Syllabus for the Post of Assistant Professor

(*Electrical Engineering, Computer Engineering, Electronics Engineering***)**

S.N.	Paper	Question Format	Full Marks	Number of Questions	Exam Time
1.	**Paper I**	**Section A :** Aptitude (Objective)	50	50	50 minutes
		Section B: Core Course (Objective)	50	50	50 minutes
2.	**Paper II**	Core Course, Research, and Teaching-Learning (Subjective)	100	10	3hrs
Total Written Exam Full Marks:			**200**		

Paper I: Section A: Aptitude Test (Objective) Marks: 1 × 50 = 50

S.N.	Area of Questions Aptitude Test	Number Questions	Details
1.	Teaching and Communication Aptitude	15	Objectives and Perspectives, Essential Qualities for Higher Education, Teaching Rolls: Individual, Social, and Professional, Teaching Methods, Student Evaluation and Assessment
2.	Research Aptitude, Publication Ethics, and Data Interpretation	15	Definition and Importance of Research, Objectives, Types, and Methods of Research, Research and Publication Ethics, Data Sources, Accessibility, Availability, and Presentation. Research-Based Articles, Journal Quality, Dissertation/Thesis Framework
3.	Information and communication Technology	10	Benefits and Risk, Use of ICT in teaching-Learning and research, Virtual Learning Platforms, Digital Education Resources, Tools and Applications
4.	Higher Education System, Tribhuvan University	10	Higher Education Policy 2076, Tribhuvan University Acts, Laws, and Bylaws

Assistant Professor

(*Electrical Engineering*)

(Detail Syllabus)

Paper I: Section B: Core Course (Objective) Marks: 1 × 50 = 50

Unit	Area of Questions	Number Questions
1.	Electric Circuits	8
2.	Electrical Machines	12
3.	Power Systems Engineering	12
4.	Power Electronics	12
5.	Instrumentation and Control	6

1. Electric Circuits

1.1. Network Theorems: Kirchhoff's laws, Nodal Analysis, Star-delta & delta-star transformation, Superposition, Thevenin's, Norton's, Maximum power transfer theorem, Reciprocity theorem

1.2. AC circuits: AC Series and Parallel Circuits. Concept of complex impedance phasor diagram, Active, Reactive & Apparent power, Resonance in AC circuits, Band width of the RLC circuit, High-Q and Low-Q circuits, Phase & line quantities in three-phase balanced and unbalanced system, 3-phase powers and their measurements.

1.3. Transient response: Transient response analysis for R-L, R-C & R-L-C circuit, Pole zero plots, Frequency Response of networks

1.4. Two-port Networks: Z-parameters, Y-parameters & ABCD -parameters, Interconnection of two-port network (Cascade, series, parallel)

2. Electrical Machines

2.1 Electromagnets: Magnetic circuits, Faraday's Law of electromagnetic induction, magnetizing inductance

2.2 Electromechanical energy conversion principle: principles of energy flow, the concept of field energy and co-energy, modeling linear and nonlinear magnetic circuits, torque expression for various machines using the principles of energy flow and the principle of co-energy.

2.3 Transformers: Equivalent circuits, Phasor diagrams, Losses & efficiency, Voltage regulations, Instrument transformers, three-phase transformer connections, parallel operation of 1-phase & 3-phase Transformers

2.4 Reference Frame Theory: Concept of space vector, components of space vector, direct and quadrature axis variables, various types of transformation, Clarke and Park's Transformations.

2.5 DC Machines: Construction, Operating principle, and characteristics of different types machines, Model of a Commutator, State space model of a DC machine

2.6 Synchronous machine: Operating principle. Effect of Excitation, Power angle characteristics, Phasor diagrams, Losses & efficiency, Parallel operation of alternator, Voltage regulations, Control of real and reactive power, Park's transformation, Derivation of *dq0* model for a salient pole synchronous machine with damper windings

2.7 Induction machine: Operating principle, T-S Characteristics, Losses and efficiency, Testing, Starting methods, Speed Control, Derivation of *dq0* model for a symmetrical induction machine, Voltage, and Torque equation in arbitrary reference frame variables, Analysis of steady-state operation

2.8 Special Electrical Machines: Introduction to special machines, Adjustable speed drives, PM material and characteristics, B-H Loop and demagnetization characteristics, Permanent Magnet Brushless D.C. Motors, Permanent Magnet Synchronous Motors, Synchronous Reluctance Motors, Switched Reluctance Motors

3. Power Systems Engineering

3.1. Power Plants: Hydropower Components, Electromechanical equipment selection criterion and their specifications, Diesel power plant, solar photovoltaic and wind as alternative power generation and their importance, grid interconnection of renewable energy.

