UPSC IES Syllabus

The UPSC IES (Indian Engineering Services) examination has 2 written exams - prelims exam and mains exam. The prelims exam has 2 papers, paper 1 will have questions based on General Studies & Engineering Aptitude which is common for all candidates. Paper 2 will have questions based on the stream. Mains exam will have 2 descriptive papers based on the engineering stream. Since the exam is discipline-specific, we will cover the UPSC IES syllabus as per Civil, electrical, Mechanical, Electronics & Telecommunication. The detailed wise subject syllabus is mentioned below.

Note: Syllabus for Paper 1 and Paper 2 of both prelims and mains exam is given below; the only difference is that prelims will have objective questions and mains will have descriptive questions.

UPSC IES General Studies & Engineering Aptitude

This section will have questions based on the recent news and events as well as the basics of Engineering. The important topics are listed below:

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◦ Current issues (national and international) ◦ Environment: Conservation, environmental pollution & Hazards, Climate Change, etc. ◦ Production & construction ◦ Maintenance ◦ General Principles of Design & Drawing, ◦ Importance of Safety ◦ Material Science	◦ Information and Communication Technologies (ICT) ◦ Project Management ◦ Ethics and values in the Engineering profession ◦ Basics of Energy ◦ Logical reasoning and Analytical ability ◦ Engineering Mathematics

UPSC ESE (IES) Syllabus for Civil Engineering

The syllabus for the civil engineering division for Prelims and the main exam is listed in the table below.

UPSC ESE Syllabus for Civil Engineering Paper 1

Topics	Paper 1 Civil Engineering Syllabus

Structural Analysis	Basics of strength of materials, Types of stresses and strains, Bending moments and shear force, the concept of bending and shear stresses; Analysis of determinate and indeterminate structures, Rolling loads, Influence Lines, Unit load method & other methods; Free and Forced vibrations of single degree and multi-degree freedom system; Suspended Cables; Concepts and use of Computer-Aided Design
Solid Mechanics	Elastic constants, Stress, plane stress, Strains, plane strain, Mohr's circle of stress and strain, Elastic theories of failure, Principal Stresses, Bending, Shear and Torsion
Building Materials	Stone, Lime, Glass, Plastics, Steel, FRP, Ceramics, Aluminum, Fly Ash, Basic Admixtures, Timber, Bricks and Aggregates: Classification, properties and selection criteria; Cement: Types
Design of Concrete and	Limit state design for bending, shear, axial compression and combined forces; Design of beams, Slabs, Lintels, Foundations,

Masonry structures	Retaining walls, Tanks, Staircases; Principles of pre-stressed concrete design
Design of Steel Structures	Principles of Working Stress methods, Design of tension and compression members, Design of beams and beam-column connections, built-up sections, Girders, Industrial roofs, Principles of Ultimate load design
Construction Practice, Planning and Management	Construction - Planning, Equipment, Site investigation and Management including Estimation with latest project management tools and network analysis for different Types of works; Analysis of Rates of various types of works; Tendering Process and Contract Management, Quality Control, Productivity, Operation Cost; Land acquisition; Labour safety and welfare

UPSC ESE Syllabus for Civil Engineering Paper 2

Topics	**Paper 2 Civil Engineering Syllabus**
Flow of Fluids, Hydraulic Machines and Hydro Power	Fluid Mechanics, Open Channel Flow, Pipe Flow, Hydraulic Machines and Hydropower

Hydrology and Water Resources Engineering	Hydrological cycle, Ground water hydrology, Well hydrology and related data analysis; Streams and their gauging; River morphology; Flood, drought, and their management; Capacity of Reservoirs. Water Resources Engineering: Multipurpose uses of Water, River basins and their potential; Irrigation systems, water demand assessment; Resources, canal and drainage design, Gravity dams, falls, weirs, Energy dissipators, barrage Distribution works, Cross drainage works and head-works and their design; Concepts in canal design, construction & maintenance; River training, measurement, and analysis of rainfall.
Environmental Engineering	Water Supply Engineering, Waste Water Engineering, Solid Waste Management, Air, Noise pollution, and Ecology
Geotechnical Engineering and Foundation Engineering	Geo-technical Engineering: Soil exploration - planning & methods, Properties of soil, classification, various tests and inter-relationships; Permeability

