keying and Phase Shift Keying for Digital Modulation.

Electrical and Electronic Measurements: Static and Dynamic Characteristics of Measurement Systems. Error and Uncertainty Analysis, Bridges and Potentiometers, Measurement of R, L and C. Measurements of Voltage, Current, Power, Power Factor and Energy. AC & DC Current Probes. Extension of Instrument Ranges. Q-Meter and Waveform Analyzer. Digital Voltmeter and Multi-Meter. Time, Phase and Frequency Measurements. Cathode Ray Oscilloscope. Serial and Parallel Communication. Shielding and Grounding.

Control Systems and Process Control: Feedback Principles. Signal Flow Graphs. Transient Response, Steady-State-Errors. Stability analysis using Routh and Nyquist Criteria. Bode Plot, Root Loci. Time DelaySystems. Phase and Gain Margin. State Space Representation of Systems. Mechanical, Hydraulic and Pneumatic System Components. Synchro Pair, Servo and Step Motors. on-off, Cascade, P, PI, PID, Feed Forward and Derivative Controller, Fuzzy Controllers.

Analytical, Optical and Biomedical Instrumentation: Mass Spectrometry. UV, Visible and IR Spectrometry. X-Ray and Nuclear Radiation Measurements. Optical Sources and Detectors, LED, Laser, Photo- Diode, Photo-Resistor and their Characteristics. Interferometers, Applications in Metrology. Basics of Fiber Optics. Biomedical Instruments, EEG, ECG and EMG. Ultrasonic Transducers and Ultrasonography. Principles of Computerized Tomography (CT) & Generations of CT.

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