

# PROBABILITY AND STATISTICS

**BEG 203 SH**

**Year: III**

**Semester: II**

Teaching Schedule Hours/ Week			Examination Scheme						Total Marks	Remarks
			Final				Internal Assessments			
			Theory		Practical		Theory	Practical		
L	P	T	Duration	Marks	Duration	Marks				
3	-	1	3	80	-	-	20		100	

- 1. Introduction and Descriptive Statistics (4 hrs)**
  - 1.1 An overview of probability and statistics
  - 1.2 Pictorial and tabular methods in descriptive statistics
  - 1.3 Measures of location: mean, median, quartiles, percentiles etc.
  - 1.4 Measures of variability
- 2. Probability (4 hrs)**
  - 2.1 Sample spaces and events
  - 2.2 Axioms, interpretations and properties of probability
  - 2.3 Counting techniques
  - 2.4 Conditional probability
- 3. Discrete Random Variables and Probability Distributions (6 hrs)**
  - 3.1 Random variables
  - 3.2 Probability distributions for random variables
  - 3.3 Expected values of discrete random variables
  - 3.4 The binomial probability distribution
  - 3.5 Hypothesis testing using the binomial distribution
  - 3.6 The hyper geometric and negative binomial distributions
  - 3.7 The poisson probability distributions.
- 4. Continuous Random Variables and Probability Distributions (6 hrs)**
  - 4.1 Continuous Random variables and probability density functions
  - 4.2 Cumulative distribution functions and expected values for continuous random variables
  - 4.3 The normal distribution
  - 4.4 The Gamma Distribution
  - 4.5 Chi-square Distribution
- 5. Joint probability Distributions and random samples (4 hrs)**
  - 5.1 Jointly distributed random variables
  - 5.2 Expected values, covariance and correlation
  - 5.3 Sums and average of random variables
  - 5.4 The central limit theorem
- 6. Point Estimation (2 hrs)**
  - 6.1 Some general concepts of estimation
  - 6.2 Methods of point estimation
- 7. Hypothesis testing procedures based on a Single sample (5 hrs)**

- 7.1 Tests about the mean of a normal population
- 7.2 Large-sample tests for a population mean
- 7.3 Large-sample tests for population proportions
- 7.4 The t-test
- 7.5 Test procedures for a population variance
- 7.6 Some comments on selecting a test procedure
  
- 8. Hypothesis Testing Based on Two Samples (4 hrs)**
  - 8.1 Z-tests for differences between two population means
  - 8.2 The two-sample t-test
  - 8.3 Analysis of paired data
  - 8.4 Testing for differences between population proportion
  
- 9. Interval Estimation (3 hrs)**
  - 9.1 A confidence interval for the mean of a normal population
  - 9.2 Large-sample intervals for population means
  - 9.3 Confidence intervals for population proportions
  - 9.4 Small-sample intervals for means of normal populations
  
- 10. Simple Linear Regression and Correlation (4 hrs)**
  - 10.1 The simple linear probabilistic model and the principle of least squares
  - 10.2 Inferences about the slope parameter  $\beta_1$
  - 10.3 Inferences concerning  $\mu_{x, y}$  and the prediction of future values
  - 10.4 Correlation and the coefficient of determination
  
- 11. The analysis of categorical data (3 hrs)**
  - 11.1 Goodness of fit tests when probabilities are completely specified
  - 11.2 Goodness of fit for composite Hypothesis
  - 11.3 Two way contingency tables

**References:**

1. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole Publishing Company, Monterey, California, 1982.

# FILTER DESIGN

**BEG 337 EC**

Year: III

Semester: II

Teaching Schedule Hours/Week			Examination Scheme			
Theory	Tutorial	Practical	Internal Assessment		Final	
3	-	3/2	Theory	Practical*	Theory	Practical**
			20	25	80	-
						125

\* Continuous

\*\* Duration: 3 hours

**Course Objectives:** To understand the behavior of passive filters and provide the fundamental knowledge of filter and filter design.

