

Nepal Engineering Council Registration Examination
Automation Engineering Syllabus (AAuE)

Chapters 1-4 are fundamentals/principles of concepts in automation 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. ENGINEERING MECHANICS AND STRENGTH OF MATERIALS (AAuE01)

1.1 Rigid bodies, deformed bodies, particles and free body diagram, equilibrium in two dimensions and three dimensions, Forces: point, surface, traction, translational and rotational.
(AAuE0101)

1.2 Center of gravity, centroid, second moment of inertia, radius of gyration, parallel axis theorem, instantaneous center of rotation, coriolis acceleration, Particles: impulsive motion, direct central impact, oblique central impact, Rigid bodies: impulsive and momentum.
(AAuE0102)

1.3 Normal stress, shear stress, bearing stress, normal strain, shear strain, factor of safety, stress concentration, poisson's ratio, torque, torsion, Point load, distributed load, axial force, shear force and bending moment.
(AAuE0103)

1.4 Pure and simple bending, elastic range deformation of a symmetric member in pure bending, Torsion: stress and deformation in a uniform shaft in elastic range.
(AAuE0104)

1.5 Transformation of stresses and strain, uniaxial stress system, biaxial stress system, pure shear stress system, plane stress system, principal stresses, maximum shearing stress, principal planes.
(AAuE0105)

1.6 Stress and strain, ductile and brittle materials, tensile test, hardness test, Brinell, Rockwell, Vickers, Knoop test, Impact test: Charpy and Izod test, fatigue test: S-N curve, endurance limit, creep test: creep failure, rupture curve, temperature and stress level on creep of material.
(AAuE0106)

2. MACHINE AND MECHANISM (AAuE02)

2.1 Shaft, shaft materials, shaft layouts, bearing types, bearing life, journal bearing, journal bearing material, lubrication, types of lubrication.
(AAuE0201)

2.2 Spur gear, helical gear, bevel gear, worm gear, clutches, brakes, couplings and flywheel.
(AAuE0202)

2.3 Belts, flat belt, round belt, V-belt, timing belt, roller chain, wire rope.
(AAuE0203)

2.4 Mechanism, configuration, links, chains, inversion, transmission of motion, mobility, degree of freedom, linkage, four bar linkage mechanism, kinematic inversion, Grashof's law.

(AAuE0204)

2.5 Cam, types of cam, geometry of involutes, characteristics of involute tooth action, interference of involute gears, backlash in involute gears.

(AAuE0205)

2.6 **Kinematics of mechanism:** displacement, velocity, acceleration, solid modeling, 2D modeling, 3D modeling, Finite element modeling, natural frequencies, mode shapes.

(AAuE0206)

3. MANUFACTURING AND PRODUCTION

(AAuE03)

3.1 **Manufacturing:** product cycle, material flow, processing, information flow, tribology in manufacturing, Material types: iron, steel, non ferrous alloys: aluminum, magnesium, copper, nickel, cobalt, titanium, polymers: thermoplastic, thermosets, elastomers, polymers, ceramic materials, composite material, nano-composite material, laminar composite material.

(AAuE0301)

3.2 Limits, fits and tolerance, selection of fits and tolerance.

(AAuE0302)

3.3 **Material joining:** mechanical, welding, brazed, metallurgy of welding, Arc welding, resistance welding, TIG welding and MIG welding, Plasma arc welding.

(AAuE0303)

3.4 **Deformation process of material:** cold work, annealing, hot work, sheet metal production, shearing, punching, sheet metal bending, tube bending, formability.

(AAuE0304)

3.5 Casting, powder metallurgy, forging, forging technology, characteristics and defects in forgings, flat rolling, shape rolling, extrusion, wire, bar and tube drawing.

(AAuE0305)

3.6 **Maintenance:** maintain, maintenance, preventive maintenance, break down maintenance, Predictive maintenance, condition based maintenance, reliable centered maintenance, fault tree, Failure mode and effective analysis.

(AAuE0306)

4. INDUSTRIAL AUTOMATION

(AAuE04)

4.1 **Actuators:** Hydraulic, Pneumatic, electrical, thermal and Mechanical Actuators.

(AAuE0401)

4.2 DC generator, separately and self excitation, series, shunt and compound generator, losses and efficiency, DC motor: starting of DC motor, speed control of DC motors losses and efficiency of DC motors, stepper motors.

(AAuE0402)

4.3 Single phase induction motor and generator, torque-slip characteristics, three phase synchronous generator and motor, excitation, load and power factor control.

(AAuE0403)

4.4 PLC, selection of PLC, number systems and codes, I/O devices, motor control, PLC programming, PLC timer, PLC counter, compare , jump, MCR instruction, PLC networks in manufacturing. (AAuE0404)

4.5 Power semiconductor, Thyristor, GTO, TRAIC. (AAuE0405)

4.6 Converters, conversion of alternating current to direct current (AC/DC), conversion of AC/AC, conversion of DC/DC, conversion of DC/AC. (AAuE0406)

5. INSTRUMENTATION AND MEASUREMENT (AAuE05)

5.1 Calibration, measurement error, methods of measurements, moving coil meter, shunt meter, volt meter, multimeter, digital multimeter, watt meter. Zero order, first order and second order measurement system. (AAuE0501)

5.2 **Transmission media:** wired media (twisted pair, fiber optics ,coaxial) (AAuE0502)

5.3 Tansducers: Potentiometer sensors, metal resistance temperature (RTD) sensors, thermistors, photoresistors, capacitive, inductive, electromagnetic, hall effect sensors, thermocouples, piezoelectric and pyroelectric, optoelectronic, ultrasound, fiber optic, biosensor and microsensor. (AAuE0503)

