POWER ELECTRONICS
BEG 335 EC

Year: III **Semester: I**

Teaching Schedule Hours/ Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
			Theory	Practical	Theory	Practical	
3	1	3/2	20	25	80	-	125

*** Continuous**
**** Duration: 3 hrs**

Course Objectives:

The objectives of this course are to introduce the concept of semiconductor devices for high power applications, to understand the concept, performance analysis and applications of power diodes and thrusters.

1. Introduction **2**

1.1 History of power electronics
1.2 Applications of power electronics
1.3 Power semiconductor devices
1.4 Control characteristics of power devices
1.5 Types of power electronics circuit
1.6 Design of power electronics equipment and peripheral effects

2. Power Semiconductor Diodes **3**

2.1 Diode characteristics
2.2 Reverse recovery characteristics
2.3 Types of power diodes
- 2.3.1 General-purpose diodes
- 2.3.2 Fast-recovery diodes
- 2.3.3 Scotty diodes

2.4 Effects of forward and reverse recovery time
2.5 Series and parallel connected diodes
2.6 SPICF diodes model

3. Diodes Circuit and Rectifier **5**

3.1 Diode with RC and RL loads
3.2 Diode with LC and RLC loads
3.3 Freewheeling diodes
3.4 Single phase half wave rectifiers, Performance parameters
3.5 Single phase full wave rectifier with RL load
3.6 Multiphase star rectifier
3.7 Three phase bridge rectifier with Rl load
3.8 Output voltage with LC filter
3.9 Rectifier circuit design

4. Thyristors **6**

4.1 Thyristor characteristics
4.2 Two-transistor model of thyristor
4.3 Thyristor turn-on, turn-off and protection
4.4 Types of thyristors
- 4.4.1 Phase controlled thyristors
- 4.4.2 Fast-switchinf thyristors
- 4.4.3 Gate-turn-off thyristors
- 4.4.4 Bidirectional triode thyristors
- 4.4.5 FET and MOS controlled thyristors

9.2.2 Resonant DC power supplies
9.2.3 Bidirectional power supplies
9.3 AC power supplies
9.3.1 Switched-mode AC power supplies
9.3.2 Resonant AC power supplies
9.3.3 Bidirectional AC power supplies
9.4 Multistage conversions
9.5 Power factor conditioning
9.6 Magnetic Considerations

10.0 DC Drives: **3**

10.1 Basic characteristics of DC motors
10.2 Operating modes
10.3 Single-phase drives
10.3.1 Single-phase half wave converter drives
10.3.2 Single- phase semi converter drives
10.3.3 Single-phase full-converter drives
10.3.4 Single-phase dual-converter drives
10.4 Closed-loop control of DC drives
10.4.1 Open- loop and closed-loop transfer function
10.4.2 Phase-locked-loop control
10.4.3 Microcomputer control of DC drives

11.0 Protection of Devices and Circuits: **2**

11.1 Introduction
11.2 Cooling and heat sinks
11.3 Snubber circuits
11.4 Reverse recovery transients
11.5 Supply and load-side transients
11.6 Voltage protection by selenium diodes and metal-oxide varistors
11.7 Current protections
11.7.1 Fusing
11.7.2 Fault current with AC source
11.7.3 Fault current with DC source

Laboratory

6 laboratory exercises based on power electronics devices.

Reference:

1. M.H.Rashid,"Power Electronics:Circuits, Devices,and Applications", Second Edition, Prentice Hall of IndiaPvt. Ltd., 1996.
2. G.De, "Principles of Thyristorised converters" Oxford & IBH Publishing Co. New Delhi

SIGNAL AND SYSTEMS
BEG 334 EC

Year: III **Semester: I**

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

*** Continuous**
**** Duration: 3 hrs**

Course Objectives:

This course provides knowledge of signals and their types, study the properties of continuous and discrete time signals and to study the basic of systems and to study their behavior

