Nepal Engineering Council Registration Examination

Industrial Engineering Syllabus (AInE)

Chapters 1-4 are fundamentals/principles of concepts in mechanical/industrial engineering; chapters 5-9 are related to application of industrial engineering principles in practice; and the last (10th) chapter is related to project planning, design and implementation.

1. Basic Mechanical Engineering Concept (AMeE01)

1.1 Mechanical drawing: Machine drawing, welded joints, rivets and riveted joints, bolt, nut & screw fasteners, keyways and keyed assembly, tolerance, limits and fits, Surface finish. (AMeE0101)

1.2 Engineering materials: Mechanical properties of materials and testing, metals and alloys, fatigue of metals, creep and stress fracture of metals, corrosion and control. (AMeE0102)

1.3 Material science: Crystal structure, deformation process, solidification, phase relations and strengthening process, iron-carbon diagram, types of steel and cast iron, Polymers and Composite Materials. (AMeE0103)

1.4 Basic electrical and electronics: Charge, current, voltage, power, and energy, Current and voltage laws (Kirchhoff, Ohm), Equivalent circuits (series, parallel), AC circuits, Motors and generators, Induction machines, Transformer, Capacitors, resistors, filters, relay, integrated circuit, diodes, transistor, amplifier and oscillator. (AMeE0104)

1.5 Mechanical workshop: Safety considerations, Hand tools and machine tools, lathe, shaper, milling machine, grinding machine, Drills and drilling processes, joining and fabrication process, arc and gas welding. (AMeE0105)

1.6 Organization management: organization & its types, Modern management theory, leadership & communication, entrepreneurship, motivation, HRM, development of business plan, Management Information System (MIS), Technology management. (AMeE0106)

2. Engineering Thermodynamics (AMeE02)

2.1 Thermodynamics basics: Systems and Surrounding, temperature, Thermodynamics properties, State Function and Path Function, Thermodynamics equilibrium, Zeroth law, Ideal gas, Ideal gas equation, Universal Gas Constant and Characteristic Gas Constant, Specific volume & quality, Two phase system, Two phase mixture, Development of property charts and table. (AMeE0201)

2.2 1st Law of thermodynamics: Conservation of mass and energy, Internal energy, Enthalpy & specific heat, Work Transfer and Heat Transfer for Isothermal, isobaric, isochoric process, adiabatic process & polytropic process; Steady and Unsteady state work and flow application. (AMeE0202)

2.3 2nd Laws of thermodynamics: Kelvin Planck & Clausius Statements its equivalence, Entropy and Entropy Relations, Isentropic process & efficiency, reversible and irreversible process Heat engine, Heat pumps, Refrigerator, thermal efficiency, coefficient of performance, Carnot cycle and its efficiency. (AMeE0203)

2.4 Thermodynamic cycles: Power and Refrigeration Cycle, Vapour compression & vapour absorption cycle, Rankine cycle, Brayton cycle, Otto cycle, Diesel cycle, and their efficiency and COP. (AMeE0204)

2.5 Internal combustion engines: Working of spark ignition engines and compression ignition engine; major components and their functions, Cycle of operation in four stroke and two-stroke cycle engines. (AMeE0205)

2.6 Applied thermodynamics: Basic HVAC System, Boilers, Compressors, Refrigerants and its properties, psychometrics. (AMeE0206)

3. Fluid Mechanics and Machines (AMeE03)

3.1 Fluid properties and statics: Fluid and Solid, Continuum, No-slip condition, Lagrangian and Eularian approach, Control Volume, Viscosity, Newtonian and non-Newtonian fluids, Surface tension, Pressure, Pressure Measurement, Force on a plane. (AMeE0301)

3.2 Kinematics: Types of fluid flow, Steady flow, Uniform Flow, Compressible Flow, Rotational Flow, Laminar and Turbulent Flow, Reynolds Number, Stream Function, Potential Function, Vorticity, Circulation. (AMeE0302)

3.3 Fluid flow equations: Continuity equation, Euler Equation, Bernoulli's Equation, Application of Bernoulli's Equation, Momentum Equation, Dimensional analysis & Similitude. (AMeE0303)