5.4 **Strain gage:** electric type, metallic resistance strain gage, ballast type strain gage, bridge circuit, constant current strain gage, constant voltage strain gage, semiconductor gage, piezoresistive gage. (AAuE0504)

5.5 **Mechanical measurement:** Force, torque and moment, pressure measurement: static and dynamic, fluid flow measurement, temperature measurement. (AAuE0505)

5.6 Static characteristics of measurement, accuracy, precision, tolerance, range, linearity, sensitivity, threshold, resolution, sensitivity to disturbance, hysteresis effect, dead space. (AAuE0506)

6. ELECTRICAL ENGINEERING (AAuE06)

6.1 Electricity, negative polarity, positive polarity, current, voltage, series circuit, parallel circuit, voltage divider, series voltage divider, series voltage divider with parallel load current, current divider, current divider with two parallel resistance, Krichhof's law, star to delta and delta to star transformation. (AAuE0601)

6.2 Conductor, function of conductor, types of conductor, connectors, printed wiring, switches, fuses, wire resistance, insulator, batteries, voltaic cell, primary cell, lead acid wet cell, series and parallel connected cells, current drain, constant current and constant voltage source. (AAuE0602)

6.3 Alternating current, alternating voltage, sine wave, frequency, period, wavelength, phase angle, time factor in frequency, phase, Average current and voltage, RMS value of current and voltage, phasor representation. (AAuE0603)

6.4 Resistor, types of resistor, variable resistor, Rheostat and potentiometer, color coding of resistor, ohm's law, power dissipation in resistance, power rating of resistor, choosing resistor for a circuit. **(AAuE0604)**

6.5 Capacitors, capacitance, charging and discharging of capacitor, electrolytic capacitor, capacitor coding, series capacitance, parallel capacitance, energy stored in a capacitor, capacitive reactance, capacitive circuit, RC circuit. **(AAuE0605)**

6.6 Inductors, induction, self induction, self induced voltage, mutual inductance, impedance variable inductance, inductance in series and parallel, energy stored in a magnetic field of inductance, inductive reactance, RL circuit, RLC circuit and phasor representation, power in resistive, inductive and capacitive circuit, active and reactive power, power factor. **(AAuE0606)**

7. ELECTRONICS ENGINEERING **(AAuE07)**

7.1 **Transformer:** ideal transformer, load and no load operation, transformer impedance, core, types of core, core losses, losses in a transformer, three phase transformer, types of transformer.

(AAuE0701)

7.2 Semiconductor, diodes, p-n junction, transistors, PNP and NPN transistors, Bipolar Junction Transistor, volt ampere characteristics, Field effect transistor, MOSFET, CMOS **(AAuE0702)**

7.3 Rectifier, half wave rectifier, full wave rectifier, full wave bridge rectifier, output waveform, ripple, ripple factor, capacitor input filter, Zener diode, light emitting diode. **(AAuE0703)**

7.4 Time constant, RC and L/R time constants, RC wave shape, long and short time constant, Resonance, resonance effect, series resonance, resonant frequency, tuning, mistuning, damping.

(AAuE 0704)

7.5 Filters, transformer coupling, capacitive coupling, by pass capacitor, filter circuits, low pass filter, high pass filter, decibels and frequency response curve, resonant filters, interference filter.

(AAuE0705)

7.6 Amplifiers, Class A amplifier, Class B amplifier, Class C amplifier, Class B push pull amplifier.

(AAuE0706)

8. DIGITAL AND MICROPROCESSOR **(AAuE08)**

8.1 Number system, logic gates, logic circuits, OR gate, AND gate, NOT gate, NOR gate, NAND gate, X-OR gate, XNOR gate. **(AAuE0801)**

8.2 Adder, subtracter, multiplexer, demultiplexer, decoder, seven segment display encoder, priority encoder, sequential circuit, flip-flop, types of flip-flop, master slave clock, counters. **(AAuE0802)**

8.3 Memories, semiconductor memory, magnetic based memory, optical based memory, main memory, second memory, storage devices, backup memory, cache memory, virtual memory. (AAuE0803)

8.4 RTL, DTL, TTL, ECL, timing circuit, multivibrators, timers, timing wave form using OP AMP, registers, types of registers, ring counters, display devices, LED, Laser, Liquid Crystal Display. (AAuE0804)

8.5 Digital to Analog converter (DAC), weighted resistor DAC, R-2R Ladder DAC, 8 bit DAC, Analog to digital converter (ADC), types of ADC. (AAuE0805)

8.6 Microprocessor, Assembly programming language, C language, 8085 microprocessor, functional component of 8085 microprocessor, register section, ALU, timing and control section, interrupt control, serial input, output control. (AAuE0806)

9. CONTROL SYSTEM ENGINEERING (AAuE09)

9.1 Control system, open loop control system, closed loop control system, transient response, steady state response, stability. (AAuE0901)

9.2 Operational amplifier, amplitude modulation, frequency modulation, pulse modulation. (AAuE0902)

9.3 Frequency domain, electrical network transfer function, translational, rotational, mechanical system transfer function, electromechanical transfer function. (AAuE0903)

9.4 Transient and steady state response, first order system, second order system, under damped second order system, system response with poles and zeros. (AAuE0904)

9.5 PID controller, characteristics of PID controller, one loop step response, proportional control, proportional derivative control, proportional integral control. (AAuE0905)

9.6 Control system by root locus method and frequency response method, lead compensation, lag compensation, lag-lead compensation, parallel compensation. (AAuE0906)

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*)