1. Signals and Systems **6**

1.1 Transformations of independent variables
1.2 Definition of continuous and discrete time signals
1.3 Types of signals and their properties such as sinusoidal signal , rectangular pulses, step functions, signum functions, sine functions, delta functions, Odd and Even signals, Energy and power signals.
1.4 Types and Properties of systems

2. Fourier analysis for Continuous time and discrete time signals **10**

2.1 Definition of periodic continuous time and discrete time signals: period, fundamentals and harmonics
2.2 Harmonically related complex exponential and Fourier representation of periodic signals, Analysis and synthesis of periodic signals
2.3 Spectral representation of of periodic signals using line spectrum for magnitude and phase spectrum
2.4 Symmetry relationships, even and odd functions, choice of origin, time shifting, level shifting
2.5 Definition of the forward and reverse Fourier transforms
2.6 Representation of A periodic continuous – time and discrete time signals, Magnitude, phase, and energy density spectrum
2.7 Properties of Fourier transform: Linearity, Periodisity, Duality, Time shifting property, Convolution property, Modulation property, Parseval's Theorem
2.8 Fourier transform of the Dirac delta function, the signum function, the step function, the periodic function, the periodic function, and the constant.

3. The Discrete Fourier Transform (DFT) **8**

3.1 Definitions and applications
3.2 Frequency domain sampling and for reconstruction: Forward and Reverse transforms, Relationship of the DFT to other transforms
3.3 Properties of the Discrete Fourier Transform: Periodically, Linearity, and symmetry properties
3.4 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, Efficient Computation of the DFT.
3.5 Introduction of the fast Fourier Transform (FFT) algorithm: Radix-2 FFT algorithms, Applications of FFT Algorithm

4. Energy and Power **3**

4.1 Parseval's theorem for periodic signals, auto-correlation, Power spectrum

4.2 parseval's theorem for finite energy signal, the energy density function.

5. Linear Time Invariant System **6**

5.1 Definition of time-inveriance and time-varience for continuous and discrete time system

5.2 Impulse response and Convolution: Convolution sum and the convolution integral, properties of linear time-Invarient system. LTI systems described by Differential and difference equations.

5.3 Block Diagram representation of LTI systems, Convolution of a rectangular pulse passed through an RC filter

6. Transmission of signals **5**

6.1 Input-output relationships in the frequency domain

6.2 Definition of transfer function

6.3 Distortion less transmission the ideal low pass filter and impulse response

7. Transmission of Signals in Discrete Time Systems **6**

7.1 Introduction to discrete time systems, linear difference equations, the effet 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. Signal simulation using MATLAB
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 signal 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. The convolution, DFT and FFT will be performed using software in computer

References:

1. A.D. Poularikas and S. Seely, "Signal & Systems" , 2nd Edition, PWS-Kent publishers, 20 Park Plaza, Boston, Mass, 1991.
2. A.V. Oppenheim and A.S. Willsky, "Signal & Systems" , PHI publication..

Numerical Methods
BEG 370 CO

Year:III Semester:I

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
			Theory	Practical	Theory	Practical	.
3	-	3	20	50	80	-	150

* Continious
** Duraton

Course objective: To solve the engineering problems by using the theory of numerical Computational procedures.

1. Solution of nonlinear equations (10 hrs)

1.1 Review of calculus, continuity, differentiability, intermediate value theorem
1.2 Absolute, relative, and round off errors
1.3 Bisection method, its error bounds and convergence
1.4 Newton's method, secant method, and their convergence properties.
1.5 Fixed point interation, its convergence properties stiffen son's algorithm

2. Interpolation and approximation (10 hrs)

2.1 Taylor's polynomial approximation, Lagrange's interpolation
2.2 Newton's Interpolation and divided differences
2.3 Interative Interpolation
2.4 Cubic spline Interpolation
2.5 Least square method of fitting continuous and discrete data or function

