AMIE Section A (ND) Syllabus (with effect from 2005)

Subjects List

| 1. Fundamentals of Design and Manufacturing | Plus 2 / Intermediate holders should study all the 10 subjects in Section A. | Diploma holders need to study only the first 4 subjects in Section A |
| 2. Material Science and Engineering |
| 3. Computing and Informatics |
| 4. Society and Environment |
| 5. Mechanical science |
| 6. Engineering Physics and Chemistry |
| 7. Engineering Drawing and Graphics |
| 8. Electronics and Instrumentation |
| 9. Engineering Mathematics |

1. FUNDAMENTALS OF DESIGN AND MANUFACTURING

Group A

Engineering design process and its structure. Identification and analysis of need, product designs specifications, standards of performance and constraints.

Searching for design concepts; morphological analysis, brainstorming. Evaluation of design concepts for physical reliability, economic feasibility and utility.

Detailed design; design for manufacture, assembly, shipping, maintenance, use, and recyclability.

Design checks for clarity, simplicity, modularity and safety. Standardization and size ranges. Reliability and robust design. Design organization and communication, technical reports, drawings, presentations and models.


Fundamentals of metal forming. Hot and cold working; basic understanding of primary metal forming process(rolling, forging, extrusion and drawing process, punching and blanking)

Group – B

Fundamentals of metal cutting: tool-work interaction for production of machined surfaces. Classification of machining process. Basic machining operations. (Turning, shaping, planning, drilling and milling processes.)

Fundamentals of grinding and finishing; overview of unconventional machining process; fundamentals of welding process; introduction to primary welding and allied process, selection of manufacturing processes. Design for manufacturability.

Need for integration- commercial, economic and technological perspective; basic tools of integration; concept of a system. Introduction to information technology and its elements.

Introduction to group technology; introduction to simulation and data base management systems.

Elements of integration – controllers, sensors, robots, automated machines; AGVs, AS, RS, etc.

Product and process design for integration; design for economic manufacturing; design for manufacturing integration.

Introduction to computer aided process planning; selection of machine tools.
2. MATERIAL SCIENCE AND ENGINEERING

**Group A**

Introduction to materials. Metals and alloys, ceramics, polymers and semi conducting materials-introduction and application as engineering materials.


Deformation of metals. Elastic and plastic deformation, slip, twin, dislocation theory, critical resolved shear stress, deformation in polycrystalline materials, season cracking, Bauchinger’s effect, strengthening mechanisms, work hardening recovery, recrystallization and grain growth, cold and hot working.

**Group B**


Thermal properties. High temperature materials, materials for cryogenic application, thermally insulating materials. (Specific heat, thermal conductivity, thermal expansion).

Ceramic materials and polymers. Silicon structures, polymerism fraction in glass, electrical properties of ceramic phased, rocks, building stones, refractories.

Polymerisation mechanism, structural properties of polymer, thermoplastics, thermosets, elastomers, resins, composites, particle and fiber reinforced composites. Composite material including nano-material.

Electronic properties. Magnetism, diamagnetism, paramagnetism, ferromagnetism, magnetic energy, zone theory of solids, zones in conductors and insulators.

3. COMPUTING AND INFORMATICS

**Group A**

Programming languages. C including C++; Languages-declaration, expressions, control statements, arrays, function, pointers and structures; Algorithms and flow-charts. Introduction to Pascal.

Informatics: Information systems for decision making; Data management and database management technology; Office automation system - LAN, WAN, electronic mail, electronic data interchange; client server technology; overview of TCP/IP; Information systems for business; Strategic information systems; Information resources management.

**Group B**


Hardware. Introduction to logic gates and flip flops. Components of a computer. input/output devices. CPU unit and memory unit. Secondary storage.

Softwares. System software; application software; compliers and translators.

Operating systems. Introduction to operating systems; types of operating systems and their function; popular operating systems- MS-DOS, UNIX and Windows; file management.
4. SOCIETY AND ENVIRONMENT

**Group A  Society**

**Societal Structures and Dynamics**
An analysis of basic sociological concepts and their applications to contemporary society; social stratification. Caste, class, cultural heritage, occupation, mobility and income distribution. Social tensions and their causes, societal responsibilities and social institutions.

**Development Process**
Parameters for development. Interrelationship between social, economic and scientific factors. Role of science and technology in development. Planning - its objectives and assessment.

**Technology Assessment**
Historical development of science and technology. Criteria for assessment of appropriate technology and technology adaptation.

