

Nepal Engineering Council Registration Exam
Automobile Engineering Syllabus (AAME)

Chapters 1-4 are fundamentals/principles of concepts in Mechanical Engineering; chapters 5-9 are related to internal combustion engines and automobiles engineering; 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 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 & 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. Automobile Engines and Electric Vehicles (AAmE05)

5.1 Basic of I.C. engines: Actual cycles for I.C Engines, Comparison of thermodynamic and actual cycles, Assumptions in fuel air analysis, Composition of cylinder gases (AAmE0501)

5.2 **Classification of I.C. Engines:** Nomenclature and parts of I.C. Engine and their materials , and their manufacturing processes – Casting, Forging , Comparison of Four stroke and Two-stroke Cycle engines, performance, components and materials (AAmE0502)

5.3 **Multi cylinder engines:** The Cyclic-torque and the Flywheel Effect, Merits and Limitations of Single- and Multi-cylinder Engines, Arrangement of Cylinders, Firing Order of Cylinders, Engine Balancing, (AAmE0503)

5.4 **Valves in I.C. engines:** Arrangement of Valves, Design aspects of intake and exhaust manifolds, inlet and exhaust valves, valve springs, rocker arm, Tappets and valve train, Valve Timing Diagram. (AAmE0504)

5.5 **Basics of electric vehicle:** Introduction, Types; Hybrid vehicles, Fully Electric Vehicle, Electric Vehicle architecture/block, High voltage system and its component, Low voltage system and its component, Electric Vehicle charging system: fast and slow charging, (AC and DC Charging System), Types of Charging connector (Type 1, Type 2, Chademo & GBT). (AAmE0505)

5.6 **Advanced I.C. engines:** Low heat rejection (LHR) Engines, Homogeneous charge compression ignition, Rotary Engine-Six stroke engine concept, Recent development in IC Engines. (AAmE0506)

6. Fuel Supply System and Ignition System (AAmE06)

6.1 **Petrol Engine Fuels:** Fuels for Spark ignition (SI) Engine, mixture requirements, Fuel-Air ratio, Simple Carburetor and auxiliary systems (AAmE0601)

6.2 **Injection system for Diesel Engine:** Drawbacks of carburettor and introduction of Injection systems, Single-point and Multipoint injection, Gasoline Direct Injection (AAmE0602)

6.3 **Ignition system:** Requirements and working of Ignition system and spark advance mechanisms; types of ignition system: Battery Point Ignition System, Magneto Ignition System, Electronic Ignition Systems; Distributor less ignition system, Combustion phenomenon in SI Engines, Ignition delay, Flame propagation, Pressure-Crank angle diagram, abnormal combustion, Auto ignition, Detonation and Knocking, Factors affecting combustion and detonation (AAmE0603)

6.4 **Compression ignition engines:** Fuels for CI engines, Air induction system, inline injection pump, distributor and unit Injection pumps, fuel injector, types of nozzle, common rail direct injection system; Combustion phenomenon in C I engines, Stages of combustion, Delay period, Knocking, Pressure-Crank angle diagram, Factors affecting combustion and knocking, Types of combustion chambers (AAmE0604)

6.5 **Lubrication and cooling system:** Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems, Necessity of engine cooling, Types of cooling system their comparison: Air cooling, Liquid cooling, Importance of coolant, types of coolant, (AAmE0605)

6.6 **Supercharging and turbo-charging:** Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers; Engine Exhaust Emission: Formation of NO_x, HC, CO and particulate matters, Constituents of exhaust emission, its harmful effect on environment and human health. (AAmE0606)

7. Engine Testing, Performance and Batteries (AAmE07)

7.1 **Engine performance parameters, basic measurements:** Measurement of Brake Power, Indicated Power, Frictional Power, Fuel Consumption, Air consumption, BMEP, Performance characteristic of SI and CI Engine, Factors affecting performance characteristics of SI engines (AAmE0701)

7.2 Effect of load and speed on Mechanical, Indicated Thermal, Brake Thermal and Volumetric efficiencies of engines, Heat balance sheet (AAmE0702)

7.3 Alternative fuels: Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas – Biodiesel- Biogas, Producer Gas, Properties and Suitability, Alternative fuel vehicles, examples, Merits and demerits
(AAmE0703)

