

**Nepal Airlines Corporation**  
**Syllabus for Senior Technical Officer Grade VII (Avionics)**  
**Aircraft Maintenance Service**  
**Internal Competition**

Subject: Service Related

Full Marks – 100

Time: 50 Minutes

Pass Marks- 40

No. of Questions -50 Objective Questions each of 2 Marks

All answers must be written in Black letters

**Part A: Fundamentals (40 Marks)**

**1. Applied Mathematics:**

**05 Marks**

- a. Arithmetic: fraction & decimals, factor & multiplies percentage, ratio & proportion, area and volume, square, cube, square root.
- b. Algebra: Addition, subtraction, multiplication & division, simple equations.
- c. Geometry: lines, angles, simple geometrical construction, graphical representation, nature and uses of graph.
- d. Trigonometry: sine, cosine & tangent ratio, solution of right angled triangle using trigonometrical ratios.

**2. Physical Science:**

**10 Marks**

- a. Matter: Nature of matter, the chemical elements, structure of atom, molecules, chemical compounds. state: solid, liquid & gases, changes between states.
- b. Mechanics static force, moment and couple, vector & scalar quantity, center of gravity, element of theory of stress, strain and elasticity, tension, compression, shear torsion, pressure and buoyancy in liquid.
- c. Kinetics: linear motion, speed, velocity, angular velocity, acceleration, inertia, momentum, torque, work, energy, power, Newton's laws of motion.
- d. US, British & metric system of measurement & their conversion.
- e. Fluid Mechanics: Pressure, density, specific gravity, viscosity, Bernoulli's Theorem, Venturi, Pascals principle. Archimedics principle, Properties of fluids.
- f. Thermodynamics: Temperature, thermometers, and temperature scales, degree Celcius, Degree Farenhiet, degree Kelvin etc. Conversion between scales. Heat definition, Quantity of Heat, Units of Heat ( Calories, B.T.U,C.H.U,) heat capacity, Specific Heat, Heat Transfer, Convection, radiation, conduction, expansion of solids and liquids, coefficient of linear expansion of solids, bimetallic strips, Elementary Thermo dynamics, First and Second Laws. Gases, ideal gases laws, Charles, and Boyles laws. Internal energy of a gas, specific heat of gas ,relationship between internal energy and heat.
- g. Isothermal and adiabatic expansion and compression, engine cycles, constant volume and constant pressure, refrigerators and heat pumps. Latent heat of fusion and evaporation, thermal energy, heat and combustion.
- h. Optics: Light, nature of light, speed of light, laws of refraction & reflection, lenses, fiber optics.
- i. Wave motion & sound: Wave motion, mechanical waves, sinusoidal wave motion, interference phenomena, standing waves.
- j. Sound: Speed of sound, production of sound, intensity, pitch and quality, Doppler effect

### 3. Electricity and Magnetism fundamentals:

10 Marks

- a. Electron theory, structure and distribution of electric charges within atoms, molecules, ions, compounds molecular structure of conduction, semi conductors & insulators.
- b. Static electricity & distribution of electrostatic charges, electrostatic laws of attraction and repulsion. Unit of charge, Coulomb's law, conduction of electricity in solids, liquids, gases & vacuum.
- c. Electrical terminology: potential difference, electromotive force, voltage, current, resistance, conductance, charge, conventional current flow, electron flow.
- d. Generation of electricity: Production of electricity by the following methods light, heat, friction, pressure, chemical reaction, magnetism and motion
- e. DC source of electricity: construction and basic chemical action of primary cells, secondary cells, lead acid cells. Nickel-cadmium cells, other alkaline cells; cells connected in series and parallel: internal resistance and its effect on battery; construction, materials and operation of thermo couples; operation of photocells.
- f. DC circuits: Ohm's law, Kirchhoff's law and current laws; calculation using the above laws to find resistance, voltage and current; significance of the internal resistance of a supply.
- g. Resistance/resistors: Resistors color code, value and tolerances, wattages ratings, resistor in series and parallel, operation and use of potentiometers and rheostats, Wheatstone Bridge, positive and negative temperature coefficient conductance, variable resistors, thermistors, voltage dependent resistors.
- h. Power: work & energy, dissipation of power by a resistor. power formula
- i. Capacitance/capacitor: operation and function of a capacitor, factors affecting capacitance: area of plates, distance, between plates, number of plates, dielectric constant, capacitor types, construction and function, capacitor color coding, calculation of capacitance and voltage in series and parallel circuits, charge & discharge of capacitor, time constant testing of capacitors.
- j. Magnetism: Theory of magnetism, properties of a magnet, magnetization and demagnetization, magnetic shielding, various types of magnetic materials, electromagnets construction and principle of operation, magneto motive force, field strength, magnetic flux density, permeability, hysteresis loop, retentivity, coercive force, reluctance, saturation, Eddy current, precautions for care and storage of magnets.
- k. Inductance/inductor
  - Faraday's Law
  - Lenz's Law
  - Back emf, self induction,
  - saturation point
  - principle uses of inductors
- l. DC motor /Generator.y
  - Basic motor and generator theory
  - Construction and purpose of components in DC generator
  - Series wound, shunt wound and compound motors
  - Starter generator construction
- m. AC theory
  - Sinusoidal waveform: phase, period, frequency, cycle, instantaneous, average, root mean square, peak, peak to peak current values and calculation of these values, in relation to voltage, current and power, single / 3 phase principles / square waves /, generation of A.C., measurement of a.c. current, voltage & frequency. Simple transformers & rectifiers.

