

**Nepal Airlines Corporation**  
**Syllabus for Senior Technical Officer Grade- VII**  
**Aircraft Maintenance Service, Maintenance/Workshop (Avionics)**  
**Open Competition**

**A. Stages and Procedure of Examination System**

चरण	विषय	अंकभार	परीक्षा प्रणाली	प्रश्न संख्या X अङ्क	समय
प्रथम ८०%	लेखन शिप सेवा सम्बन्धी	पुर्णाङ्क १०० उत्तिर्णाङ्क ४०	<b>Multiple Choice Questions</b> (वस्तुगत)	५० x २ = १००	४५ मिनेट
द्वितीय २०%	अन्तरवार्ता	२०	<b>मौखिक</b>		

**B. Material Contents**

**Part I: FUNDAMENTALS – 24 Marks (12 Questions)**

**1. Computer**

- *Historical development:* Classes of computer, historical development of computers, generation of electronics computers.
- *Computer systems and organization:* Computer hardware, computer software.

**2. Electrical**

- *Circuit elements:* functional behavior of resistors, capacitors and inductor: Voltage and current sources.
- *Series and parallel circuits:* Kirchhoff's law, Network analysis. Single phase AC circuit analysis. Power and energy in AC Circuits, Three phase circuits analysis – basics.

**3. Basics Electronics**

- *Introduction to instrumentation:* The oscilloscope and its operation, digital voltmeter, ammeter, ohmmeter.
- *Circuit concepts:* diodes and diode circuit, semi conductor devices.

**4. Mechanical**

- *Engineering Static:* Equivalent force systems: Equilibrium, friction, cables and center of gravity.
- *Engineering Dynamics:* Velocity, acceleration and momentum; Newton's second law of motion. The moment law, work and energy.
- *Strength of Materials:* Concepts of stress, strain and stress- strain diagram; Hook's law.
- *Thermodynamics:* Properties of substances: first law of thermodynamics; Entropy and second law of thermodynamics; Thermodynamics cycles, gas compression and refrigeration and gas turbine engines – axial and centrifugal flow gas turbines.
- *Fluid Mechanics:* Introductory concepts; Fluid in motion; Continuity equation; Mass conservation Viscosity, Bernoulli's equation, Boundary layer; Laminar and turbulent flow.
- *Heat Transfer:* Steady state and transition; heat conduction; Heat transfer by radiation; convective heat transfer, free and forced convection.

## 5. Engineering Drawing

Machine drawings; electrical and electronics diagram, Basic drawing concepts, Nowerrelative; project various projections drawing concept.

### Part II – MANAGEMENT- 16 Marks (8 Questions)

#### 1. Organization and management

- Principles of organization and management, organization behavior, management level and function, managerial roles, importance of management. Theory of management.
- Internal Organization of companies: Policy and executive groups. Administrative and functional groups. Organization structure.
- Management information system
- Motivation and leading people, Personnel management.

#### 2. Industrial engineering and management

- Quality Assurance, Quality Control, Production systems and planning forecasting techniques.

### Part III – ELECTRICAL/ELECTRONICS/ COMMUNICATIONS – 50 Marks

#### 1. Communication: 12 Marks ( 6 Questions)

##### A. Analog Communication

- Communication Channels Overview: free space, wire, cable waveguide and fiber, telephone and data channels.
- Liner Modulation: Modulation properties, AM and DSBSC modulation, demodulators and detectors- square law.
- Angle Modulation: instantaneous frequency and Bessel functions, frequency modulation, and narrowband FM, modulator configurations, demodulators, discriminators.

##### B. Digital Transmission:

- Fundamentals of Baseband Pulse Transmission: transmission channels, Basic digital communication transformations. Time division multiplexing and asynchronous transfer mode.
- Introduction to Switching System: Evolution, basics of switching systems, digital and time division switching SPC
- Signaling Equipment and systems: Signaling functions, analog and digital subscriber, signaling, signaling within an exchange, voice frequency and outband register, line signaling, common channel signaling, new trends in switching systems- a case study.

