

**Nepal Airlines Corporation
Human Resources Department**

OPEN COMPETITION

**Syllabus for Senior Technician, Grade- V
Aircraft Maintenance Service, Ground Equipment Sub-Group (Electrical)**

(1) GUIDELINES

A. Stages and Procedures of Examination System

चरण	विषय	अंकभार	परीक्षा प्रणाली	प्रश्न संख्या X अङ्क	समय
प्रथम ८०%	सेवा सम्बन्धी	पुर्णांक १०० उत्तिर्णांक ४०	Multiple Choice Questions (वस्तुगत)	५० X २ = १००	४५ मिनेट
द्वितीय २०%	अन्तरवार्ता	२०	मौखिक		

B. Weightage Allocation and Marks Distribution Chart of Material Contents

sn	Parts	Topics	Number of Questions	Marks Distribution in Sections
1	I	Fundamentals	08	A (1), B (2), C (3), D (2)
2	II	Management and Economics	05	A (2), B (2), C (1)
3	III	Electrical/Electronics/Communications	30	A (3) F(2) K(3) B (2) G(2) L(3) C (2) H(2) M(1) D(3) I (1) N (2) E(3) J(1)
4	IV	Applied Electrical/Electronics and Application of Control Systems	07	A (1) D(1) B (2) E(1) C (1) F(1)
Total			50	50

(2) MATERIAL CONTENTS

Part I Fundamentals

A. Computer Engineering

1. Historical development

Classes of computer, historical development of computers, generation of electronics computers.

2. Computer systems and organization

Computer hardware, computer software, Networking and web-pages; Software Development.

B. Electrical/ Electronics Engineering

1. Circuit elements

Passive Elements: resistors, capacitors and inductor:

Active Elements: Ideal Voltage source, Ideal current sources, Voltage Controlled Current Source, Voltage Controlled Voltage Source, Current Controlled voltage Source, Current Controlled Current Source.

2. Series and parallel circuits

Kirchhoff's law, Network analysis. Single phase AC circuit analysis. Power and energy in AC Circuits, Three-phase circuit analysis – basics.

3. Fundamentals of Instrumentation

Sensors and Transducers, Op-amps, Oscilloscope, Digital/Analogue, ammeter, voltmeter, Ohmmeter & Multimeter, tachometer, digital thermometer.

4. Circuit concepts

Diodes and diode circuit, semi conductor devices, Rectifiers.

C. Mechanical Engineering

1. Engineering Statics

Equivalent force systems: Equilibrium, friction, center of gravity, Tension and compression, Pascal's law of pressure.

2. Engineering Dynamics

Velocity, acceleration and momentum; Newton's second law of motion. The moment law, work and energy.

3. Strength of Materials

Concepts of stress, strain and stress- strain diagram; Hook's law, Thick/Thin wall cylinders.

4. 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

5. Fluid Mechanics

Introductory concepts; Fluid in motion; Continuity equation; Mass conservation Viscosity, Bernoulli's equation, Boundary layer; Laminar and turbulent flow

6. Heat Transfer

Steady state and transition; heat conduction; Heat transfer by radiation; convective heat transfer, free and forced convection, Fins and Extended surfaces

D. Engineering Drawing

Machine drawings; electrical and electronics diagram, Basic drawing concepts, Orthographic Projections. Drawing paper layouts. Electrical & Electronic Circuit Symbols. Limit, Fit and Tolerances

Part II Management and Economics

A. Organization and Management

1. Organization and Accountabilities

Principles of organization and management, organization behavior, management level and function, managerial roles, importance of management. Theory of management

2. Internal Organization of Companies

Policy and executive groups. Administrative and functional groups. Organization Structure.

3. Management Information System, Quality Management Systems

4. Motivation and leadership, Personnel Management

B. Industrial Engineering and Management

1. Production and Operations Management

Production systems and planning, Forecasting Techniques, Quality Assurance, Quality Control, Make or Buy Decision; System Management

2. Inventory Management

Procurement Process; Material Requirement Planning; Capacity Requirement Planning, EOQ Models.

3. Project Management

CPM, PERT, Project Engineering

C. Engineering Economics

Financial and Economic Feasibility of Projects, Project Evaluation Techniques, Business Analysis (Cost-Volume-Profit).

Part III Electrical/Electronics/Communications

A. Basic Electrical Engineering

1. Atomic Structure, Electronic Structure, Periodic table and Electronegativity.
2. Voltage, Resistors, DC / AC Power Supply, unit of measurement, phase & phase difference, EMF, frequency.
3. Concept of resistance, inductance, capacitance and their role in electric circuits.

4. Series and parallel connection of resistance, inductance and capacitance.
5. Ohm's law and Kirchhoff's law.
6. Alternating current fundamentals: Faraday's laws of electromagnetic induction, generation of alternating voltages and currents and their equations and waveforms, amplitude, frequency, phase, phase difference, average and rms values, A.C. through resistance, inductance, capacitance and through their combinations, single phase and three phase AC systems.
7. Heating effect of electric current
8. General norms of system voltage regulation and frequency regulation.