**4. Semiconductor Physics and Electronics Fundamentals: 05 Marks**

- a) Diode, symbols, characteristics & properties, main characteristics and use of silicon controlled rectifiers (SCR thyristors), LED, photo conductive diode, varistor, rectifier, diode, functional testing of diodes. Zenner Diode.
- b) Transistors
- c) Transistors symbols, Component description, Transistor characteristics and properties of transistor. Testing of transistors.
- d) Integrated circuit (IC)  
Description and operation of logic circuits & linear circuit , Operational amplifier used as : integrator; differentiator, voltage follower, comparator. Advantage & disadvantage of positive and negative feedback.
- e) Printed circuit boards: description and use of PCB.
- f) Servomechanism  
Understanding of the following terms:  
Open and closed loop system, feedback, follow up, analogue transducers, principle of operation and use of the following synchro system components/features, resolvers, differential, control and torque, transformers, inductance and capacitance transmitters.
- g) Understanding of the following terms: Open and closed loop, follow up, servomechanism, analogue, transducer, null, damping, feedback, dead band, construction operation and use of the following synchro system components: resolvers, differential, control and torque, E & I transformers, inductance /capacitive transmitters, synchronous transmitters, magnetic amplifiers.

**5. Digital techniques, electronic instrument systems: 10 Marks**

- a) Electronic Instrument system Typical systems arrangement & cockpit layout of electronic instrument system, moving panels, vibration protection, pneumatic instruments, pipe system and markings ,leak tests, location of pitot heads , static vents,. Computer, black boxes etc.
- b) Numbering system, binary, octal & hexadecimal.
- c) Data conversion: Analogue Data, digital data, operation & application of analogue & digital system, digital and analogue conversion/convertors.
- d) Data buses: operation of data buses in aircraft systems, including knowledge of ARINC and other specifications.
- e) Logic circuits: Identification of common logic gate symbols, tables and equivalent circuits, application used for aircraft systems, schematic diagrams. interpretation of logic diagram.
- f) Basic computer structure: CPU, IC, RAM, ROM, PROM etc computer terminology, bit, byte, software, hardware, computer technology as applied to aircraft systems operation, layout & interface of the major components in a micro computer including their associated bus system Typical memory devices, data storage system.
- g) Microprocessor, control & processing unit, clock, register, arithmetic logic unit,
- h) Integrated circuit: operation and use of encoders and decoders, use of medium and large scale integration .
- i) Multiplexing: operation, application and identification in logic diagram of multiplexers & demultiplexers
- j) Fibre optics: Advantages and disadvantages of fibre optics data transmission over electrical wire propagation, fibre optic data bus, fibre optic related terms, terminations, couplers, control terminals, remote terminals, application of fibre optics in aircraft systems.
- k) Electronic displays: CRT, LED, LCD