	& Seepage, Compressibility, consolidation, and Shearing resistance, Earth pressure theories and stress distribution in soil; Properties and uses of geo-synthetics. Foundation Engineering: Types of foundations & selection criteria, bearing capacity, settlement analysis, design and testing of shallow & deep foundations; Slope stability analysis, Earthen embankments, Dams, and Earth retaining structures: types, analysis and design, Principles of ground modifications.
Surveying and Geology	Classification of surveys, various methodologies, instruments & analysis of measurement of distances, elevation, and directions; Field astronomy, Global Positioning System; Map preparation, Survey Layout for culverts, canals, bridges, road/railway alignment, and buildings, Setting out of Curves.

	Basic knowledge of Engineering geology & its application in projects
Transportation Engineering	Highways - Planning & construction methodology, Alignment, and geometric design; Traffic Surveys and Controls Railways Systems – Terminology, Planning, designs, and maintenance practices; track modernization. Harbours – Terminology, layouts and planning. Airports – Layout, planning & design. Tunnelling - Alignment, methods of construction, disposal of muck, drainage, lighting, and ventilation.

UPSC IES ECE Syllabus

The syllabus for the IES exam's Electronics and Telecommunication Engineering division is listed below:

UPSC ESE (IES) ECE Syllabus for Paper 1

Topics	**Paper 1 Electronics and Telecommunication Engineering Syllabus**

Basic Electronics Engineering	Basics of semiconductors, Junction & Field-Effect Transistors, Transistor amplifiers of different types, oscillators, and other circuits; Basics of Integrated Circuits (ICs); Bipolar, MOS and CMOS ICs, Optical sources/detectors
Analog and Digital Circuits	Small signal equivalent circuits of diodes, Active filters, timers, multipliers, waveshaping, A/D-D/A converters; Boolean Algebra & uses; Logic gates, Digital IC families, Combinatorial/sequential circuits, BJTS, and FETs, Analysis/design of amplifier single/multi-stage
Network Theory	Network graphs & matrices; Wye-Delta transformation; Linear constant coefficient differential equations- time-domain analysis of RLC circuits; 26 Solution of network equations using Laplace transforms-frequency domain analysis of RLC circuits; 2-port network parameters, State equations for networks; Steady state sinusoidal analysis.

Materials Science	Electrical Engineering materials; Crystal structure & defects; Ceramic materials-structures, composites, processing and uses; Insulating laminates for electronics, structures, properties and uses; Magnetic materials, basics, classification, ferrites, Ferro/para-magnetic materials and components; Nano materials-basics, preparation, purification, sintering, nanoparticles and uses; Nano-optical/magnetic/electronic materials
Electronic Measurements and Instrumentation	Principles of measurement, accuracy, precision, and standards; Analog and Digital systems for measurement, measuring instruments for different applications; Static/dynamic characteristics of measurement systems, errors, statistical analysis and curve fitting; Measurement systems for non-electrical quantities; Basics of telemetry; Different types of transducers and displays; Data acquisition system basics
Basic Electrical Engineering	DC circuits ohm's & Kirchoff’s laws, mesh and nodal analysis, circuit theorems;

	Electromagnetism, Faraday's & Lenz's laws, induced EMF and its uses; Single-phase AC circuits; Transformers, efficiency; Basics-DC machines, induction machines, and synchronous machines; Electrical power sources

UPSC ESE (IES) ECE Syllabus for Paper 2

Topics	**Paper 2 Electronics and Telecommunication Engineering Syllabus**
Advanced Electronics Topics	VLSI technology: Processing, lithography, interconnects, packaging, testing; VLSI design: Principles, MUX/ROM/PLA-based design, Moore & Mealy circuit design; Pipeline concepts & functions; Design for testability, examples; DSP: Discrete-time signals/systems, uses; Digital filters: FIR/IIR types, design, speech/audio/radar signal processing uses; Microprocessors & microcontrollers, basics, interrupts, DMA, instruction sets, interfacing; Controllers & uses; Embedded systems.