- 1. Introduction (3 hrs)**
  - 1.1 The filter and its importance: Types of filter in of magnitude response.
  - 1.2 Filter design techniques
  - 1.3 Review of Poles and Zeros and its affect on magnitude response
- 2. Normalization and de-normalization (2 hrs)**
  - 2.1 Importance and uses of normalization and de-normalization in filter design
  - 2.2 Impedance (magnitude) scaling and Frequency scaling
- 3. One-Port and Two-Port Passive Circuits (6 hrs)**
  - 3.1 Properties of passive circuits
  - 3.2 Properties of loss less circuits PRE.
  - 3.3 Review of properties of LC, RC, RL one port current and synthesis
  - 3.4 Properties of passive two-port circuits, Connection of two port networks
  - 3.5 Synthesis of passive two-port LC and RC ladder circuits transmission and reflection coefficients.
- 4. Low Pass Approximation Methods (6 hrs)**
  - 4.1 Importance of approximation in filter designing
  - 4.2 The Butterworth characteristics and Network functions
  - 4.3 Chebyshev and Inverse Chebyshev characteristics and network functions
  - 4.4 The elliptic filter characteristics and Network functions
  - 4.5 Delay: Group delay and phase delay, Importance of Delay equalization in filter design
  - 4.6 Bessel-Thomson approximation and Network functions for constant delay.
- 5. Frequency Transformation (2 hrs)**
  - 5.1 Frequency transformation and its importance in design of HP, BP, BS from low pass approximation
  - 5.2 Type of transformations: Low pass to Low pass, Band pass and Band stop
  - 5.3 Network functions of different filters
- 6. Design of Resistively-Terminated LC ladder Filters (5 hrs)**
  - 6.1 LC ladder with current and voltage source
  - 6.2 Singly and doubly terminated LS ladders: LC ladders with equal and unequal terminations.
  - 6.3 Synthesis of LC ladder circuits to realize all-pole low pass functions
- 7. Fundamental of Active Filter Circuits (3 hrs)**
  - 7.1 Review of Ideal and non-ideal properties of Operational amplifiers: GBP,

CMRR.

- 7.2 Inverter, Multiplier, Summer/subtractor, Differentiators circuit first order and second order sections, RC-CR transformation
- 8. Biquad Circuits (6 hrs)**
- 8.1 KHN and Two-Thomas biquads
  - 8.2 Sallen-key biquads: Low pass, High pass, Band pass and Band stop design criteria.
  - 8.3 Multiple-Feedback Biquad (MFB): Low pass, High pass, Band pass and Band stop design criteria.
  - 8.4 Biquad selection criteria
  - 8.5 Gain reduction and enhancement
- 9. Sensitivity (3 hrs)**
- 9.1 Importance of sensitivity in filter design
  - 9.2 Single parameter and Multi-parameter sensitivity
  - 9.3 Centre frequency and Q-factor sensitivity
  - 9.4 Sensitivity properties of biquads
  - 9.5 Sensitivity comparison between passive and active filter circuits.
- 10. Design of Higher-order Active filters (2 hrs)**
- 10.1 The Cascade realization
  - 10.2 Sequencing of filter blocks
  - 10.3 Centre frequency, Q-factor and gain
- 11. Simulation of passive filters (3 hrs)**
- 11.1 The GIC
  - 11.2 LC ladder design with simulated inductors
  - 11.3 LC ladder design with frequency-development negative resistors (FDNR)
  - 11.4 Leapfrog simulation of LC ladders
- 12. Switched-Capacitor Filters (3 hrs)**
- 12.1 The MOS switch
  - 12.2 Simulation of resistors by switched capacitor
  - 12.3 Switched-capacitor circuits for op-amp based analog operations: addition, subtraction, multiplication, integration and differentiation
  - 12.4 First order and second order switched capacitor circuits
  - 12.5 Switched capacitor biquads, Leapfrog switched capacitor filters for LC ladder.
- 13. Introduction to High Frequency Filter (1 hr)**
- 13.1 Wave guide filter

### **Laboratory**

1. Design of passive and active filter on MATLAB
2. Design of passive and active filters circuit for given parameters
3. Study of sensitivity using hardware implementation
4. Design of active simulated passive filters
5. Design of switched capacitor filters
6. Demonstration of high frequency filter

### **References**

1. M.E. Van Valkenberg, "Analog Filter Design", Holt, Rinehart and Winston, Inc., New York, 1982.

2. W.K. Chen, "Passive and Active Filters: Theory and Implementations", John Wiley and Sons, 1986. (A slightly more advanced treatment of approximation and properties of passive circuits)
3. R. Schaumann, M.S. Ghausi and K.R. Laker, "Design of Analog Filters: Passive, Active RC and Switched-Capacitor", Prentice Hall, Englewood Cliffs, New Jersey, 1990.
4. G.C. Themes and S.K. Mitra, "Modern Filter Theory and Design", John Wiley & Sons.