- l) Electromagnetic sensitive devices: Special handling of components sensitive to electrostatic discharge. Awareness of risk and possible damage to components and personnel anti-static protection devices. markings.
- m) Electromagnetic environment : Influence of the following phenomena on maintenance practices for electronic system:
  - EMC- Electromagnetic Compatibility
  - EMI- Electromagnetic Interference
  - HIRF- High Intensity Radiated Field
  - Lightning/lightning protection
- n) Software management control
  - Awareness of restrictions, requirements and possible catastrophic effects of unapproved changes to software programmes.
- o) Typical Electronic/ Digital Aircraft Systems
- p) General arrangement of typical electronic /digital aircraft systems and associated BITE (Built In Test Equipment) testing such as:
  - ACARS-ARINC Communication and Addressing and Reporting System
  - ECAM- Electronic Centralized Aircraft Monitoring
  - EFIS- Electronic Flight Instrumental System
  - EICAS- Engine Indicator & Crew Alerting System
  - FBW- Fly by Wire
  - FMS- Flight Management System
  - GPS- Global Positioning System
  - IRS- Inertial Reference system
  - TCAS- Traffic Alert Collision Avoidance System

**Part B: Material Science:**

**( 10 Marks )**

- a) Metals & Alloys (Ferrous & Non ferrous)
  - Mechanical properties of metals, elasticity, hardness, ductility, tensile strength, fatigue strength and impact resistance
  - Steel: Type of steel, classification of steel, heat treatment, surface hardening.
  - Aluminum Alloys, Properties, heat treatment, corrosion protection.
  - Non-ferrous Alloys: utilization and properties of magnesium alloy, nickel alloy, brass, bronze,, titanium alloy.
- b) Joining of metals: Welding gas arc and resistance brazing, and silver soldering, adhesive bonding
- c) Non-destructive testing: Types of defects, dye penetrant and electromagnetic methods, elementary principles of ultra sonic & eddy current methods.
- d) Corrosion protection, chemical fundamentals, causes & types of corrosion, protection of metals by anodizing, plating, coating, and painting.
- e) Non-metallic materials: properties & utilization of wood, glue, fabric, paint, rubber, plastics, glass, fiberglass & textiles on aircraft. Structural composite materials, Sealant & bonding agents.
- f) The detection of defects/deterioration in composite & non metallic material. Repair of composite & non metallic material.

**Part C: Hardware Components:**

**10 Marks**

- a) Fasteners, screw threads, screw nomenclature, Thread forms, dimension and tolerance for standard threads used in aircraft, measuring screw threads.
- b) Bolt types, specifications, identification and marking of aircraft bolts, international standards. Nuts: self locking , anchor, standard types. Machine screws, aircraft specifications, Studs, types and uses self tapping screws, dowels, insertion and removal.

- c) Locking devices: Tab & spring washers, locking plates, split pins, pal nuts, wire locking, quick release fasteners, keys, circlips, cotter pins.
- d) Aircraft Rivets: Types of solid and blind rivets. specification and identification, heat treatment.
- e) Pipes & Unions: Identification of & types of rigid and flexible pipes and their connector used in aircraft, standard union for aircraft hydraulic ,fuel, oil, pneumatic & air system pipes.
- f) Springs, types of springs materials, characteristics & application.
- g) Bearing : Purpose of bearings, loads, materials, construction, type of bearings & their application.
- h) Transmission: Gear type & their application, gear ratio, reduction & multiplication gear system, driven and driving gears, idler gear, mesh Pattern, belts & pulleys, chains and sprocket.
- i) Control cables: Type of cables, end fittings, turnbuckles and compensation devices: pulleys & cable system components :Bowden cables, aircraft flexible control systems.
- j) Electrical cables & connectors:  
cable types, construction and characteristics. High tension and coaxial cables. Crimping, splicing, swaging. Connectors types, pins, plugs. Sockets, insulators, current and voltage ratings, coupling, identification codes, turnbuckles and tensioning devices locking and safety.

