Probability and Statistics (3 – 2 – 0)

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objective:

This course is designed to familiarize the students with basic knowledge about probability and statistics. After successful completion of this course students would be able to understand and apply the concept ofpresentation and summarization of data, probability and probability distributions,sampling and estimation, hypothesis testing, simple regression and correlation.

Course Contents:

1. Introduction of Statistics and Presentation of Data **(4 hrs)**

1.1 Introduction of statistics
1.2 Application of statistics in engineering
1.3 Variables, types of variable: numerical and categorical variable
1.4 Sources of data: primary and secondary source
1.5 Presentation and classification ofdata: stem- and-leaf displays
1.6 Frequencydistribution
1.7 Diagrammatic and graphical presentation of data: Pareto diagram
1.8 Pie-diagram, histogram, frequency curve and frequency polygon
1.9 Cumulativefrequency curve or ogive curve

2. Summarizing and Describing the Numerical Data **(4 hrs)**

2.1 Measure of central tendency (mean ,median, mode), partition values
2.2 Measure of variation: range, inter-quartile range, standard deviation
2.3 Coefficient of variation
2.4 Box and whisker plot

3. Probability **(5 hrs)**

3.1 Random experiment, sample space, event and types of events, counting rule
3.2 Various approaches to probability
3.3 Laws of probability-additive, multiplicative
3.4 Conditional-probability and independence
3.5 Baye's theorem

4. Random Variable and Probability Distribution **(12 hrs)**

4.1 Random variable: discrete and continuous random variable
4.2 Probability mass function
4.3 Expectation, laws of expectation (addition and product law)
4.4 Discrete probability distribution: Binomial distribution, Poisson distribution,Hyper Geometric distribution and Negative binomial distribution

4.5 Probability density function,cumulative distribution functions, expected values ofcontinuous random variables

4.6 Continuous probability distribution: rectangular distribution, exponentialdistribution, Gamma distribution, Beta distribution, Normal distribution, Log-Normal distribution

5. Bi-variate Random Variables and Joint Probability Distribution (3 hrs)

5.1 Joint probability mass function,joint probability density function,joint probability distribution function

5.2 Marginal probability mass function, marginal probability density function,conditional probability mass function

5.3 Sums and average of random variables

6. Sampling and Estimation (5 hrs)

6.1 Population and samples

6.2 Sampling distribution of mean

6.3 Types of sampling: probability and non-probability sampling

6.4 Determination of sample size

6.5 Central limit theorem and its application

6.6 Estimation: concept of point and interval estimation, criteria of good estimator, interval estimation, maximum likelihood estimation

6.7 Confidence interval for population mean and population proportion

7. Testing of Hypothesis (7 hrs)

7.1 Null and alternative hypothesis, level of significance, type I and type II error, critical value, P-value, one and two tailed test, steps involved in hypothesis testing

7.2 One Sample test for mean and proportion

7.3 Two sample test for mean (independent and dependent) and proportion

8. Simple Linear Regression and Correlation (5 hrs)

8.1 Simple correlation and its properties

8.2 Concept of simple regression analysis, estimation of regression coefficient by using least square estimation method

8.3 Standard error, coefficient of determination.

Text Book:

Johnson, Richard A. *Probability and Statistics for Engineers* (8th edition). New Delhi: PHI learning private limited. 2011.

References:

1. Devore, Jay L. *Probability and Statistics for Engineering and the Sciences* (8th edition). New Delhi: Cengage learning.
2. Sheldom, M. Ross. *Probability and Statistics for Engineers and Scientist* (4th edition). New Delhi: Cengage Learning.
3. Shrestha, Hridya B. *Statistics and Probability* (2nd edition).Kathmandu: Ekata Books Distributer Pvt. Ltd.