##### C. Digital Communication:

- Data transmission and digital Modulation Techniques: Signal receivers and error probability, optimum filters the matched filter, coherent and non coherent receivers, binary phase shift keying (BPSK), quadrature phase shift Keying (QPSK) and M-ary PSK, frequency shift keying (FSK), imperfect synchronization and error probability in PSK and FSK systems, quadrature amplitude shift keying (QASK), other methods of digital modulation.
- Pulse Code Modulation (PCM): Encoders, decoders and companders, multiplexing and synchronizing, differential PCM, noise in PCM systems.

## 2. Wave and Propagation: 18 Marks (9 Questions)

### *A. Electromagnetic field and Wave.*

Introduction: Review of electromagnetism, Laplace's and Poisson's equations, boundary value problems, sinusoidally varying field, Maxwell's equations in Phasor form.

Uniform Plane Waves: Uniform plane waves in free space, wave polarization, the wave equation and solutions for material media, wave impedances and intrinsic impedance, waves in dielectrics and conductors, Poynting vector, power dissipation, energy storage, refraction and reflection, standing waves, skin depth.

Transmission lines: Transmission line configurations, transmission line equations, primary and secondary parameters, time domain analysis, discontinuities and reflection, shorted and open line, reflection coefficient, VSWR, arbitrary terminations, impedance matching, Smith chart, matching methods, the dissipative transmission line.

Waveguides: Introduction to waveguides, TE and TM modes in a parallel plate wave guide dispersion, phase and group velocities, rectangular waveguides, cylindrical waveguides, cavity resonators, dielectric waveguides, optical waveguides and systems.

### *B. Antenna and Wave Propagation:*

Antenna fundamentals: Review of Maxwell's equations and the wave equations. Solution of the wave equations in free space, wave velocity, wave impedance, Poynting's vector and Polarization.

Antenna Terminology and Parameters: Radiation pattern, radiation lobes, half power beamwidth, front to back ratio, beam angle, beam efficiency, directivity, directive gain, power gain antenna efficiency, frequency bandwidth, antenna input impedance, self impedance, mutual impedance.

Various Types of Antennas: Short and long dipoles: radiation pattern, radiation resistance and directivity; folded dipoles, monopoles, ground plane considerations, travelling wave antennas: beverage antennas, Vee antennas, rhombic antennas; broadband antennas: biconical antennas, discone antennas, helical antennas; Frequency independent antennas: spiral antennas, log periodic antennas; Array antennas: Yagi Uda arrays, log periodic arrays; Reflector antennas, feed configuration for parabolic antennas, lens antennas.

Wave Propagation: Free space propagation, Friis transmission formula, ground wave propagation, pseudo Brewster angle, skywave propagation, refraction, virtual height, critical frequency, maximum usable frequency, skip distance, VHF and UHF propagation, diffraction Fresnel zones, path loss due to smooth earth and knife edge obstacles, microwave propagation.

### *C. Signal and systems:*

Introduction: Signal classification, use of signals, examples of signals, continuous and discrete time signals and systems.

Fourier series and transform: Fourier series: representation of periodic signals and properties; Fourier integral: representation of periodic and aperiodic signals; Forward and reverse/inverse Fourier transform properties.

Signal Transmission: Filtering: frequency selective and frequency shaping: Modulation Noise, Energy and power: white and colored noise, stochastic signals finite energy and finite power signals, Parseval's theorem, signal to noise ratio.

### 3. POWER: 20 Marks (10 Questions)

#### *Power Electronics:*

Introduction : Recent advancement in power electronics and its application: power semiconductor switching devices; power diodes, power transistors, power MOSFET, IGBT, MCT and their characteristics; Freewheeling; diodes with RC and RL, LC and RLC loads.

Thyristor: Principle of operation, construction, two transistor analogy, gate characteristics, rating turn on/off mechanism, protection and cooling, firing circuits, optoisolators and pulse transformer, trigger devices (UJT, PUT, DIAC, UJT/PUT relaxation oscillator), series and parallel operation of Thyristor, Triacs and GTO.