3.2. Transmission line: Line parameters, per unit system representation, single line diagrams, short, medium & long lines, efficiency & regulations, SIL, Reactive power compensation

3.3. Power flow analysis: Formulation of load flow problem, NR, Fast decoupled, DC load flow, harmonic load flow analysis

3.4. Power system protection: Analysis of symmetrical and unsymmetrical faults, Fault calculations, short circuit faults, open circuit faults, Low-voltage ride through, protection philosophy and coordination under renewable energy, Adaptive relay settings, Wide area monitoring and protection system.

3.5. Power system stability: Concept of modal analysis for small-signal stability, Transient stability, voltage stability (static and dynamic), Converter driven stability, Impact of power electronics technologies such as variable speed wind turbine generators, grid-connected solar farms, FACTS devices, virtual inertia on different aspects of power system stability.

3.6. Distributed Generation Technology and Microgrid: Integration and interconnection of distributed energy resources, configuration of microgrids- AC, DC, bipolar type DC and hybrid AC-DC microgrids and power electronic interfaces Issues, Power electronics control technology, Operation and control of micro grids DC, AC and Hybrid AC-DC micro grids

3.7. Load dispatching: Principle of economic load dispatch, requirements, tools and role of dispatcher, Rationale and tools of demand side management, optimal power flow, optimum generation scheduling with renewables.

4. Power Electronics

4.1 Power electronics devices: Diodes, Thyristors, TRIAC, GTO, BJT, MOSFET, IGBT, Operating Characteristics, Device ratings, Gate drive circuits, di/dt and dv/dt protections, Heat sink design and device packaging.

4.2 Rectifiers (Un-Controlled and Controlled): Single phase and Three phase rectifier with resistive, inductive, capacitive load, Operating principle and Fourier analysis of output voltage waveforms, Design of filter circuits. Three phase full converter with highly inductive load, Effect of source inductance in rectifier circuit, Input power factor improvement techniques in rectifier circuit: - Extinction angle control, Symmetrical angle control, Pulse width modulation

4.3 DC-DC converters: Step down and up DC chopper, operating principle, Constant frequency operation and variable frequency operation, Buck converter, Boost converter, Buck-Boost converter, Controller design for DC-DC converter: PID controller, Hysteresis band controller

4.4 Inverters: Single phase and three phase inverter, Analysis and control, Fourier analysis of output waveforms. Analysis with AC motor as load, Positive, Negative and zero sequence series of output voltage.

4.5 AC voltage controller: single phase and Three phase AC voltage controller, Analysis with resistive load and three phase induction motor as load, Fourier analysis of output voltage waveform, Cyclo-converters: Single phase and three-phase.

5. Instrumentation and Control

5.1 Instrumentation: Instrumentation systems, theory of measurements (static performance – accuracy, precision, sensitivity, resolution and linearity, dynamic Performance – response time, frequency response, bandwidth and errors in the measurements), types and applications of various transducers

5.2 Measurement Transducers: Temperature, light level, strain and displacement, acceleration, pressure, force, velocity, magnetic field measurement, thermocouples

5.3 Digital to Analog Conversions: A/D and D/A conversions

5.4 Control System Basics: Component Modeling and Linearization: Differential equations, Laplace transform, Z-transform and transfer function. State space formulation, Combinations of components to physical systems and system reductions.

5.5 Time and Frequency Responses: Transient and steady state analysis. Performance specifications, Error analysis.

5.6 Stability: characteristic equation, complex plane interpretation of stability, root locations and stability, Root Locus Method, frequency response method, Controllability, Observability.

5.7 Control System performance and design: open loop control, close loop control, PID control and tuning. Lead Compensator, Lag compensator,

5.8 Non-linear Control: Fuzzy Logic Control. Concept of Optimal Control and Intelligent Control.

Paper II: **Core Course** **Marks: $10 \times 10 = 100$**

Subjective Knowledge, Research, and Teaching-Learning Questions

S.N.	Area of Questions	No of Questions
1.	**Unit 1 :** Electric Circuits	**1**
2.	**Unit 2:** Electrical Machines	**2**
3.	**Unit 3:** Power Systems Engineering	**2**
4.	**Unit 4:** Power Electronics	**2**
5.	**Unit 5:** Instrumentation and Control	**1**
6.	Research Methodology, and Applications; Problem - Solving	**1**
7.	Teaching Learning and Student Evaluation; Syllabus Structure (Bachelors and Masters, TU)	**1**