Control Systems (3 – 1 – 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

1. To provide knowledge of feedback Control Principles.
2. To design and implement PID control system.

Course Contents:

1. Concept of Control System (3 hrs)

1.1 Introduction to control system, History of automatic control system

1.2 Open-loop and closed-loop control system (feedback control systems), Human control system Effect of feedback on gain, System stability and sensitivity, External noise to the system

1.3 Types of feedback control system, Liner versus non-linear and Time-invariant versus –variant systems

2. Mathematical Modeling of Physical System (6hrs)

2.1 Complex variables and the s-plane, poles and zeros locations and their significance, Differential equations of physical systems

2.2 Classical and Laplace transforms methods in solutions of differential equations, Modeling of electrical and mechanical system elements, Modeling of thermal, Fluid and fluidic component, Mixed systems modeling

2.3Sensors, Encoders and DC Motors in control system, Linearized approximations of non-linear characteristics

3. System Transfer Functions and Responses (5 hrs)

3.1 Combinations of components to physical systems

3.2 Block diagram and SFG algebra, Impulse response and transfer function of linear single-input single –output systems and multivariable systems

3.3 Laplace transform analysis of systems with standard input functions-steps, Ramps, Impulses, Sinusoids, Initial and final steady-state equalibria of systems

3.4 principles and effects of feedback on steady-state gain, Bandwidth, Error magnitude, Dynamic responses, Decomposition of transfer functions

4. State-Variable Analysis (4 hrs)

4.1 Vector-matrix representation of state equations, State transition matrix and eqations and their relationships with higher order differential equations

4.2 State-space Formulation of a system, Relationship between state equations and transfer functions,

4.3 Characteristic equation, Eigen values and Eigen vectors

5. Stability (4 hrs)

5.1 Heuristic interpretation of the conditions for stability of a feedback system, BIBO, Characteristic equation

5.2 Complex plane interpretation of stability, Root locations and stability, Routh-Hurwitz criterion, Eigen value criterion

5.3 Setting loop gain using the R-H criterion, Relative stability from complex plane axis shifting, Stability test, BIBO, Zero-input

6. Ti me-Domain Analysis of Control Systems (5 hrs)

6.1 Time response of continuous system, Unit-step response and time-domain specifications, Steady-state error

6.2 Transient response of second order system, Time-domain analysis of a position-control system

6.3 Effects of adding poles and zeros on transfer function, Dominant poles of transfer function

7. Root Locus Technique (6 hrs)

7.1 Relationship between Root-Loci and time responses of systems

7.2 Rules for construction of Root-Loci diagrams, Computer solutions for Root-Loci plotting, Polynomial root finding and repeated eigenvalue methods

7.3 Derivative feedback compensation design with Root-Locus, Setting controller parameters using root locus

7.4 Parameter change sensitivity analysis by root locus methods

8. Frequency Domain (Response) Method (5 hrs)

8.1 Frequency domain characterization of systems

8.2 Relationship between real and complex frequency response, Bode amplitude and phase plots, Effects of time constants on Bode plot, Stability analysis from the Bode plot, Correlation between Bode plots and real time response: gain and phase margins, Damping ratio, Effects of adding poles and zero on frequency response

8.3 Nyquist stability criterion with minimum phase transfer function, Correlation between Nyquist diagrams and real time response of systems: stability, Relative stability, Gain and phase margin, Damping ratio

8.4 The Nichols chart and its application, Sensitivity studies

9. Performance Specifications for Control Systems (2 hrs)

9.1 Time domain specifications: steady state errors, Response rates, Error criteria, Hard and soft limits on responses

9.2 Damping ratio, Log decrement, Frequency domain specifications: Band width, Response amplitude ratio

10. Design of Control System (5 hrs)

10.1 Application of Root-Locus, Frequency Response and computer simulation in control system design

10.2 Meeting steady-state error criteria, Feedback compensation, Lead, Lag, and Lead-lag compensation

10.3 Design of PID controllers, Pole-Zero cancellation design of Robust control system, Forward and feed forward controllers

*With control System Toolbox

Laboratory:

1. Identification of control system components
   -Establish transfer function and block diagram of a servo system for position and velocity control.
2. Open and closed loop performance of servo position control system.
   - Check effects of loop gain on response
   - compare results with theory
3. Open and closed loop performance of servo velocity control system.
   - check effects of loop gain on response
   - compare results with theory
4. Simulations MATLAB and TUTSIM as a simulation tools.
5. Design a PID controller
   - design of a PID controller for position control servo
   - verify design with TUTSM
6. Non-electrical control system
   - study of a hydraulic or pneumatic servo system

Text Books:

1. K.Ogata, *Modern Control Engineering*, 2nd Edition, Prentice Hall, Englewook Cliffs, New Jersey, 1990.
2. B.C. Kuo, *Automatic Control Systems*, prentice Hall of India.