3.4 Laminar flow: Laminar flow in a pipe, Laminar flow between parallel plates, Major losses, Minor losses, Boundary layer, Boundary layer thickness, Laminar and Turbulent Bound Layer Flow, Flow separation (AMeE0304)

3.5 Turbines: Classification of turbines, working principle, components and their functions, turbine governors, Cavitation, Performance Curves, Draft Tube. (AMeE0305)

3.6 Pumps: Classification of pump, working principle, components and their functions, Priming, Net Positive Suction Head (NPSH), Performance Curves. (AMeE0306)

4. Engineering Mechanics and Strength of Material (AMeE04)

4.1 Applied mechanics: Concept of Particles, rigid and deformable bodies, Concept in Statics and Static Equilibrium, Forces acting on particle and rigid body, Friction, Newton's law of motion, Newton's Law of Gravitation, Work Energy Theorem, Impulse Momentum Principle. (AMeE0401)

4.2 Theory of elasticity: Stress, Strain, Hook's Law, Modulus of elasticity, Thermal stress, longitudinal strain, Lateral strain, Poisson's ratio, volumetric strain, bulk modulus, strain energy and impact loading. (AMeE0402)

4.3 Strength of materials: Centre of Gravity, Centroid, mass & area moment of inertia, polar moment of inertia, shear force and bending moment, Deflection of Beam, Analysis of Truss, Torsion of Shaft. (AMeE0403)

4.4 Theory of machines: Degree of Freedom, linkage mechanism (4R, 3R-1P, 2R-2P), kinematics of motion, kinetics of motion, velocity in mechanism, acceleration in mechanism, Force in mechanism, mechanisms with lower pairs. (AMeE0404)

4.5 Mechanism: gyroscopic couple & processional motion, governor, flywheel, balancing of mass, cam and follower mechanism, SHM, Cyclodial Motion, Uniform motion, & Uniform acceleration and retardation motion, belt, rope and chain drives, gear & gear trains. (AMeE0405)

4.6 Mechanics of solid: Analysis of Deformable body, stress on deformable body, Determinate and indeterminate structures, Thick Wall and Thin Wall Cylinder, Torsion of Non-circular sections. (AMeE0406)

5. Manufacturing and Production Engineering (AInE05)

5.1 Metrology and measurement: Introduction to metrology and measurement, general metrological terms, errors in measurement, linear measurement, angular and taper measurement, measuring instruments, applications of metrology, needs of inspection, accuracy and precision, roles and responsibilities of institution concerning metrology, calibration of measurements, acceptance test on machine tools. (AInE0501)

5.2 Fabrication processes: Different types of casting process; mould and moulding process; sheet metal forming operation, sheet metal fabrication process. Arc welding; Gas welding; Resistance welding; soldering and brazing; different inspection methods of welding; Heat affected Zone in welding; welding defects, metallurgical aspects of welding. (AInE0502)

5.3 Metal working processes: Cold Working, Hot working; advantages and limitation of metal working process; forging; rolling; drawing; extrusion; Determination of flow stress; Principal stresses; Tresca & Von-Mises yield criteria; Concepts of plane stress & plane strain. (AInE0503)

5.4 Non-conventional machining and manufacturing: Electric discharge machining; ultrasonic machining; electro chemical machining; laser beam machining; CNC machining; industrial robotics. (AInE0504)

5.5 Theory of metal cutting: Single point cutting tool nomenclature and geometry; merchants circle diagram and analysis; tool life and tool failure. (AInE0505)

5.6 Cutting tools: Types and selection of cutting tool materials; Cutting fluid and its properties; Heat Generation in metal cutting; Heat Distribution in tool and work in progress. (AInE0506)

6. Industrial Management (AInE06)

6.1 Management theories: Evolution of management theory, Decision making, Leadership and communication, Production/Operation Management and System Concepts, Marketing management process, Marketing strategy and selecting marketing strategies, Customer analysis, Organizational Behaviour and Basic psychology in organizations, Motivation. (AInE0601)

6.2 Entrepreneurship development: Importance and evolution of enterprises, Evolution, theories and themes of entrepreneurship development, Identification of viable business ventures, Small and medium enterprises (SMEs) in Nepal, Women Entrepreneurs in Nepal, Procedure and requirement of initial environment examination (IEE) and environment impact assessment (EIA). (AInE0602)