**Group B  Environment**

**Ecosystems**

**Environmental Degradation**
Causes for degradation - its effects. Control of air, water, soil and noise pollutions. Protection of ozone layer.

**Waste Management**
Agricultural, Urban and industrial wastes.

**Sustainable Development.**
Definition and concept. Technology for sustainable energy and materials.

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Compiled By

**JYOTHIS ACADEMY**
Kanjikuzhy,
Kottayam-4
Kerala.

Phone +91 949595 1100
Email  jyothisacademy@gmail.com
www.amieindia.in

Contact us for
AMIE Study Materials
Question Bank etc
5. MECHANICAL SCIENCE

Group A

Mechanics of solids
Coplanar force systems, moment of a force, couple, equilibrium conditions, free-body diagram, laws of friction.
Centroid and area moment of inertia, mass moment of inertia, principle of virtual work, screw jack.
Kinematics of particles, velocity, acceleration, Newton’s laws, equation of motion (rectilinear), momentum, impulse, work/energy, projectiles, moment of momentum, rotation and simple harmonic motion, free vibration.

Mechanics of Deformation
Stress, strain, Hooke’s law, elastic constants, ultimate strength. Mohr’s circle of stress, thin walled pressure vessels.
Deflection of beam-bending moment and shear force in beam/cantilevers, torsion of circular sections.

Group B

Fluid Mechanics
Fluid and their properties, viscosity, compressibility, surface tension, non-Newtonian fluids, pressure at a point, hydrostatic on immersed and floating bodies, type of flow, velocity and acceleration of a flow particle, hydrodynamics.

Thermodynamics
Basic concepts—properties of gases and equation of state, work, heat, heat capacity, internal energy, enthalpy.
First law of thermodynamics and law of conservation of energy, basic thermodynamic processes for ideal gases.
Second law of thermodynamics, cannot cycle, entropy, various process on T-s ans H-s planes.
Ideal heat engine cycles-SI and CI engine cycles, principle of operation of SI and CI engines.

Recommended Book

Reference Books
6. ENGINEERING PHYSICS AND CHEMISTRY

Group A  Engineering Physics

Atomic structure, Rutherford and Bohr’s models, atomic process. Proton and neutron, radioactivity and decays. Nuclear energy and reactions, nuclear reactor. Introduction to quantum physics.


Optics. Interference, diffraction and polarization, laser, holography, fibre optics.


Group B  Engineering Chemistry

Chemical bond. Ionic and covalent bonding; Lattice energy; Hybridisation; Resonance; Bond order; Fajan’s rule; Metallic bond and intermolecular forces; Chemical kinetics.

Structure of organic molecules, nomenclature. Introduction to stereochemistry; Optical activity. Titration involving potassium permanganate, potassium dichromate. Titration involving EDTA.

Oxidation-reduction reactions. Colloid and surface chemistry; Corrosion; chromatography and ion-exchange catalysis; Crystal structure and electro-chemistry; UV-visible spectrophotometry. Chemical kinetics-simple reactions.

Environmental chemistry. Pollutant analysis, e.g., CO, H2, S, NOx, Sox, oxidant.

Recommended Books
Engineering Physics

Engineering Chemistry

7. ENGINEERING DRAWING AND GRAPHICS

Group A

Projection graphics. Objects, condition and methods of projection; Gnomonic, stereographic and orthographic projections; Cordinate systems and grid scales, scale distortion, and conditions of conformality and equivalence. Azonometric projections; Isometric; Dimetric and oblique projections; conical equivalent and equivalent cylindrical projections.

Spatial graphics. Basic principles of multiview drawings and Monge’s projections; Points in quadrants and octants; Projections of lines and traces of line; True relative positions of two planes
and of a straight line and a plane; Method of revolution. Projections of polyhedrons, curved lines and surfaces; contour mapping of curved surfaces; Plane sections of polyhedrons and curved surfaces; Development of curved surfaces. Affine correspondence and its applications.

Product graphics. Introduction to various product features; ide4ntification of functional and non-functional surfaces; selection of datum; Toleraching of diemensions; Compatibility of product elements for manufacturing and assembly requirements; Sectional and auxiliary views.

Computer graphics. Basic principles for interactive computer graphics; Systems and peripherals required; Point plotting technique; Line drawing displays; Modelling of two- and three-dimensions; Display of solid objects.

**Group B**

Drafting principles. Manipulation and use of drafting equipment and instruments; Exercises in instrumental drawing; Introduction to drafting codes as per ISO and BIS; Technical lettering.