Signal and Systems (3 – 1 – 2)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

1. Make students familiar with the basics of signals and their types.
2. Enable students to explain the properties of continuous and discrete time signals and to conduct their analysis and synthesis.
3. Make student familiar with basics of systems and to study their behavior.

Course Contents:

1 Introduction (6 hrs)

1.1 Signals: Transformations of independent variables, Definition of continuous and discrete time signals,
1.2 Types of signals and their properties such as sinusoidal signal, Rectangular pulses, Step function, Signum functions, Sinc functions, Delta function.
1.3 Odd and even signals,
1.4 Energy and power signals.
1.5 Systems: Types and properties of systems.

2 Fourier Analysis for continuous and Discrete Time Signals (10 hrs)

2.1 Fourier Series: Definition of periodic continuous time and discrete time signals period,
2.2 Fundamental and harmonics, Harmonically related complex exponential and Fourier representation of periodic signals, analysis and synthesis of periodic signals, Spectral representation of periodic signals using line spectrum for magnitude and phase spectrum, Symmetry relationships,
2.3 Even and odd functions, choice of orgin, Time shifting, Level shifting.
2.4 Fourier Transforms: Definition of the forward and reverse transforms,
2.5 Representation of aperiodic continuous time and discrete time signals, CTFT, DTFT, Magnitude, Phase and energy density spectrum,
2.6 Properties of Fourier transform: Linearity, Periodicity, Duality, Time shifting property, Convolution property, Modulation property, Parseval's Theorem, Fourier transform of the Dirac delta function, the signum function, the step function, the periodic function and the constant.

3 The Discrete Fourier Transforms (DFT) (9 hrs)

3.1 Definition and applications,
3.2 Frequency domain sampling and for reconstruction, Forward and Reverse transforms,
3.3 Relationship of the DFT to other transforms,
3.4 Properties of the Discrete Fourier Transform: Periodicity, Linearity and symmetry properties, Multiplication of two DFTs and Circular convolution, Time reversal, Circular time shift and Multiplication of two sequences circular frequency shift, Circular correlation and Parseval's Theorem,
3.5 Efficient computation of the DFT: FFT/IFFT Algorithms.

4 Energy and Power **(2 hrs)**

4.1 Parseval's theorem for periodic signals, Auto-correlation, Power spectrum,
4.2 Parseval's theorem for finite energy signals, The energy density function.

5. Linear Time Invariant System **(6 hrs)**

5.1 Definition of time-invariance and time-variance for continuous and discrete time systems,
5.2 Impulse response and convolution: Convolution sum and the convolution integral,
5.3 Properties of Linear Time-invariant system, LTI systems described by Differential and difference equations,
5.4 Block diagram representation of LTI systems, Convolution of a rectangular pulse passed through an RC filter.

6 Transmission of Signals **(5 hrs)**

6.1 Input-output relationships in the frequency domain, Definition of transfer function, Distortion less transmission, the ideal lowpass filter and impulse response,
3.6 Introduction to signal transmission in communication systems.

7 Transmission of Signals in Discrete Time Systems **(7 hrs)**

7.1 Introduction to discrete time systems, Linear difference equations, the effect of the delay operation on signals,
7.2 Introduction to finite duration Impulse Responses (FIR) systems and Infinite Impulse Response (IIR) systems,
7.3 Frequency response of FIR and IIR system, Implementation of FIR and IIR system.

Laboratory:

1. Software simulation using MATLAB software
2. The hardware experiments will involve the use of a spectrum analyzer to examine simple periodic signals such as square waves and triangular waves as well as more complex signals such as those from voice or musical instruments.
3. There will also be a number of hardware experiments dealing with signal transmission systems and with modulation.
4. Convolution DFT and FFT will be performed using software in computer.

Text Book:

A.V. Oppenheim and A.S Willsky, Signals and Systems, PHI Publication.