3. Numerical differentiation and integration (5 hrs)

3.1 Numerical differentiation formula
3.2 Newton's cote's numerical integration formula composite numerical integration
3.3 Romberg integration algorithm
3.4 Gaussian integration formula

4. Linear algebraic equations (10 hrs)

4.1 Review of the properties of matrices
4.2 Matrix form of Gaussian elimination pivoting strategies ill conditioning
4.3 Cholesky's and related algorithms for matrix factorization
4.4 Eigen values and Eigen vectors and the power methods

5. Solution of ordinary differential equations (7 hrs)

5.1 Euler's method for solving ordinary differential equation of first order
5.2 Runga-Kutta methods
5.3 Extension to higher order equation
5.4 Initial value problems
5.5 Boundary value problem

6. Solutions of partial differential equations (3 hrs)

6.1 Introduction to the solutions of Partial differential equations
6.2 Civil engineering examples

References:

1. S. Yakwitz and F. Szidarovszky, "An Introduction to Numerical computations " , 2nd Edition, Mc Millan publishing Co., New York.
2. W.C. dhency and D. Kincaid, "Numerical Mathematics and Computing", 2nd Edition, Brooks/Cole publishing Co. 1985.

3. C.F. Gerald and P.O. Wheatley, “Applied Numerical Analysis”, 4th edition, Addition Wesley Publishing Co., New York.
4. W.H. Press, B.P. Flannery et. al., “Numerical Recipesin C”, 1st edition, Cambridge Press, 1988.

Numerical Methods
BEG 370 CO

Year: III
Semester: I

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
			Theory	Practical	Theory	Practical	.
3	-	3	20	50	80	-	150

* Continious
** Duraton

Course objective: To solve the engineering problems by using the theory of numerical computational procedures.

1. Introduction
2

1.1 Introduction to Numerical Method
1.2 Needs of Numerical Methods
1.3 Number and their accuracy
1.4 Errors (Absolute, Relative, rounding off error, truncation error, general error formula)
1.5 Convergence

2. System of non-linear equations
8

2.1 Introduction
2.2 Graphical Method
2.3 The interaction Method
2.4 The bisection Method
2.5 Newton Raphson Method
2.6 Secand Method
2.7 Fixed point interaction
2.8 Zeros of polynomials ------method

3. Interpolation
10

3.1 Introduction
3.2 Polynomial forms
3.3 Linear interpolation
3.4 Language interpolation polynomial
3.5 Spline interpolation
3.6 Chebyshev interpolation polynomial
3.7 Least square method of fitting continuous and discrete data or function

4. Numerical differentiation and integration
5

4.1 Introduction
4.2 Numerical differentiation
4.3 Numerical integration
4.4 Numerical double integration

5. Matrices and linear systems of equations
10

5.1 Introduction
5.2 Review of the properties of matrices
5.3 Solution of linear system-direct methods
5.4 Solution of linear system- iterative methods
5.5 The eigenvalue Problem
5.6 Singular value decomposition

6. Numerical solution of ordinary differential equations
7

6.1 Introduction
6.2 Euler's method for solving ordinary differential equaton
6.3 Runga-Kutta methods
6.4 Predictor- Corrector methods
6.5 Simultaneous and higher order equations
6.6 Initial value problems
6.7 Boundary value problems

7. Numerical Solution of partial differential equations
3

7.1 Introduction
7.2 Finite-difference approximations to derivates
7.3 Laplace's Equation
7.4 Parabolic Equations
7.5 Iterative methods for the solution of equations
7.6 Hyperbolic equation

Laboratory:

There shall be 12 laboratory exercises using high level programming language

References:

1. Computer Oriented Numerical Methods, V. rajaraman
2. Introductory methods of Numerical analysis, S.S. Sastry
3. An Introduction to numerical computations, S. Yakowitz and F. Szidarovszky.