Drawing exercise. Drafting problems involving consideration of stereometric features; Toleranced dimensioning; partial views and sectioning. Auxiliary sections, schematic product symbols. Drafting exercises involving (a) preparation of details, (b) aggregation for assembly, (c) exploded machine kinematics, etc.

**Recommended Books**

- P S Gill. Engineering Drawing. S K Kataria & Sons, Delhi

**8. ELECTRONICS AND INSTRUMENTATION**

**GROUP A Electronics**

Semiconductor materials, intrinsic and extrinsic semiconductors.

p-n junction diodes, rectifiers-half wave, full wave, capacitive filters, Zener diodes, their operation, characteristics and applications.

Transistors-p-n-p and n-p-n transistors, transistor as amplifier- CE, transistor characteristics, blasting and biasing stability, small signal equivalent circuits. Field effect devices- MOSFET – characteristics and applications. BJT – characteristics.

Amplifier-Hybrid parameter equivalent circuits for common emitter configuration, current and voltage gain, input-output impedance, frequency response, concepts of feedback amplifiers, regenerative feedback and conditions for oscillation.

Thyrisors-characteristics and applications. Triacs and GTOs.

Intergrated circuits- IC devices. OPAMP applications. Analogue to Digital Conversion (ADC), Digital to analogue Conversion (DAC).
Group B  Instrumentation

Indicating instruments. Moving coil, moving iron, rectifier and dynamometer type meters for measurement of voltage, current, resistance and power. Integrating meters.

Electronic voltmeters-peak, r.m.s. and average reading type voltmeter. CRO-functional block diagram, operation and application.

Electronic instruments. Q-meters, distortion meters, spectrum analyzers, audio oscillators and RF signal generators, introduction to digital voltmeters, digital display devices.

Sensors and transducers. Resistive, inductive and capacitive pick ups for non-electrical quantities. Analogue and digital data acquisition and transmission systems.

Recommended Books

- A D Helfrick and W D Cooper. Modern Electronic Instrumentation and Measuring Techniques. Prentice- Hall of India (P) Ltd., New Delhi

9. ENGINEERING MATHEMATICS

Group A

Calculus of Functions of Variables

Calculus of Functions of one variable: Successive differentiation, Leibnitz’s theorem, Rolle’s and Mean value theorems. Taylor’s and Maclaurin’s expansion theorems. Fundamental theorem of integral calculus. Elementary reduction formulae for integrals. Applications to length, area, volume, surface area of revolution, moments of centre of gravity. Infinite series- convergence, divergence ratio tests, etc.


Vector Calculus

Scalar and vector fields. Line and surface integrals. Gradient and divergence. Green’s and Stoke’s theorems and their applications.

Linear Algebra


Group B

Ordinary Differential Equations (ODEs)

Formation of ODEs, definition of order, degree and solutions. ODEs of first order; separable variables, homogeneous and non-homogeneous equations, exactness and integrating factors, linear equations and Bernoulli’s equations (general linear ODEs of nth order, solutions of homogeneous and non-homogeneous equations, operator method, methods of undetermined
coefficients and variation of parameters). Solutions of simple simultaneous ODEs. Partial differential equations and its applications. Transforms theory-Laplace, Fourier, etc.

**Numerical Methods**

Difference operators-forward, backward, central, shift and average operators, and relations between them. Newton’s forward and backward interpolations. Lagranges interpolation and the error formula for interpolation. Numerical differentiation and integration-Trapezoidal rule and Simpson’s one-third rule, including error formulae.

**Introduction to Probability and Statistics**

Basic concepts, including introduction to probability theory, Venn diagrams, central limit theorem, mean, mode and median. Properties of Beta, Poission, Exponential and Normal distributions. Correlation and regression, Students t-distribution test, Chi-square and F tests of significance.

**Recommended Books**


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10. **ELECTRICAL SCIENCE**

**Group A**


**Group B**

Elements of power distribution-d.c. 2-wire, 3-wire distribution. a.c. 3-wire and 4-wire distributions. Radial and ring main distributions. Current loadings and voltage profile in distributions. Comparison of copper efficiencies in different systems of distribution.

Power transformers, theory of operation, phase diagram, equivalent circuit. Efficiency and regulation.

Principles of energy conversion; Basic concepts rotating machines, torque and emf; d.c. machines characteristics of series, shunt and compound motors and generators.


Single-phase induction and commutator machines.

**Recommended Books**

- A H Cotton. Transmission and Distribution. ELBS edition (for Group B, first para of the syllabus only.)