References:

1. A.D Pularikas and S. Seely, signals and Systems, 2nd Edition, PWS-Kent Publishers, 20 Park Plaza, Boston, Mass, 1991.
2. Charles L. Phillips, John M. Part, Evea A. Risking; "Signals, System and Transform", Prentice Hall, Latest Edition.
3. Haykin, Simon and Vanveen, Barry, Signals and System, Weley, Latest Edition
4. Poularikas, A. D. and Seely, S. Signals and Systems, PWS Engineering, Latest edition.

Advanced Electrical Machines (3 – 0 – 1)

Evaluation:

	Theory	Practical	Total
Sessional	30	20	50
Final	50	-	50
Total	80	20	100

Course Objectives:

1. To impart the knowledge on principles of electromagnetic energy conversion
2. To provide the knowledge of synchronous machines, other special machines their application and control

Course Contents:

1. Principle of electromechanical conversion (8 hrs)

1.1 Basic electromagnetic laws, Force and Torque in magnetic field systems
1.2 Energy Balance ,Singly excited magnetic field system ,Field and co energy concept
1.3 Energy flow in electromechanical devices
1.4 Reluctance torque in rotating machine
1.5 Doubly xcited magnetic field systems
1.6 Torque for single phase cylindrical rotor machine
1.7 Torque for single phase salient pole machine
1.8 Force and torque in Permanent Magnet systems

2. Synchronous Generator (10 hrs)

2.1 Constructional details, Operating principle, EMF equations,
2.2 Winding factors, Harmonics in generated voltages and their suppression
2.3 Armature reaction, synchronous impedance, phasor, diagram
2.4 Load characteristic, Regulation and its determination from sync. Impedance method, Zero p.f. methods
2.5 Two reaction Theory for salient pole machine, Vector diagram with d-q axis leakage reactance
2.6 Power and torque developed by Synchronous generator
2.7 Transient condition of an alternator, Transient and sub-transient reactance

3. Parallel Operation of Alternators (4 hrs)

3.1 Parallel operation, concept of infinite bus
3.2 Synchronizing with infinite bus bars, synchronizing power
3.3 Real and reactive power sharing due to change in excitation and input power. effect of R/X ratio

4. Synchronous Motor (4 hrs)

4.1 Operating principle, phasor diagram, Starting methods,
4.2 Effects of excitation, V and Λ curves,
4.3 Hunting effect and its prevention
4.4 Power angle characteristics of cylindrical salient pole and rotor machine
4.5 Two reaction model of salient pole machine
4.6 Synchronous condenser and its applications.

5. Induction type Machine (IM) **(4 hrs)**

5.1 Starting of induction motors, methods of starting and types of starters
5.2 Double cage and deep rotor bar rotor machines
5.3 Speed control: resistance control, pole changing, cascading, injected emf into rotor, variable frequency methods
5.4 Induction generator theory and application.
5.5 Double field theory and Cross field theory for 1phase IM
5.6 Types and characteristics of 1Phase IM

6. Three Phase Transformers **(4 hrs)**

6.1 Introduction, phasor diagram and effective ratio for all possible connections and open delta connection
6.2 Harmonic and In-rush current
6.3 Tertiary winding transformer operation and advantages

7. Special Machines **(8 hrs)**

7.1 Permanent magnet material for electrical machine
7.2 Square wave Permanent magnet brushless machine
  7.2.1 Torque and Emf equation
  7.2.2 Torque and speed characteristics
  7.2.3 Motor with 120^0 and 180^0 magnet arc commutation
  7.2.4 Winding inductance calculation
7.3 Permanent magnet sync. Machine
  7.3.1 Torque and Emf equation
  7.3.2 Torque and speed characteristics
  7.3.3 Winding inductance calculation
7.4 Switched Reluctance Motor
  7.4.1 Poles , phase and windings
  7.4.2 Static torque production , energy conversion loop
  7.4.3 Partition of energy and effect of saturation
  7.4.4 Drive circuits
7.5 Stepper Motor
  7.5.1 Variable reluctance
  7.5.2 Single stack VRM and Multi stack VRM
  7.5.3 Torque Vs stepping rate characteristics , Drive circuits