6.3 Industrial laws: Laws in Nepal and International Perspective; Capital and Assets of Industry; Industry registration rules, regulation and process in Nepal; Facilities and Exemptions to be obtained by different types of Industries, Labour relation and ILO & UN related provisions; Intellectual Property Rights. (AInE0603)

6.4 Supply chain management: Supply chain stages and decision phases, process view of a supply chain; Competitive supply chain strategies and Strategic fit; Drivers of supply chain performance, Distribution Networking; Models for facility location and capacity allocation; Designing transportation network; Modes of transportation and their performance characteristics; Revenue Management in the supply chain, Co-ordination in a supply chain and Bullwhip effect; The Supply Chain IT framework; Customer Relationship Management; Internal Supply Chain Management; Supplier Relationship Management. (AInE0604)

6.5 Inventory management and control: Material requirement planning, safety stock and re-order point, quantitative inventory models; determination of continuous and discrete demand situations; Dependent and independent demand items; Just-In-Time (JIT) inventory management systems; Store management; Inventory evaluation and stock verification. (AInE0605)

6.6 Production management: New Product Development; Production and operations strategy and interfaces; Production/operation function and the organization; Production/operation strategy, Relationship between Production and Operation Management & financial management; Production and Operation Management in manufacturing and service environments; Concepts of Lean Manufacturing and Six Sigma; Principles of Quality Management, Statistical Quality Control / Statistical Process Control; ISO Certification (9001, 14001). (AInE0606)

7. Decision Making (AInE07)

7.1 Economics: Application of supply and demand, Demand and consumer behaviour Analysis of Costs; Analysis of perfectly competitive markets, Imperfect competition and monopoly; Oligopoly and Monopolistic competition; Uncertainty and game theory; Factor Markets: Labour, Land and Capital; Unemployment; Inflation; Fiscal Policy; Monetary Policy. (AInE0701)

7.2 Concurrent engineering: Basic Principles and components of Concurrent Engineering; Benefits of CE and cooperative CE Teams; Introduction of Manufacturing Competitiveness; Product and Services, Process and Methodologies; Performance Measurement; Process Reengineering approaches

and Enterprise Models; System Thinking, System Complexity and System Integration; Sequential versus Concurrent Engineering. (AInE0702)

7.3 Value engineering: Concept of Value engineering, value management and value analysis; Application of value engineering in product design; Value engineering phases, value engineering process; Relationship Between Value Engineering and Quality and Productivity. (AInE0703)

7.4 Operations research: Mathematical Modelling; Regression analysis; Linear Programming, Duality theory and sensitivity analysis, Time series and Moving average methods; Formulations of Game Theory, Simulation Process; Types of Probability Distribution, Types of Simulation and application; Monte Carlo Sampling Process. (AInE0704)

7.5 Work study: Concepts and Measurement of Productivity; Factors affecting Productivity and Productivity Improvement Techniques; Concepts of Work Study; Recording Techniques of Motion Study; Time study and Work Measurement and Determination of Standard Time. (AInE0705)

7.6 Ergonomics: Concepts of Ergonomics; Design of Man Machine System; Design of Display and Controls; Design of Work Places; Measurement of Work on Human Body; Computer Based Ergonomics. (AInE0706)

8. Industrial Systems (AInE08)

8.1 Hydraulic and pneumatic systems: Hydraulic circuits and pneumatic circuits; fundamentals, design and selection of hydraulic and pneumatic circuits; Working principle and application of different types of compressor. (AInE0801)

8.2 Electrical systems: Constructional Details and Working principle of Transformers; Operation of Transformer with Load; Voltage Regulation; Efficiency and Losses of Transformer; Constructional Details and Working principle of DC Generator, DC Motor, Three Phase Induction Motor, Three Phase Synchronous Motor; Industrial and domestic electrical supply system. (AInE0802)

8.3 Thermal systems: Working Principle and application of Boiler and Furnace; Operating strategies for cogeneration plant; Types of fuel used in furnace; General fuel economy measures in furnaces; Boiler performance assessment; Boiler safety. (AInE0803)