7.4 Basic electronic engine controls: Electronic Control module (ECM), Inputs required and output signals from ECM, Basics of CAN bus and its protocol
(AAmE0704)

7.5 Sensors: Throttle Position, Inlet Air Temperature, Coolant Temperature, Crankshaft Position, Camshaft Position, Mass Air flow and Exhaust Gas Oxygen sensors, their construction and importance in ECM, Electronic Spark control, Air Management system, Idle speed control, Electronic Throttle Control, Fuel Pump, Purge Control Solenoid Valve, Injectors, their construction, and importance in output system.
(AAmE0705)

7.6 Storage battery: Types of storage battery, Principles of operation, Lead Acid Battery construction, charge measurement, capacity, efficiency, battery life and maintenance.
(AAmE0706)

8. Fundamentals of Automobiles **(AAmE08)**

8.1 Development history and basic structure: Scope and future of automobiles, Classification of motor vehicle, vehicle specifications, Major Components of an automobile; Basic Structure: Chassis layout and components, Types of chassis frames, Vehicle operation, front wheel, rear wheel, all-wheel drive, Vehicle design considerations.
(AAmE0801)

8.2 Transmission system: Clutch-Purpose and function of a clutch, Types of clutches, Fluid couplings, clutch common troubles and diagnosis; Gearbox: Manual and Automatic - Introduction, purpose and function, Types of transmission: Constant mesh, sliding mesh, synchromesh, and epicyclic gearboxes, Double Clutch Transmission(DCT) and CVT (Continuous Variable Transmission) Overdrive and transfer case: Function, operation, common troubles and diagnosis, Universal joints and propeller shafts: Types and function of universal joints, Common troubles and diagnosis, Final drive: Main parts, function and types, differential, four wheel drive, Common troubles and diagnosis, Limited slip differential
(AAmE0802)

8.3 Suspension and steering system: Suspension: Introduction, objectives, types and main parts, and troubleshooting; Steering System – Introduction, types, function of steering system, Steering gear boxes, Power steering systems, Steering geometry, Wheel alignment; Wheel and Tyres - Types of wheels, wheel dimension, Types of tyres, Tyre properties and Nomenclature; Factors affecting tyre life, tyre pressure and its effect, changing of tyres and tyre rotation.
(AAmE0803)

8.4 Braking system: Introduction and objective of brakes, stopping distance and braking distance, Main parts of brakes, Types of service brake: Mechanical, hydraulic, pneumatic, power-assisted brakes, Brake adjusting, bleeding, Brake drum and caliper construction, Brake shoe and lining materials, working of Antilock braking system.
(AAmE0804)

8.5 Electrical system: Lighting and wiring system, starting system, charging system, electrical and electronic instruments, other accessories in modern cars relating safety and antitheft system.
(AAmE0805)

8.6 Vehicle dynamics: Forces acting on a vehicle body, Tyre forces and moments, Traction characteristic of vehicle, Aerodynamics of vehicle, Dynamic characteristics of motor vehicle, Braking dynamics and stability of vehicle, suspension dynamics of motor vehicle.
(AAmE0806)

9. Workshop Layout and Vehicle Maintenance **(AAmE09)**

9.1 Garage and workshop: Garage and workshop layout and design, measuring instrument, types of measurement, errors in measurements, tools and equipment, calibration of tools and equipment, On Board Diagnosis (OBD) System Diagnosis and procedure.
(AAmE0901)

9.2 Fundamentals of workshop operation: ERP, Inventory management and control, Calculation of workshop post, number of workers and area of different Sections of the workshop. (AAmE0902)

9.3 Vehicle maintenance and repair: Types and purposes, advantages and limitations. (AAmE0903)

9.4 Emission in vehicles: Role of Maintenance and repair on pollution control, Vehicular pollution control methods, Evaporative emission control system, Exhaust Gas Recirculation system, closed loop control system, Catalytic convertors, particulate traps, Noise Pollution control methods. (AAmE0904)

9.5 Norms and Standards: EURO and other standards, Road safety standards, Road transport management, Road norms and Standards. (AAmE0905)

9.6 Motor vehicle Acts and Rules, Registration of motor vehicles: Driving license, traffic control, Insurance against risk (Comprehensive and Third-Party Policy). (AAmE0906)

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)