8. Temperature rise in Electrical Machine **(3 hrs)**

8.1 Heating and cooling time curve , Duty cycles
8.2 Rating machines , Choice of rating of motors
8.3 Methods of Ventilation and cooling

Practical:

1. Determination of V curve of Synchronous Motor
2. Synchronization of three phase alternator to supply
3. Determination of power sharing of parallel connected alternators and study of effects of excitation and input power
4. Simulation in dynamics of electrical machine and effect of disturbances

References

1. E. Fitzgeral, C. Kinsley & S. Dumans, *Electric Machinery*, Tata McGraw Hill, India Ltd.
2. Alexander and Langsdrof ,*Theory of Alternating Current Machine* , ISBN: 9780070994232
3. Puchstein, A. F., Lloyd, T. C, *Alternating Current Machine*. John Wiley & Sons, Inc., New York.
4. T.J.Miller. *Brushless permanent magnet machine and Reluctance Motor Drive* Oxford Science Publication
5. Ramu Krishana. *Permanent Magnet Synchronous and Brushless DC Motor Drives CRC Press.*
6. J. B. Gupta. *Theory and Performance of Electrical Machine* S. K. Kataria & Sons.
7. Bhag S. Guru and Huseyin R. Hiziroglu *Electrical Machinary and Transformers*
8. P.S. Bimbhra *Generalized Theory of Electrical Machine* Khanna Publication 1987

Transmission and Distribution System (3 – 2 – 0)

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objectives:

1. To provide the knowledge of electrical power transmission and distribution system.
2. To impart the knowledge of evaluation technique of transmission and distribution systems parameters.

Course Contents:

1. Structure of Power System and Few Other Accepts **(4 hrs)**

1.1 Structure of Electrical Power System, Types of Generating Systems
1.2 Load Curves, Unit Generated Per annum, load duration curves, types of load and typical demand and diversity factor
1.3 Selection of generating units, peak load and base load
1.4 Power Factor, its improvements and economic power factor
1.5 Per Unit Modeling of Power System Network
1.5.1 Advantage
1.5.2 P.U. impedance of two and three winding transformers

2. Resistance and Inductance of Transmission Line **(6 hrs)**

2.1 Line resistance, line Inductance, skin effect
2.2 Inductance of single conductor, inductance due to internal and external flux linkage
2.3 Inductance of single phase two wire
2.4 Inductance of three phase transmission line with symmetrical spacing, Inductance of
2.5 transposed line
2.6 Self and mutual inductance, inductance of composite conductor, Self GMD and
2.7 mutual GMD
2.8 Inductance of three phase double circuit

3. Capacitance of Transmission Line **(4 hrs)**

3.1 Electrical field and potential differences
3.2 Capacitance of single phase and three phase line
3.3 Capacitance of three phase double circuit
3.4 Effect of earth on capacitance

4. Performance of Transmission Line **(7 hrs)**

4.1 Types of transmission line. Vector diagram, Voltage regulation for short and medium T. L.

4.2 Long transmission line, voltage waves, attenuation propagation delay, SIL, equivalent pi model
4.3 Two Port network, ABCD Parameters of different model of TL
4.4 Power flow trough transmission line, receiving and sending end power circle diagram
4.5 Voltage compensation from circle diagram
4.6 Voltage control methods, shunt and series compensation

5. Electrical Supply System **(3 hrs)**

5.1 Typical A.C. Power supply schemes, comparison of DC and AC transmission systems
5.2 Advantage of high transmission voltage, various system of power transmission
5.3 Comparisons of conductor material for different overhead transmission system
5.4 Economic choice of transmission voltage and conductor size

6. Mechanical Design of Overhead Line **(7 hrs)**

6.1 Main component of overheads line, conductor materials
6.2 Line supports, insulators, types of insulator
6.3 Potential distribution of overhead insulation, string efficiency
6.4 Method to improve string efficiency
6.5 Corona, factors affecting corona
6.6 Advantage and disadvantage of corona and methods reducing corona effect
6.7 Sag, calculation of sag of overhead lines
6.8 Effect of Ice loading and wind pressure in sag
6.9 Skin, Ferranti, proximity effects