8.4 Material handling systems: Factors in Material Handling Problems; Principles of Material Handling, Reduction in Time, Reduction in Handling, Maintenance and Repair, Material Handling equipment and selection, Unit Load principle of Material Handling. (AInE0804)

8.5 Energy systems and policies: Types of energy, Energy conversion and conservation, Energy and the environment, Types and characteristics of power systems, characteristics of power systems, Basic elements of all power systems; Calculations of power systems; Energy Policies; National and international energy scenario; Financial and Economic analysis of energy project and selection; Energy pricing and Tariff Selection. (AInE0805)

8.6 Industrial automation: Control Systems, Automatic Control, Open Loop and Closed Loop Control, Path and speed control systems, Types of Standard Inputs (Signals), Adaptive Control, Servo Systems; Position Sensors, Pneumatic Limit Valves and Backpressure Sensors, Pressure Switches, Resolvers, Incremental& Absolute Encoders, Decoders, Displacement Sensors, Velocity Sensors, Electromagnetic Actuators and Programmed Control, Basic Computer Numerical Control System and Micro Controllers. (AInE0806)

9. Industrial Facility Design and Maintenance (AInE09)

9.1 Plant layout and design: Plant Design; Location Factors, Location Theory and Models; Industrial Building Design and Construction; Types of Plant Layout; Classes of Plant Layout Problems; Evaluation of Plant Layouts; Systematic Layout Planning. (AInE0901)

9.2 Occupational health and safety: Fundamental of safety, accident, causes and preventions; engineering methods of hazards identification and reduction, physical environment; code and regulation for workers safety and health; Rules and regulation of national and international organization regarding hygiene and safety. (AInE0902)

9.3 Maintenance of industrial systems: Concepts of Maintenance Management; Types of Maintenance; Maintenance practices in Nepal; Maintenance work of mechanical and electrical systems; Lubricants and Lubrication system; Condition monitoring techniques; Maintenance Facilities; Maintenance Organisations and Quality Circle. (AInE0903)

9.4 System reliability: Concepts of Reliability, Failure of systems and its modes, Measure of Reliability, Reliability Function, Hazard Rate, Mean Time before Failure and their interrelations. Reliability Data Analysis, Performance Parameters, Calculation of Failure Rate, Application of Weibull distribution. System Reliability and Modelling, Simulation and Reliability Prediction. (AInE0904)

9.5 Heat, ventilation and air conditioning system: Concepts Air refrigeration; Vapour compression system and Cryogenics; Refrigerants and its types; Methods of food preservation; Control components used in refrigeration systems: automatic expansion valve, thermostatic expansion valve and superheat setting. (AInE0905)

9.6 HVAC system design: Concepts of Psychometric Chart; Factors Influencing Thermal Comfort; Air quality and Contaminants; Indoor air quality and Effects on health conditions; Controlling Indoor Air Quality; Heating and Cooling Load Determination. (AInE0906)

10. Project Planning, Design and Implementation (AALL10)

10.1 Engineering drawings and its concepts: Fundamentals of standard drawing sheets, dimensions, scale, line diagram, orthographic projection, isometric projection/view, pictorial views, and sectional drawing. (AALL1001)

10.2 Engineering Economics: understanding of project cash flow; discount rate, interest and time value of money; basic methodologies for engineering economics analysis (Discounted Payback Period, NPV, IRR & MARR); comparison of alternatives, depreciation system and taxation system in Nepal. (AALL1002)

10.3 Project planning and scheduling: project classifications; project life cycle phases; project planning process; project scheduling (bar chart, CPM, PERT); resources levelling and smoothing; monitoring/evaluation/controlling. (AALL1003)

10.4 Project management: Information system; project risk analysis and management; project financing, tender and its process, and contract management. (AALL1004)

10.5 Engineering professional practice: Environment and society; professional ethics; regulatory environment; contemporary issues/problems in engineering; occupational health and safety; roles/responsibilities of Nepal Engineers Association (NEA). (AALL1005)

10.6 Engineering Regulatory Body: Nepal Engineering Council (Acts & Regulations). (AALL1006)