ELECTRICAL ENGINEERING

PAPER-I

1. **Circuits—Theory :**
   - **Circuit components; network graphs; KCL, KVL;**
   - **Circuit analysis methods : nodal analysis, mesh analysis; basic network theorems and applications; transient analysis : RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits; coupled circuits; balanced 3-phase circuits. Two-port networks.**
2. **Signals and Systems :**
   - Representation of continuous-time and discrete-time signals and systems; LTI systems; convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations.
   - Fourier transform, Laplace transform, Z-transform, Transfer function.
   - Sampling and recovery of signals DFT, FFT Processing of analog signals through discrete-time systems.
3. **E.M. Theory :**
   - **Maxwell's equations, wave propagation in bounded media. Boundary conditions, reflection and refraction of plane waves.**
   - **Transmission lines : travelling and standing waves, impedance matching, Smith chart.**
4. **Analog Electronics :**
   - **Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET.**
   - **Diode circuits : Clipping, clamping, rectifier. Biasing and bias stability. FET amplifiers. Current mirror;**
   - **Amplifiers : single and multi-stage, differential, operational feedback and power. Analysis of amplifiers; frequency-response of amplifiers. OPAMP circuits. Filters;**
   - **Sinusoidal oscillators : criterion for oscillation;**
   - **single-transistor and OPAMP configurations.**
   - **Function generators and wave-shaping circuits. Linear and switching power supplies.**

5. **Digital Electronics :**
    - **Boolean algebra; minimisation of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS).**
    - **Combinational circuits : arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits: latches and flip-flops, counters and shift-registers.**
    - **Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs.**
    - **Semiconductor memories.**
    - **Logic implementation using programmable devices (ROM, PLA, FPGA).**

6. **Energy Conversion :**
    - **Principles of electromechanical energy conversion : Torque and emf in rotating machines.**
    - **DC machines : characteristics and performance analysis; starting and speed control of motors.**
    - **Transformers : principles of operation and analysis; regulation, efficiency; 3-phase transformers. 3-phase induction machines and synchronous machines : characteristics and performance analysis; speed control.**
7. **Power Electronics and Electric Drives :**
    - **Semi-conductor power devices : diode, transistor, thyristor, triac, GTO and MOSFET-static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters : fully-controlled and half-controlled; principles of thyristor choppers and inverters; DC-DC converters; Switch mode inverter; basic concepts of speed control of dc and ac motor drives applications of variable-speed drives.**

8. **Analog Communication :**
    - **Random variables : continuous, discrete; probability, probability functions. Statistical averages; probability models;**
    - **Random signals and noise : white noise, noise equivalent bandwidth; signal transmission with noise; signal to noise ratio.**
    - **Linear CW modulation : Amplitude modulation : DSB, DSB-SC and SSB. Modulators and Demodulators;**
    - **Phase and Frequency modulation : PM & FM signals; narrows band FM; generation & detection of FM and PM, Deemphasis, Preemphasis.**
    - **CW modulation system : Superhetrodyne receivers, AM receivers, communication receivers, FM receivers, phase locked loop, SSB receiver Signal to noise ratio calculation or AM and FM receivers.**

PAPER II

1. **Control Systems :**
    - **Elements of control systems; block-diagram representations; open-loop & closed-loop systems; principles and applications of feed-back. Control system components.**
    - **LTI systems : time-domain and transform-domain analysis.**
    - **Stability : Routh Hurwitz criterion, root-loci, Bode-plots and polor plots, Nyquist's criterion; Design of lead-lad compensators. Proportional, PI, PID controllers. State-variable representation and analysis of control systems.**
2. **Microprocessors and Microcomputers** : PC organisation; CPU, instruction set, register settiming diagram, programming, interrupts, memory interfacing, I/O interfacing, programmable peripheral devices.

3. **Measurement and Instrumentation :**
    - Error analysis; measurement of current voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurements.
    - Signal conditioning circuit; Electronic measuring instruments : multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyser, distoration-meter.
    - **Transducers :** thermocouple, thermistor, LVDT, strain-guage, piezo-electric crystal.
4. **Power System**s:
    - **Analysis and Control :** Steady-state performance of overhead transmission lines and cables; principles of active and reactive power transfer and distribution; per-unit quantities; bus admittance and impedance matrices; load flow; voltage control and power factor correction; economic operation; symmetrical components, analysis of symmetrical and unsymmetrical faults.
    - **Concepts of system stability :** swing curves and equal area criterion. Static VAR system. Basic concepts of HVDC transmission.
5. **Power System Protection :**
    - Principles of overcurrent, differential and distance protection. Concept of solid state relays. Circuit brakers.
    - **Computer aided protection :** introduction; line, bus, generator, transformer protection; numeric relays and application of DSP to protection.
6. **Digital Communication** :
    - Pulse code modulation (PCM), defferential pulse code modulation (DPCM), delta modulation (DM), Digital modulation and demodulation schemes : amplitude, phase and frequency keying schemes (ASK, PSK, FSK).
    - **Error control coding :** error detection and correction, linear block codes, convolation codes. Information measure and source coding. Data networks, 7-layer architecture.

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