7. Underground Cables **(4 hrs)**

7.1 Structure of Cables and materials for undergraduate cables, Cables for three phases Services
7.2 Insulation resistance of single core cable, capacitance of single core cable, di-electrical strength and most economical size
7.3 Grading of Cable, capacitance grading and inter sheath grading
7.4 Capacitance of three phase cable and measurement of capacitance
7.5 Permissible current capacity, types of cable fault

8. Distribution Systems **(4 hrs)**

8.1 Introduction, DC and AC distributers, Distributor fed from single end with tapping at different points and UDL (Uniform Distributed load)
8.2 Distributor fed from both end with tapping at different points and UDL
8.3 Ring Distributor and ring distributer with interconnectors
8.4 Feeder, types and design consideration

9. Load Flow Studies **(6 hrs)**

9.1 Introduction, Classification of buses, formation of Y bus of Network
9.2 Basic load flow equation for voltage and power
9.3 Gauss Seidel Methods for load flow and limitation of this method

Test Books:

1. C. L. Whadwa *Electrical Power System*. New Age International.
2. B. R. Gupat *Power System Analysis and Design* S. Chand Limited.

References:

1. John Joseph Grainger, William Damon Stevenson *Power System Analysis* MCGRAW-HILL Higher Education.
2. William D. Stevenson *Elements of Power System* Analysis. Mcgraw-Hill Book Comp.
3. D. Das *Electrical Power System*
4. V.K. *Mehta Principle of Power System*. S. Chand Company and Limited
5. Kothari & Nagrath *Power System Engineering*

Organization and Management (2-0-0)

Evaluation:

	Theory	Practical	Total
Sessional	50	-	50
Final	50	-	50
Total	100	-	100

Course Objectives:

To make the students able to understand and analyze the professional environment where they have to practice their profession. This course will also help them in bringing attitudinal as well as behavioral change.

Course Contents:

1 Introduction **(2 hrs)**

1.1 Meaning and concept of management
1.2 Functions of management
1.3 Scope and application of management
1.4 Importance of management

2 Organization **(4 hrs)**

2.1 Meaning and concept of organization
2.2 Characteristics of organization
2.3 Principles of organization
2.4 Formal and informal organizations
2.5 Organization chart
2.6 Types of organization-line
  2.6.1 Line and staff
  2.6.2 Functional and matrix.
2.7 Authority and responsibility and their interrelationships.

3 Motivation and leadership **(6 hrs)**

3.1 Concept of motivation
3.2 Incentives
3.3 Theories of motivation: Need hierarchy, Dual Factoral, Expectancy and Achievement theories.
3.4 Leadership styles: Participative management, Management by objectives, management by exception,
3.5 Learning organizations

4 Human Resource Management **(6 hrs)**

4.1 Meaning and functions of human resource management
4.2 Recruitment
4.3 Job analysis, Job specification, Job description
4.4 Elements of compensation

4.5 Human resource development: Training (on the job and off the job)
4.6 Performance appraisal

5 Introduction to Industrial Relations **(6 hrs)**

5.1 Meaning of Industrial Relations
5.2 Trade union
  5.2.1 Collective bargaining
  5.2.2 Trade union movement in Nepal
5.3 Employee grievances
5.4 Employee Discipline
5.5 Employee health and safety
5.6 Compensation and its relation with industry
5.7 Challenges of industrial relations in Nepal
5.8 Methods of improving industrial relations in Nepal

6 Human Behavior and Conflict Management **(7 hrs)**

6.1 Concept of Human Behavior and Conflict Management
6.2 Types of Conflict Management
6.3 Conflict Management and its impact to the HRM
6.4 Modes of Conflict Management
  6.4.1 Negotiation
  6.4.2 Facilitation
  6.4.3 Mediation
  6.4.4 Arbitration
  6.4.5 Legal action

References:

1. Harold Koontz and Heinz Weihrich, Essentials of Mangement
2. Govinda Ram Agrawal, Organization and Management in Nepal.
3. C.B Mamoria, Personnel Managemnt
4. Fred Luthans Organizational Behavior, (McGraw Hill)