Standard and Syllabi

The standard of paper in General Studies and Engineering Aptitude (Preliminary Stage-I Examination) will be such as may
be expected of an Engineering/Science Graduate. The standard of papers in other subjects will approximately be that of an
Engineering Degree Examination of an Indian University. There will be no practical examination in any of the subjects.

General Studies and Engineering Aptitude (Preliminary Examination/Stage-I, Paper I, Objective type, Common to all Candidates)

1. Current issues of national and international importance relating to social, economic and industrial development 2.
Engineering Aptitude covering Logical reasoning and Analytical ability 3.
Engineering Mathematics and Numerical Analysis 4.
General Principles of Design, Drawing, Importance of Safety 5. Standards and Quality practices in production, construction,
maintenance and services 6. Basics of Energy and Environment: Conservation, environmental pollution and degradation, Climate
Change, Environmental impact assessment 7. Basics of Project Management 8.
Basics of Material Science and Engineering 9.
Information and Communication Technologies (ICT) based tools and their applications in Engineering such as networking, egovernance
and technology based education. 10. Ethics and values in Engineering profession.

**Note: The paper in General Studies and Engineering Aptitude will include Knowledge of relevant topics as may be expected
from an engineering graduate, without special study. Questions from all the 10 topics mentioned above shall be set. Marks
for each Topic may range from 5% to 15% of the total marks in the paper.**

Civil Engineering

**Contents for syllabi of both the Papers together for Preliminary Examination/Stage-I (objective type Paper–II) and
separately for Main/Stage-II Examination (Conventional type Paper-I and Paper – II).**

PAPER – I

1. 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, Composition, Properties, Uses, Specifications and various Tests;
Lime & Cement Mortars and Concrete:
Properties and various Tests; Design of Concrete Mixes: Proportioning of aggregates and methods of mix design.

2. 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.

3. Structural Analysis:

Basics of strength of materials, Types of stresses and strains, Bending moments and shear force, concept of bending and
shear stresses; Analysis of determinate and indeterminate structures; Trusses, beams, plane frames; 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.

4. 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.

5. Design of Concrete and Masonry structures:

Limit state design for bending, shear, axial compression and combined forces; Design of beams, Slabs, Lintels, Foundations,
Retaining walls, Tanks, Staircases; Principles of pre-stressed concrete design including materials and methods; Earthquake
resistant design of structures; Design of Masonry Structure.

6. 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.

PAPER – II

7 . 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.

8. Engineering Materials:

Basic Crystallography, Alloys and Phase diagrams, Heat Treatment, Ferrous and Non Ferrous Metals, Non metallic materials,
Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control

9. 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 aircrafts, Governors.

10. 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.

11. Manufacturing ,Industrial and Maintenance Engineering:

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. 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.

12. **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 Systems- Mathematical modeling 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.

PAPER – I

1. **Engineering Mathematics**

Matrix theory, Eigen values & Eigen vectors, system of linear equations, Numerical methods for solution of non-linear
algebraic equations and differential equations, 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, probability and statistics fundamentals, Sampling
theorem, random variables, Normal and Poisson distributions, correlation and regression analysis.

2. Electrical Materials

Electrical Engineering Materials, crystal structures and defects, ceramic materials, insulating materials, magnetic materials
– basics, properties and applications; ferrities, ferro-magnetic materials and components; basics of solid state physics,
conductors; Photo-conductivity; Basics of Nano materials and Superconductors.

3. 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, basic filter concepts, two-port networks, three phase circuits, Magnetically coupled circuits, Gauss Theorem,
electric field and potential due to point, line, plane and spherical charge distributions, Ampere's and Biot-Savart's laws;
inductance, dielectrics, capacitance; Maxwell's equations.