Control Systems	Classification of signals and systems; Application of signal and system theory; System realization; Transforms & their applications; Signal flow graphs, Routh-Hurwitz criteria, root loci, Nyquist/Bode plots; Feedback systems-open & close loop types, stability analysis, steady-state, transient and frequency response analysis; Design of control systems, compensators, elements of lead/lag compensation, PID and industrial controllers.
Advanced Communication Topics	Communication Networks: Principles /practices /technologies /uses /OSI model/security; Basic packet multiplexed streams/scheduling; Cellular networks, types, analysis, protocols (TCP/TCPIP) Microwave & satellite communication: Terrestrial/space type LOS systems, block schematics link calculations, system design; Communication satellites, orbits, characteristics, systems, uses; Fibre-optic communication systems, block schematics, link calculations, system design.

Analog and Digital Communication Systems	Random signals, noise, probability theory, information theory; Analog versus digital communication & applications: Systems-AM, FM, transmitters/receivers, theory/practice/ standards, SNR comparison; Digital communication basics: Sampling, quantizing, coding, PCM, DPCM, multiplexing-audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA; Optical communication: fibre optics, theory, practice/standards.
Electro Magnetics	Elements of vector calculus, Maxwell's equations-basic concepts; Gauss', Stokes' theorems; Wave propagation through different media; Transmission Lines-different types, basics, Smith's chart, impedance matching/transformation, S-parameters, pulse excitation, uses; Waveguides-basics, rectangular types, modes, cut-off frequency, dispersion, dielectric types; Antennas-radiation pattern,

	monopoles/dipoles, gain, arrays-active/passive, theory, uses.
Computer Organization and Architecture	Basic architecture, CPU, I/O organisation, memory organisation, peripheral devices, trends; Hardware /software issues; Data representation & Programming; Operating systems-basics, processes, characteristics, applications; Memory management, virtual memory, file systems, protection & security; Databases, different types, characteristics, and design; Transactions and concurrency control; Elements of programming languages, typical examples.

UPSC IES (ESE) Electrical Engineering Syllabus

The syllabus for the UPSC IES exam's Electrical Engineering division is listed below:

UPSC IES (ESE) Electrical Engineering for Paper 1

Topics	**Paper 1 Electrical Engineering Syllabus**
Engineering Mathematics	Matrix theory, Eigen values & Eigen vectors, system of linear equations, Numerical methods for the solution of non-linear algebraic equations and differential

	equations, probability and statistics fundamentals, Sampling theorem, random variables, Normal and Poisson distributions, correlation and regression analysis, integral calculus, partial derivatives, maxima and minima, Line, Surface and Volume Integrals. Fourier series, linear, non-linear and partial differential equations, initial and boundary value problems, complex variables, Taylor's and Laurent's series, residue theorem
Electrical Materials	Electrical Engineering Materials, crystal structures, and defects, ceramic materials, insulating materials, magnetic materials – basics, properties and applications; ferrites, ferromagnetic materials, and components; basics of solid-state physics, conductors; Photo-conductivity; Basics of Nano materials and Superconductors.
Electric Circuits and Fields	Circuit elements, network graph, KCL, KVL, Node, and Mesh analysis, ideal current and voltage sources, Thevenin's, Norton's, Superposition and Maximum Power Transfer theorems, transient response

	of DC and AC networks, Sinusoidal steady-state analysis, and spherical charge distributions, Ampere's and Biot-Savart's laws; inductance, dielectrics, capacitance; Maxwell's equations,basic filter concepts, two-port networks, three-phase circuits, Magnetically coupled circuits, Gauss Theorem, electric field and potential due to point, line, plane
Electrical and Electronic Measurements	Principles of measurement, accuracy, precision, and standards; Bridges and potentiometers; moving coil, moving iron, dynamometer and induction type instruments, Basics of sensors, Transducers, basics of data acquisition systems, measurement of voltage, current, power, energy and power factor, instrument transformers, digital voltmeters and multimeters, phase, time and frequency measurement, Q-meters, oscilloscopes, potentiometric recorders, error analysis
Computer Fundamentals	Peripheral devices, data representation and programming, basics of Operating system,

	and networking, virtual memory, file systems; Elements of programming languages, typical examples, Number systems, Boolean algebra, arithmetic functions, Basic Architecture, Central Processing Unit, I/O and Memory Organisation
Basic Electronics Engineering	Basics of Semiconductor diodes and transistors and characteristics, Junction and field-effect transistors (BJT, FET, and MOSFETS), different types of transistor amplifiers, equivalent circuits and frequency response; oscillators and other circuits, feedback amplifiers.

