

UPSC Mains Electrical Engineering Optional Paper-I Syllabus

1. Circuits Theory:

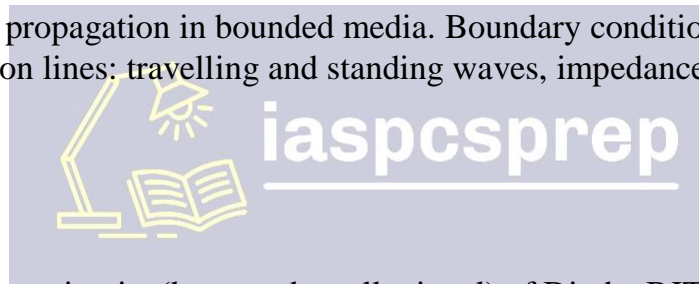
Circuit components; network graphs; KCL, KVL; Circuit analysis methods: nodal analysis, mesh analysis; basic network theorems and applications; transient analysis: RL, RC, and RLC circuits; sinusoidal steady state analysis; resonant circuits; coupled circuits; balanced 3-phase circuits. Two-port networks.

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; narrow band FM; generation & detection of FM and PM, Deemphasis, Pre-emphasis. CW modulation system: Superheterodyne receivers, AM receivers, communication receivers, FM receivers, phase locked loop, SSB receiver Signal to noise ratio calculation or AM and FM receivers.