# RESEARCH METHODOLOGY

## BEG 396 MS

Year:III

Semester:II

Teaching Schedule Hours/ Week			Examination Scheme				Total Marks	Remarks
			Final		Internal Assessments			
			Theory		Theory			
L	P	T	Duration	Marks	Duration	Marks		
2	-	1	1.5	40		10	50	

1. **Social Research** (3 hrs)
  - 1.1 Definition
  - 1.2 Objectives
  - 1.3 Phases on Social Research
  - 1.4 Types of Social Research: Basic & Applied Research
  
2. **Fundamental Concept on Research** (5 hrs)
  - 2.1 Hypothesis
  - 2.2 Sampling, its characteristics, types, benefits and problems
  - 2.3 Field work
  - 2.4 Validity
  - 2.5 Reliability
  
3. **Research Design** (5 hrs)
  - 3.1 Definition of Research Design
  - 3.2 Types of research Design
  - 3.3 Research Proposal
  - 3.4 Selection of topics of Research
  
4. **Data Collection** (4 hrs)
  - 4.1 Meaning of Data Collection
  - 4.2 Importance of Data collection
  - 4.3 Types of Data
  - 4.4 Source of Data Collection
  
5. **Data Collection Techniques and Classification** (5 hrs)
  - 5.1 Survey
  - 5.2 Interview
  - 5.3 Questionnaire
  - 5.4 Case Study
  - 5.5 Observation
  - 5.6 Analysis and Presentation of data
  
6. **Mean, Median and Standard Deviation** (5 hrs)
  - 6.1 Definition
  - 6.2 Different methods of calculation of mean, median and standard Deviation
  
7. **Report Writing** (3 hrs)
  - 7.1 Definition
  - 7.2 Organization of Report
  - 7.3 Presentation of Diagram

- 7.4 Construction of tables
- 7.5 Bibliography

**References:**

1. Best, John W.; "Research in Education, Prentice Hall of India, New Delhi.
2. Wolf Howard K. and Prem R. Panta, "Social science Research and Thesis writing" Research Division TU, Kirtipur, 1975.
3. Goode William J. and Paul K. Hatt, "Methods in Social Research" Mcgraw Hill, Kogakusha Ltd., 1952.
4. Tika Bhattarai, "Research Methodology"

# ENGINEERING ECONOMICS

BEG 495 MS

Year: III

Semester: II

Teaching Schedule Hours/ Week			Examination Scheme						Total Marks	Remarks
			Final				Internal Assessments			
			Theory		Practical		Theory	Practical		
L	P	T	Duration	Marks	Duration	Marks				
3	-	1	3	80	-	-	20		100	

**Course Objectives:** To provide the students a knowledge of the basic tools and methodology of economics studies for evaluation engineering project in private industry in the public sector and in the utilities area.

- 1. Introduction 3**
  - 1.1 Business and accounting terminology
  - 1.2 Cash flow
  - 1.3 Economic system
- 2. Cost Classification and Analysis 5**
  - 2.1 The elements of cost
  - 2.2 Classification of cost: overhead cost, prime cost
  - 2.3 Cost variance analysis
  - 2.4 Job and process costing
- 3. Interest and Time Value of Money 6**
  - 3.1 Simple interest, compound interest, interest tables, interest charts
  - 3.2 Present worth
  - 3.3 Nominal and effective interest rates
  - 3.4 Continuous compounding and continuous compounding formula
  - 3.5 Interest calculations for uniform gradient
- 4. Basic Methodologies of Engineering Economic Studies 7**
  - 4.1 Present worth and annual worth methods
  - 4.2 Future worth method
  - 4.3 Internal rate of return method
  - 4.4 Draw backs of the internal method
  - 4.5 External rate of return method
  - 4.6 Minimum attractive rate of return method
  - 4.7 The playback (pay-out) period method
- 5. Cost/Benefit Analysis 4**
  - 5.1 Conventional cost/benefit ratio
  - 5.2 Modified cost/benefit ratio
  - 5.3 Break-even analysis
- 6. Investment Decisions 8**
  - 6.1 Comparison of alternatives having some useful life
  - 6.2 Comparison of alternatives having different useful life