**Part D: Workshop Technology and Maintenance Practices:**

**15 Marks**

- a) Safety precautions / especially when working with electricity , gases, oxygen, oil, & chemicals. Remedial action to be taken in the event of fire, or another accident with one or more of these hazards, Including knowledge of extinguishing agents.
- b) Care of tools, control of tools, use of workshop materials, dimensions, allowances & tolerance calibration of tools and equipment.
- c) Basic tools: hand tools, power tools, use of precision measuring tools, lubrication, Driving, Cutting and Shaping tools, spanners, wrenches, torque wrenchs, grinding, broaching.operation, function & use of electrical general test equipment. Avionics general test equipments.
- d) Measurement : Ruler, dividers,calipers, Micrometers, Vernier gauges, Dial gauges, thread gauge ,marking out.
- e) Engineering drawings, diagram & standards: orthographic projection . First Angle & third angle , isometric and oblique projection. Dimensioning standard symbols, Microfilm, microfiche & computerized presentation, specification 100 of ATA.Aeronautical and other applicable standards including ISO, AN,MS,NAS and MIL. Wiring diagrams & schematic diagrams.
- f) Fits & Clearance: Drill Sizes for bolt holes, classes of fits, common system of fits and clearances: Schedule of fits and clearances for aircraft and engines. Limits for bow, twist & wear. Standard methods for checking shafts & bearings
- g) Electrical cables & connectors :  
Contuinity, insulation & bonding test. Use of crimp tools ( Hand and Hydraulic Operated.) Testing of Crimp Joints, Connector pin removal and insertion, Coax- Cable testing and installation precautions. Wiring protection techniques ,Cable looming and loom support, Cable Clamps, Protective sleeving techniques including heat shrink wrapping and shielding.
- h) Riveting , rivet joints, rivet spacing and pitch, tools used for riveting and dimpling, inspection of riveted joint.
- i) Pipes and hoses, bending and belling/flaring aircraft pipes. Inspection and testing of aircraft pipes and hoses. Installation and clamping of pipes.

- j) Bearing,,: testing, cleaning and inspection of bearing. lubrication requirements of bearings defect in bearing and their causes.
- k) Transmission – inspection of gears , backlash , inspection of belts, pulleys, chain and sprockets, inspection of screw Jack, lever devices, push pull rod systems.
- l) Control Cables: swaging of end fittings , inspection and testing of control cable, Bowden cable and aircraft flexible control control system.
- a. Material handling, sheet metal, marking out and calculation of bend allowances. Sheet metal workings including bending and forming. Inspection of sheet metal work.
- m) Composite and non metallic bonding practice , environmental condition, inspection methods.
- n) Welding, Brazing, soldering and bonding, soldering methods, inspection of soldered joints, welding and brazing methods, inspection of welded and brazed joints, bonding methods and inspection of bonded joints.
- o) Aircraft weight and balance  
C.G/balance limits calculation, use of relevant documents, preparation of aircraft for weighing, aircraft weighing.
- p) Aircraft Handling and Storage. Aircraft taxing, towing and associated safety precautions. Aircraft jacking, chocking , securing and associated safety precautions, aircraft storage methods, re-fueling and de-fueling procedures, de-icing and anti-icing procedures. Electrical, hydraulic and pneumatic ground carts. effect of environmental condition on aircraft handling and operation.
- q) Disassembly , inspection , repair and assembly techniques.  
Types of defects and visual inspection techniques, corrosion removal , assessment and re-protection.

**Part E: Human Factors, Industrial Hygiene and Safety:**

**(10 Marks)**

- a) General; Need to take Human Factor into account, incidents attributable to human factor/human error, Murphy's law.
- b) Human factor performance and limitations, vision, hearing, information processing; attention & perception; memory, claustrophobia & fear of heights.
- c) Social psychology, social environment, responsibility individual & group; motivation and de-motivation, peer pressure, culture issues, team working, management, supervision and leadership.
- d) Factors affecting performance: Fitness/health, stress:-domestic and work related, time pressures and deadlines, workload, overload & under load, sleep and fatigue, shift work, alcohol, medication, drug abuse.
- e) Physical environment: Noise, fumes, illumination, climate & temperature, motion and vibration, confined spaces, working environment.
- f) Tasks: Physical work, repetitive tasks, visual inspection, complex systems
- g) Communication: within and between team ,\_work logging and recording, keeping update, currency, dissemination of information.
- h) Human error: understanding human error, Error models & theories, Types of error in maintenance tasks: implications of error, avoiding and managing errors.
- i) Hazards in the workplaces  
Recognizing and avoiding hazards  
Dealing with emergencies
- j) Summary: Dirty dozen aviation errors (put safety first and minimize 12 common causes of mistakes in the aviation workplace)
- k) Hazard identification and Risk Management.

**Part F: Introduction to Aircraft (Essential knowledge):**

**(15 Marks)**

- a) Aircraft flight, theory of flight, general principle, fixed wing & rotary wing advantages & disadvantages
- b) Wing design, Aerodynamic and structural requirements, Aspect ratio, plan form, sweep back, Delta wings design of subsonic, transonic & supersonic planes.
- c) Engines: Piston Engine, Turbine Engine. Types and their principles

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