UPSC IES (ESE) Electrical Engineering for Paper 2

Topics	**Paper 2 Electrical Engineering Syllabus**
Analog and Digital Electronics	Microprocessor basics- interfaces and applications, basics of linear integrated circuits; Analog communication basics, Modulation, and demodulation, noise and bandwidth, transmitters and receivers, signal to noise ratio, digital communication basics, sampling, quantizing,

	coding, frequency and time domain multiplexing, power line carrier communication systems, Operational amplifiers, combinational and sequential logic circuits, multiplexers, multivibrators, sample and hold circuits, A/D and D/A converters, basics of filter circuits and applications, simple active filters
Systems and Signal Processing	Representation of continuous and discrete-time signals, Shifting and scaling operations, linear, time-invariant and causal systems, Discrete Fourier transform, FFT, linear convolution, discrete cosine transform, FIR filter, IIR filter, bilinear transformation, Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Laplace transforms, Z transforms
Control Systems	Routh-Hurwitz criterion, Nyquist techniques, Bode plots, root loci, lag, lead and lead-lag compensation, stability analysis, transient and frequency response analysis, state-space model, state transition matrix, controllability and observability, linear state variable feedback, PID and industrial controllers, Principles of

	feedback, transfer function, block diagrams and signal flow graphs, steady-state errors, transforms and their applications;
Electrical Machines	Single-phase transformers, three-phase transformers - connections, parallel operation, auto-transformer, energy conversion principles, DC machines, generator characteristics, armature reaction and commutation, starting and speed control of motors, Induction motors, Synchronous machines
Power Systems	Matrix representation of power systems, load flow analysis, voltage control and economic operation, System stability concepts, Swing curves and equal area criterion. HVDC transmission and FACTS concepts, Concepts of power system dynamics, Basic power generation concepts, steam, gas and water turbines, transmission line models and performance, cable performance, insulation, corona, and radio interference, power factor correction, symmetrical components, fault analysis, principles of protection systems, basics of solid-state relays and digital protection; Circuit

	breakers, Radial and ring-main distribution systems, distributed generation, solar and wind power, smart grid concepts, environmental implications, fundamentals of power economics.
Power Electronics and Drives	Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs, principles of choppers and inverters, basic concepts of adjustable speed DC and AC drives, DC-DC switched-mode converters, DC-AC switched-mode converters, resonant converters, high-frequency inductors and transformers, power supplies.

UPSC ESE (IES) Mechanical Engineering Syllabus

The syllabus for the UPSC IES exam's Mechanical Engineering division is listed below:

UPSC ESE (IES) Mechanical Engineering Syllabus for Paper 1

Topics	IES Mechanical Engineering Syllabus
Fluid Mechanics	Basic Concepts and Properties of Fluids, Manometry, Fluid Statics, Buoyancy, Equations of Motion, Bernoulli’s equation and applications, Viscous flow of

	incompressible fluids, Laminar and Turbulent flows, Flow through pipes and head losses in pipes.
Power Plant Engineering	Rankine and Brayton cycles with regeneration and reheat, Fuels and their properties, Flue gas analysis, Boilers, steam turbines and other power plant components like condensers, air ejectors, electrostatic precipitators and cooling towers
IC Engines, Refrigeration and Air conditioning	Vapour compression refrigeration, Refrigerants, and Working cycles, Compressors, Condensers, Evaporators and Expansion devices, SI and CI Engines, Engine Systems and Components, Performance characteristics, and testing of IC Engines; Fuels; Emissions and Emission Control. Other types of refrigeration systems like Vapour Absorption, Vapour jet, thermoelectric, and Vortex tube refrigeration. Psychometric properties and processes, Comfort chart, Comfort and industrial air