6.3	Comparison of alternatives including of excluding the time value of money	
6.4	Comparison of alternatives using the capitalized worth method	
6.5	Definition of mutually exclusive investment alternatives in terms of combinations of projects	
6.6	Comparison of mutually exclusive alternative	
<b>7.</b>	<b>Risk Analysis</b>	<b>4</b>
7.1	Project operating under conditions of certainty	
7.2	Project operating under conditions of uncertainty	
7.3	Decision tree	
7.4	Sensitivity analysis	
<b>8.</b>	<b>Taxation System in Nepal</b>	<b>3</b>
8.1	Taxation law in Nepal	
8.2	Depreciation rates for buildings, equipments, furniture etc.	
8.3	Recaptured depreciation	
8.4	Taxes on normal gains	
8.5	Taxes on capital gains	
8.6	VAT	
<b>9.</b>	<b>Demand Analysis and Sales Forecasting</b>	<b>5</b>
9.1	Demand analysis	
9.2	Correlation of price and consumption rate	
9.3	Multiple correlation of price and consumption rate	
9.4	Market research	
9.5	Sales forecasting	
9.6	Criteria for desirable sales forecasting procedures	
9.7	Factors affecting accuracy of forecasting	

### **Tutorials**

3 Assignments, 2 Quizzes, 3 Case Studies.

### **Note:**

The case studies will concentrate on economic analysis and selection of public projects, economic analysis and selection of private projects, risk analysis and demand analysis.

### **Recommended Books**

1. E.P. DeGarmo, W.G. Sullivan and J.A. Bontadelli, 8th Edition, Macmillan Publishing Company, 1988
2. N.N. Borish and S. Kaplan, "Economic Analysis: For Engineering and Managerial Decision Making", McGraw-Hill.

# DIGITAL CONTROL SYSTEMS

**BEG 338 EC**

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
3	-	3/2	Theory	Practical*	Theory	Practical**	125
			20	25	80	-	

\* Continuous

\*\* Duration: 3 hours

**Course Objectives:** This course provides basic concepts of analysis and design of digital control systems.

- 1. Discrete-Time Control Systems (6 hrs)**
  - 1.1 Principle and features of capital control systems
  - 1.2 Signal sampling, Quantizing and Coding
- 2. Review of Z-Transform (8 hrs)**
  - 2.1 Fundamental of the Z-Transform
  - 2.2 Important properties of Z-transform for control system applications
  - 2.3 Z-transform from the convolution integral
  - 2.4 Reconstruction of original signal from samples
  - 2.5 S-plane to Z-plane mapping and vice versa
  - 2.6 Criteria for stability in the Z-domain
- 3. Analysis of Control Systems (12 hrs)**
  - 3.1 Discrete-time equivalents of continuous-time system
  - 3.2 Discrete-time equivalents of analog controllers
  - 3.3 Steady-state and transient responses
  - 3.4 The root locus method
  - 3.5 Frequency response method
- 4. Design and Compensation (10 hrs)**
  - 4.1 Control system controllers: structures; features; hardware/software; responses to control signals, use of foot locus and frequency domain concept
  - 4.2 Phase-Lead and Phase-Lag compensator design
  - 4.3 PID controller design and selection of parameters for discrete-time systems
- 5. Discrete-Time State Equations (9 hrs)**
  - 5.1 Discretization of the continuous-time state-space equations
  - 5.2 Pulse transfer function matrix
  - 5.3 Stability assessment from the discretized state space equations