Static Switches: Single phase and three phase AC switches, three phase reversing switches, AC switches for bus transfer, DC switches, solid state relay and design of static switches.

Thyristor Converters: Single and three phase rectification, half and full controlled rectifiers, introduction to twelve pulse converters, rectifiers with inductive load, AC voltage controllers and cycle converters, Harmonic analysis and their remedial methods.

Inverters: Principles and types, adjustment of AC frequency and voltage, PWM- inverter; Commutation; Inverter operation with inverse power flow.

#### *INSTRUMENTATION AND MEASUREMENT:*

Introduction to process control: Definitions of terms used in measurement and instrumentation; measurement, instrument, measured, meter, metrology, Example of process control, automatic process control. Advantages of electronics in measuring systems; Measurement and process control systems; analog measuring system model: temperature control process with analog method; Digital processing systems; digital supervisory and analog process control systems, computer based direct digital control.

Fundamental and Derived Units in the SI Units: Standards, accuracy, precision, resolution, sensitivity, significant figures, errors, limiting error, statistical analysis: average/mean value, deviation from mean value, average deviation, standard deviation, variance, probability of error, histogram, probable error.

Introduction to Electromechanical indicating Instruments: Operating principle of permanent magnet moving coil (PMMC) galvanometer, dynamic behavior of PMMC movement, taut band suspension galvanometer; DC meters: ammeters, voltmeter, ohmmeter, voltmeter loading effects, meter protection techniques, electronic voltmeter.

AC Measurement: Sinusoidal signal parameters (average, RMS, peak and peak to peak relations): parameter relations in half wave rectified sinusoidal signals, triangular wave forms and signals with sinusoidal waves superimposed and square waves. Measurement with PMMC movement using single diode and bridge diode rectification; The form factor, Operating principle of AC voltmeter, peak reading meter, current transformer, power meters, power factor meter, watt hour meter and electro-dynamometer, Cathode Ray Oscilloscope based principles and application.

Introduction to signal Conditioning: Analog signal conditioning: Linearization techniques, signal conversion, filtering, impedance and power matching; operational amplifier in various configurations: ideal Op-amp analysis, Op amp specifications, non inverting amplifier, inverting amplifier, summing amplifier, differential amplifier, instrumentation amplifier, integrator, differentiator, logarithmic amplifier, comparator.

Digital Signal conditioning Circuits: Interfacing with the analog world (principle); Digital to analog conversion principle and circuits: standard DAC with binary inputs, DAC resolution, step size, input weight etc. DAC formulae, DAC with BCD input codes, bipolar DACs, DAC circuits, integrated circuit DACs; Analog to digital conversion: Counter type ADC, successive

approximation type ADC, flash type ADC and design principle, resolution, reference voltage and formulae, integrated ADC circuits, sample and hold techniques and circuit principle. Time multiplexing techniques.

Actuators: Relays, solenoids and electronic switches; silicon-controlled rectifiers, triacs, diacs.  
Transducer and Sensors: Measuring principles using bridges: resistance measurement with wheat stone bridge, inductance measurement with Maxwell and Hay bridges, capacitance measurement with scheming bridge, bridge unbalanced conditions and their use in measurement, problems in bridges; Voltage measurement using potentiometer, semiconductor sensors (thermistors) thermocouple; Optical sensor, light to resistance.

#### **Part IV – AVIONICS- 10 Marks (5 Questions)**

- Operation of Aircraft Communication System: VHF Communication, HF Communication
- Operation of short range navigation system
- Automatic Direction Findings (ADF): Introduction, basic principles
- VHF Omni directional Range (VOR): Introduction, basic principles
- Instrumental Landing system (ILS): Introduction, basic principles
- Distance measuring Equipment (DME): Introduction, basic principles
  
- Operation of flight instrument
- Air Speed Instrument (ASI): Introduction, basic principles
- Vertical Speed Indicator (VSI): Introduction, basic principles
- Altimeter: Introduction, basic principles
- Gyro: Introduction, basic principles
- Turn and Slip Indicator (TSI) : Introduction, basic principles

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