4. Electrical and Electronic Measurements:

Principles of measurement, accuracy, precision and standards; Bridges and potentiometers; moving coil, moving iron,
dynamometer and induction type instruments, measurement of voltage, current, power, energy and power factor,
instrument transformers, digital voltmeters and multi-meters, phase, time and frequency measurement, Q-meters,
oscilloscopes, potentiometric recorders, error analysis, Basics of sensors, Transducers, basics of data acquisition systems

5. Computer Fundamentals:

Number systems, Boolean algebra, arithmetic functions, Basic Architecture, Central Processing Unit, I/O and Memory
Organisation; peripheral devices, data represenation and programming, basics of Operating system and networking, virtual
memory, file systems; Elements of programming languages, typical examples.

6. 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.

PAPER – II

1. Analog and Digital Electronics:

Operational amplifiers – characteristics and applications, 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;

Microprocessor basics- interfaces and applications, basics of linear integrated circuits; Analog communication basics,
Modulation and de-modulation, 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.
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2. Systems and Signal Processing :

Representation of continuous and discrete-time signals, shifting and scaling operations, linear, time-invariant and causal
systems, Fourier series representation of continuous periodic signals, sampling theorem, Fourier and Laplace transforms, Z
transforms, Discrete Fourier transform, FFT, linear convolution, discrete cosine transform, FIR filter, IIR filter, bilinear
transformation.

3. Control Systems:

Principles of feedback, transfer function, block diagrams and signal flow graphs, steady-state errors, transforms and their
applications; 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.

4. Electrical Machines :

Single phase transformers, three phase transformers - connections, parallel operation, auto-transformer, energy conversion
principles, DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed
control of motors, Induction motors - principles, types, performance characteristics, starting and speed control, Synchronous
machines - performance, regulation, parallel operation of generators, motor starting, characteristics and applications, servo
and stepper motors.

5. Power Systems :

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, 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, distributed generation, solar and wind power, smart grid concepts, environmental implications,
fundamentals of power economics.

6. Power Electronics and Drives :

Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles
of operation, triggering circuits, phase control rectifiers, bridge converters - fully controlled and half controlled, principles of
choppers and inverters, basis 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.

Electronics & Telecommunication Engineering

**Contents for syllabi of both the Papers together for Preliminary/Stage-I Examination (objective type Paper–II) and
separately for Main/Stage-II Examination (Conventional type Paper-I and Paper – II).**

PAPER – I

1. Basic Electronics Engineering:

Basics of semiconductors; Diode/Transistor basics and characteristics; Diodes for different uses; Junction & Field Effect
Transistors (BJTs, JFETs, MOSFETs); Transistor amplifiers of different types, oscillators and other circuits; Basics of
Integrated Circuits (ICs); Bipolar, MOS and CMOS ICs; Basics of linear ICs, operational amplifiers and their applications linear/
non-linear; Optical sources/detectors; Basics of Opto electronics and its applications.

2. Basic Electrical Engineering:

DC circuits-Ohm's & Kirchoff's laws, mesh and nodal analysis, circuit theorems; Electro-magnetism, 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- basics: hydroelectric, thermal, nuclear, wind, solar; Basics of batteries
and their uses.

3. 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, nano particles
and uses; Nano-optical/magnetic/electronic materials and uses; Superconductivity, uses.

4. 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.

5. Network Theory:

Network graphs & matrices; Wye-Delta transformation; Linear constant coefficient differential equations- time domain
analysis of RLC circuits;

Solution of network equations using Laplace transforms- frequency domain analysis of RLC circuits; 2-port network
parameters-driving point & transfer functions; State equations for networks; Steady state sinusoidal analysis.

6. Analog and Digital Circuits:

Small signal equivalent circuits of diodes, BJTS and FETs; Diode circuits for different uses; Biasing & stability of BJT & JFET
amplifier circuits; Analysis/design of amplifier- single/multi-stage; Feedback& uses; Active filters, timers, multipliers, wave

shaping, A/D-D/A converters; Boolean Algebra& uses; Logic gates, Digital IC families, Combinatorial/sequential circuits;
Basics of multiplexers, counters/registers/ memories /microprocessors, design& applications.

PAPER – II

1. 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.

2. 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.

3. 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; Data bases, different types, characteristics and design; Transactions and
concurrency control; Elements of programming languages, typical examples.

4. 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, Sparameters,
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.

5. **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.

6. 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.