**Laboratory :** There shall be six laboratory exercises related to the control problem

## References

K. Ogata, "Discrete-Time Control Systems", Prentice Hall, Englewood Cliffs, New Jersey, 1987.

# COMMUNICATION SYSTEMS I

BEG 336 EC

Year: III

Semester: II

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
3	-	2	Theory	Practical*	Theory	Practical**	125
			20	25	80	-	

\* Continuous

\*\* Duration: 3 hours

**Course Objective:** To introduce the students to the principles and practices of Analog Communication systems.

- 1. Introduction to communication systems** **5**
  - 1.1 Sources of information, signal types, transmitters, channels and receivers in analog and digital communication systems.
  - 1.2 Relation between channel capacity, bandwidth and noise.
  - 1.3 Need for modulation types of modulation.
- 2. Review of signals and systems** **8**
  - 2.1 Types of signals and systems time domain and frequency domain representation of signals, Review of Fourier series and transform.
  - 2.2 Signal transfer in linear time invariant (LTI) systems, concept of transfer function, impulse response and convolution.
  - 2.3 Low-pass signals and systems, ideal low-pass filter.
  - 2.4 Band-pass signals and systems, band-pass filter.
  - 2.5 The Hilbert transformation and its properties.
  - 2.6 Distortionless transmission, concept of system and signal bandwidth.
- 3. Amplitude Modulation** **10**
  - 3.1 Double side-band suppressed carrier (DSB-SC) Amplitude modulation (AM): time domain representation, spectrum, generation, demodulation, bandwidth, power efficiency and uses.
  - 3.2 Double side-band full carrier AM (DSB-AM): time domain representation, spectrum, generation, bandwidth, power efficiency and uses
  - 3.3 Single side-band AM (DSB-AM): time domain representation, spectrum, generation, demodulation to vestigial side-band and Independent side-band modulation techniques.
  - 3.4 Introduction to vestigial side-band and Independent side-band modulation techniques.
  - 3.5 Synchronous (coherent) demodulation of AM signals effect of frequency and phase errors in the quality of demodulated signals: Carrier recovery techniques.
  - 3.6 Envelop (peak) detector and square law detector of DSB-AM.
  - 3.7 Introduction to Phase Locked Loop (PLL).

<b>4.</b>	<b>Frequency Modulation (FM) and Phase Modulation (PM)</b>	<b>9</b>
4.1	Instantaneous frequency and phase, time domain representation of FM and PM.	
4.2	Time domain expression for single tone modulated FM and PM, concept of modulation index, spectral representation of single tone modulated FM signal.	
4.3	Transmission bandwidth for FM, Carlson's rule, narrow band and wide band FM.	
4.4	Generation of FM signals.	
4.5	Demodulation of FM signals.	
4.6	Commercial stereo FM broadcasting and receiving techniques.	
<b>5.</b>	<b>Frequency Division Multiplexing (FDM) systems</b>	<b>6</b>
5.1	FDM in telephony hierarchy	
5.2	Filter and oscillator requirements in FDM.	
5.3	Introduction to satellite communication systems. Frequency division multiple access (FDMA) systems in satellite communication.	
<b>6.</b>	<b>Spectral analysis</b>	<b>7</b>
6.1	Review of Fourier transform theory, energy and power, Parseval's theorem.	
6.2	Deterministic and Random signals.	
6.3	Power spectral density function (PSDL) and its relation with autocorrelation function.	
6.4	PSDF of harmonic signal and uncorrelated (white noise) signals.	
6.5	Analog spectrum analyzer: Principle and uses.	

#### **Laboratory works:**

1. At least selected laboratory works on modulation and demodulation of DSB-SC, DSB-AM, SSB, FM; Operation and use of spectrum analyzer, PLL circuits.

#### **References:**

1. S. Haykin, "An introduction to Analog and Digital Communication" (Latest Edition)
2. Leon W. Couch H., "Digital and Analog Communication System", Sixth Edition, Pearson Education Asia, 2001.
3. B.P. Lathi, "Modern Digital and Analog Communication Systems", Third Edition, Oxford University Press, 1999.
4. J. Proakis, M. Saheli, "Communication Systems Engineering", Prentice Hall, New Jersey, 1994.