

Nepal Engineering Council Registration Examination

Mechanical Engineering Syllabus (AMeE)

Chapters 1-4 are fundamentals/principles of concepts in mechanical engineering; chapters 5-9 are related to application of 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 Eulerian 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 Boundary 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 & precessional motion, governor, flywheel, balancing of mass, cam and follower mechanism, SHM, Cycloidal 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 Technology

(AMeE05)

5.1 Foundry: cast making, metal melting, metal casting, die casting, precision casting, cleaning the castings, application of foundry. (AMeE0501)

5.2 Heat treatment: Annealing, Quenching, Tempering, Normalizing, material modification, cyaniding, nitriding, solidification process, Powder metallurgy. (AMeE0502)

5.3 Metal working: advantages, types of hot working (rolling, forging, extrusion), benefits, cold rolling, drawing, squeezing, bending, shearing, shot peening, hobbing. (AMeE0503)

5.4 Machine tools: Lathe, milling machine, drilling machine, grinding, boring machine, shapers, sawing and broaching; their types and operations, pressing. (AMeE0504)

5.5 Welding: Fundamentals of welding, types of welded joints, applications of arc welding, gas welding, spot welding; types of brazing and their applications, defects of welding, soldering & brazing. (AMeE0505)

5.6 CAD/CAM (Computer-aided Design & manufacturing): Additive manufacturing: principle and benefit of CAD/CAM, Rapid Prototyping, Flexible Manufacturing System, CNC in manufacturing. (AMeE0506)

6. Mechanical Design (AMeE06)

6.1 Design classification: Design requirement, design consideration, needs and benefits of codes and standards, mechanical engineering standards, ISO series. (AMeE0601)

6.2 Mechanical components: Gears, belt & pulley, coupling, bearing and its types, bolts, spring and damper, screw, brakes, clutch, shaft. (AMeE0602)

6.3 Loads and tools: forces and moments, cutting tools, press tools, drill, forging dies, lubrication and coolants. (AMeE0603)

6.4 Static analysis of systems: Design for static strength, Transmission components, Design of fasteners and connections, Design of load carrying members. (AMeE0604)

6.5 Mechanical vibrations: Generalized Coordinates & Degree of freedom of system (DoF), damped and un-damped free responses, Forced Harmonic Responses of Discrete System, natural frequency and resonating frequency. (AMeE0605)

6.6 Problem solving and decision-making: The Problem-Solving Process, Invention, Brainstorming, Problem Statement, Preparation, incubation, inspiration and verification, Decision matrix and tree. (AMeE0606)

7. Repair and Maintenance of Engineering System (AMeE07)

7.1 Need for maintenance: Reasons for need of maintenance, Benefits of a good maintenance plan. (AMeE0701)

7.2 Safety precautions and protective coating: Fire Protection, electrical Hazards, Machine Tools Safety, types of corrosion, prevention methods, coating systems and cathodic protection. (AMeE0702)

7.3 Maintenance strategy: Factors for choosing maintenance strategy, Preventive maintenance, Scheduled maintenance, Break down maintenance, Total productive maintenance, Total planned quality maintenance, condition monitoring. (AMeE0703)

7.4 System safety and reliability: Failure modes, Mean Time before Failure and their interrelations, Bathtub characteristics of failure of equipment and machinery, Causes and Effects of failure, Fault Tree Analysis, Event Tree Analysis, Hazard Analysis, Block Diagram, Fish Bone Diagram. (AMeE0704)

7.5 Risk assessment: Definition and measurement of risk, risk analysis techniques, risk reduction resources, industrial safety and risk assessment. (AMeE0705)

7.6 Non-destructive techniques (NDT): Ultrasonic testing, Dye Penetration, Magnetic resonance testing, X-ray; Eddy Current testing. (AMeE0706)

8. Industrial Engineering and Automation (AMeE08)

8.1 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, calibration of measurements, acceptance test on machine tools. (AMeE0801)

8.2 Sensors and actuators: Types, uses in fluid pressure measurement, liquid flow measurement, temperature measurement, selection of sensors, mass measurement, force and torque measurement, hydraulic, pneumatic electric actuators, its applications and selection. (AMeE0802)

8.3 Measurement of physical quantity: Standards, linear and angular measurement, error in measurement, calibration, zero order, first order and second order system, damping, static characteristics of measurement. (AMeE0803)

8.4 Design of production systems: Plant Layout and Location, Material Handling, Production planning and Control. (AMeE0804)

8.5 Inventory control: Economic Order Quantity, Safety Stock; Reorder Quantity; Lead Time, ABC Analysis, Forecasting Techniques. (AMeE0805)

8.6 Engine performance and testing: Engine efficiencies, testing of engines, engine power and heat, engine cooling, knocking and pre-ignition, carburetor and fuel injection system. (AMeE0806)

9. Heat Transfer, Energy Resources and Environment (AMeE09)

9.1 Heat transfer: Conduction process, convection process, electromagnetic spectrum (radiation), heat transfer in plane wall, tubes & sphere, Stefan's Boltzmann law, Reflectivity, transmissivity & absorptivity, Overall heat transfer Coefficient. (AMeE0901)

9.2 Application of heat transfer: Free and Forced Convection, Fins, Heat Exchangers its types and effectiveness. (AMeE0902)

9.3 Conventional and non-conventional energy resources: classification, properties of coal, oil and natural gas, solar, bio, wind, micro and small hydro, harnessing technologies, Nuclear energy, fuel cells and hydrogen fuel system use and their impacts on environment. (AMeE0903)

9.4 Combustion and combustion products: combustion process, condition necessary for combustion, phases of combustion, methods of controlling fire, harmful effects of combustion products and their controls, Engine emissions. (AMeE0904)

9.5 Engine fuels: Chemical structure of petroleum, rating of engine fuels, fuel supply system, fuel injection system, lubrication system, grading of lubrications, specific fuel consumption, conversion. (AMeE0905)

9.6 Environment and pollution control: air pollution, water pollution, noise pollution, solid waste, air quality, pollution dispersion, Global issues, National issues. (AMeE0906)

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)