B. Electric Circuit Theories

1. Ohm's Law, Kirchhoff's Voltage Law (KVL), Kirchhoff's Current Law (KCL), Thevenin Equivalent Circuit, Norton Equivalent Circuit, principle of superposition

C. Electrical Engineering Materials

1. Metal, Non-Metals, Ceramic, Polymer Semi-Conductor
2. Stress, Strain, Deformation, Conductivity, Resistivity, Insulator & Dielectric Properties
3. Bond Energy and Interatomic Spacing, Crystal Structure

D. Electromagnetics and Electrical Machines

1. Faraday Law of electromagnetic Induction, Biot and Savart Law, generation of alternating voltage and current, A.C. characteristics (wave, amplitude, phase, inductance, capacitance), flux linkage, hysteresis and losses
2. Transformers, D.C. Machinery Fundamentals, A.C. Machinery Fundamentals
3. DC Motors & Generator – working principle, series/shunt types, losses and efficiency
4. Synchronous Motor/Generator-working principle, EMF, short circuit and open circuit characteristics
5. Induction Motors/Generator- working principle, types (squirrel cage, slip ring).

E. Power System

1. Principles of transformers; single-phase and three-phase, transformers, Rectification: half-and full-wave rectification, metal rectifiers, bridge rectifiers; hard and soft tube rectifiers
2. Fundamental of Star and Delta connection, unbalanced load in three phase system.
3. Current Transformer and Potential Transformer (principle and characteristics)

F. Automobile Control System

1. Electronic Control Unit, Components & types
2. Sensors (Throttle position, knock, oxygen concentration) and Actuation unit
3. Fuel injection control system
4. Anti-lock braking system
5. Traction Control System
6. Electronic Clutch Control
7. Electronic Brake Distribution System
8. Integration of various Control unit and communication between them (CAN Bus)

G. Switchgear and Protection

1. Concept of overcurrent, overvoltage, fuse, earthing and heating effect of electricity
1. Oil/Vacuum/Gas filled circuit breaker
2. Lightning protector / surge arrester / Isolators (types, rating, characteristics, applications)

H. Power Distribution

1. Overhead and underground cables, types of cable, selection of cable, Mechanical & Electrical design of overhead lines, Sag, tension, Earthing, Corona effect, Skin effect, Connection Scheme of distribution System

I. Communication

1. Communication Channels Overview

Free space, wire, cable waveguide and fiber, telephone and data channels

2. Liner Modulation

Modulation properties, AM and DSBSC modulation, demodulators and detectors- square law

3. Angle Modulation

Instantaneous frequency and Bessel functions, frequency modulation, and narrowband FM, modulator configurations, demodulators, discriminators

4. Digital Transmission

a) Fundamentals of Baseband Pulse Transmission

Transmission channels, Basic digital communication transformations. Time division multiplexing and asynchronous transfer mode

b) Introduction to Switching System

Evolution, basics of switching systems, digital and time division switching SPC

c) 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

5. Digital Communication

a) 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.

b) Pulse Code Modulation (PCM)

Encoders, decoders and companders, multiplexing and synchronizing, differential PCM, noise in PCM systems.

J. Wave and Propagation

1. Electromagnetic Field and Wave

a. Introduction

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

b. 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 refraction, standing waves, skin depth

c. 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

d. 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

2. Antenna and Wave Propagation**a. 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

b. 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

c. 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, disc 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.

d. Wave Propagation

Free space propagation, Friis transmission formula, ground wave propagation, pseudo Brewster angle, sky wave 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.

3. Signal and systems**a. Introduction**

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

b. Fourier series and transform

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

c. Signal Transmission

Filtering: frequency selective and frequency shaping: Modulation

d. Noise, Energy and Power

White and colored noise, stochastic signals finite energy and finite power signals, Parseval's theorems, signal to noise ratio

K. Power Electronics**1. 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

2. 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 GTOSO

3. 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

4. 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

5. Inverters

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

L. Instrumentation and Measurement

1. 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

2. 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

3. 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 de 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

4. 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, simple and hold techniques and circuit principle. Time multiplexing techniques

5. Actuators

Relays, solenoids and electronic switches; silicon-controlled rectifiers, triacs, diacs

6. 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.

M. Power Plant Equipment

1. Concept of Hydroelectric power plant

Large/mini/micro electric plant, elements/components, types of hydraulic turbines.

2. Concept of Thermal power plant

Diesel power plant, biomass based power plant, geothermal power plant, advantage/disadvantage, performance and efficiency.

N. Electrical Safety

1. Health and safety guidelines

Earthing, insulation, isolation, Electric fire hazards prevention, Occupational Health and Safety, Safety Signals and Symbols.

Part IV

Applied Electrical/Electronics and Application of Control Systems

A. Modern Automotive Control Systems

1. Electrical Engineering in Automotive Control Systems
2. Programmed Logic Controls and Associated Hard-wares
3. Electronic Fuel Ignition Systems of Modern Automotive Engines

B. Electric Vehicles and Alternatives of Conventional IC Engine Systems

1. Concept and Technological Advantages
2. Future Application
3. Cost/Benefit Analysis
4. Environmental/ Hygiene/Safety Advantages

C. Higher Frequency and Most Sensitive Equipment

1. Generators for Aircraft supply
2. Consumption Systems and Devices

D. Automatic Controls in Hydraulic and Pneumatic Systems

1. Concept
2. Basic Components
3. Accessories

E. Modern Electrical Energy Storage System

1. Concept
2. Basic Components and Devices
3. Uses/Application
4. Energy Density and Environmental Advantages over Conventional System
5. Cost/Benefit Analysis

F. Applied Photovoltaic Systems

1. Grid connected / standalone PV System.
2. Series Parallel connection of PV module and charge storage mediums
3. Types, advantage/disadvantage of various charge storage mediums.
4. System Design and Load Calculation
5. Concept, advantage/disadvantage of Active/passive/manual solar tracking.
6. Maximum power point tracker, Power conditioner and its working principle.