	conditioning, Load calculations, and Heat pumps.
Turbo Machinery	Reciprocating and Rotary pumps, Pelton wheel, Kaplan and Francis Turbines, velocity diagrams, Impulse and Reaction principles, Steam and Gas Turbines, Theory of Jet Propulsion, Rotary Compressors
Renewable Sources of Energy	Plate and focusing collectors their materials and performance. Solar Thermal Energy Storage, Applications, Bio-mass and Tidal Energy
Thermodynamics and Heat transfer	Thermodynamic systems and processes; properties of pure substance; Zeroth, First and Second Laws of Thermodynamics; Entropy, Irreversibility, and availability; analysis of thermodynamic cycles related to energy conversion: Rankine, Otto, Diesel and Dual Cycles; ideal and real gases; compressibility factor; Gas mixtures. Modes of heat transfer, Steady and unsteady heat conduction, Thermal resistance, Fins, Free and forced

	convection, Correlations for convective heat transfer, Radiative heat transfer

UPSC ESE (IES) Mechanical Engineering Syllabus for Paper 2

Topics	**IES Mechanical Engineering Syllabus**
Engineering Materials	Basic Crystallography, Alloys and Phase diagrams, Heat Treatment, Ferrous, and Non-Ferrous Metals, Nonmetallic materials, Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control
Design of Machine Elements	Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as riveted, welded and bolted joints. Shafts, Spur gears, rolling and sliding contact bearings, Brakes and clutches, flywheels.
Manufacturing, Industrial and Maintenance Engineering	Failure concepts and characteristics-Reliability, Failure analysis, Machine Vibration, Data acquisition, Fault Detection, Vibration Monitoring, Field

	Balancing of Rotors, Noise Monitoring, Wear and Debris Analysis, Signature Analysis, NDT Techniques in Condition Monitoring. Metal casting-Metal forming, Metal Joining, Machining and machine tool operations, Limits, fits and tolerances, Metrology and inspection, computer Integrated manufacturing, FMS, Production planning and Control, Inventory control and operations research - CPM-PERT.
Mechatronics and Robotics	Microprocessors and Microcontrollers: Architecture, programming, I/O, Computer interfacing, Programmable logic controller. Sensors and actuators, Piezoelectric accelerometer, Hall effect sensor, Optical Encoder, Resolver, Inductosyn, Pneumatic and Hydraulic actuators, stepper motor, Control SystemsMathematical modelling of Physical systems, control signals, controllability and observability. Robotics, Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics;

	Homogeneous Coordinates and Arm Equation of four Axis SCARA Robot
Engineering Mechanics	Analysis of System of Forces, Friction, Centroid and Centre of Gravity, Dynamics; Stresses and Strains-Compound Stresses and Strains, Bending Moment and Shear Force Diagrams, Theory of Bending Stresses- Slope and deflection-Torsion, Thin and thick Cylinders, Spheres.
Mechanisms and Machines	Types of Kinematics Pair, Mobility, Inversions, Kinematic Analysis, Velocity and Acceleration Analysis of Planar Mechanisms, CAMs with uniform acceleration and retardation, cycloidal motion, oscillating followers; Vibrations – Free and forced vibration of undamped and damped SDOF systems, Transmissibility Ratio, Vibration Isolation, Critical Speed of Shafts. Gears – Geometry of tooth profiles, Law of gearing, Involute profile, Interference, Helical, Spiral and Worm Gears, Gear Trains- Simple, compound and Epicyclic; Dynamic Analysis – Slider

	– crank mechanisms, turning moment computations, balancing of Revolving & Reciprocating masses, Gyroscopes –Effect of Gyroscopic couple on automobiles, ships and aircraft, Governors.

Personal Interview for UPSC ESE

The interview round is for maximum marks 200. Your all-round personality is the focal point of personal interviews. A Positive attitude, Smart body language, Proper communication and Knowledge about current affairs reflect a great Persona. Along with this Sound technical knowledge can create a great impression in personal interviews. Familiarizing yourself with the previous UPSC IES Interview will help you better in your preparation. You must keep assessing yourself. You must prepare to answer queries about your strong and weak traits.

UPSC IES Prelims Exam Pattern

The prelims exam will consist of two papers namely General Studies & Engineering Aptitude and paper based on engineering discipline. Both these papers will be objective type. 1/3rd marks will be deducted for every wrong answer.

Paper	Subject	Total Marks	Duration (hours)
Paper 1	General Studies & Engineering Aptitude	200	2 hours
Paper 2	Concerned Engineering Stream	300	3 hours
Total		500	-