ELECTRONIC CIRCUIT II
BEG 333 EC

Year: III **Semester: I**

Teaching Schedule Hours/ Week			**Examination Scheme**				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
			Theory	Practical	Theory	Practical	
3	1	3	20	50	80	-	150

*** Continuous**
**** Duration**

Course Objectives:

This course provides knowledge of electronic circuits on data conversion, Instrumentation, Logarithmic amplifiers, basic of communication and switched power supplies.

1. Differential Amplifiers **(4 hrs)**

1.1 Characteristics and features of differential amplifier ; Voltage gain, Common mode and Differentia mode gain.
1.2 Circuit design considerations: Non - ideal properties
1.3 Application

2. Instrumentation and Isolation Amplifiers **(7 hrs)**

2.1 Type of Instrumentation amplifiers
  2.1.1 Characteristics and properties
  2.1.2 Application
2.2 Isolation amplifier principles and essential of isolation amplifier
  2.2.1 Characteristics and properties
  2.2.2 Circuit design
  2.2.3 Applications

3. Logarithmic Amplifier **(6 hrs)**

3.1 Characteristics and feature of Logarithmic and amplifier
3.2 Design of logarithmic amplifier circuit: Stability consideration
3.3 Anti-logarithmic operations
3.4 Applications

4. Introduction to Communication Circuits **(6 hrs)**

4.1 Modulation and demodulation circuits
4.2 Frequency converters and mixers
4.3 AM and FM receiver circuits
4.4 Phase – locked loops

5. Data conversion **(7 hrs)**

5.1 Principle of D/A conversion
5.2 The R-2R ladder circuits. Unipolar and bipolar D/A conversion
5.3 Principle of A/D conversion
5.4 Count- up and tracking A/D’s based on D/A’s

5.5 Successive approximation A/D conversion
5.6 Integrating voltage – to – time conversion A/D conversion
5.7 Dual and slope types
5.8 Sigma – delta – A/D converters and Flash A/D converters

6. Switched Power – supply Circuits (6 hrs)

6.1 Characteristics and feature of switching power supply circuit
6.2 Voltage step down, step up, regulator circuits and Step-up / step-down regulator circuit
6.3 Filtering considerations
6.4 Control circuits
6.5 IC switched regulator controllers

7. Power conversions circuits (9 hrs)

7.1 Construction and characteristics of Power Diodes, Power transistors, Thyristors and Triacs
7.2 Controlled rectifier circuits
7.3 Inverter circuit, Chopper circuit, DC-to-dc conversion, AC-to-ac conversion

Laboratory

1. D/A and A/D conversion
2. Characteristics measurement of Differential amplifier, Instrumentation
3. Design of AM and FM modulator and demodulator circuits
4. Switched voltage regulator design
5. Simple inverter circuit design
6. DC-to-DC circuit design

References

1. K.C. Clarke and D.T. Hess, "Communication Circuits: Analysis and Design" ' Addition-Wisley Publishing Company.
2. J.G. Graeme, "Application of Operational Amplifiers: Third Generation Techniques" ' Mc-Graw-Hill.
3. N. Mohan, T.M. Undeland and W. P. Robbins, "Power Electronics: Converters, Applications and Design" , John Wiley and Sons, New York, 1989.
4. W. Stanely, "Operational Amplifiers with Linear Integrated Circuits", Charls E. Merrill Publishing Company, Canada.
5. C.W. Lander, "Power Electronics", Mc Graw Hill Book Company.

CONTROL SYSTEMS
BEG 320 EL

Year: III **Semester: I**

Teaching Schedule Hours/Week			Examination Scheme				
Theory	Tutorial	Practical	Internal Assessment		Final		Total
			Theory	Practical	Theory	Practical	
3	1	3/2	20	25	80		125

*** Continuous**
****Duration: 3 hrs**

Course Objectives: To provide knowledge on feedback control principles and to apply these concepts to control processes.

1. System Modeling **7**

1.1 Differential equation and transfer function
1.2 State-space formulation of differential equations, matrix notation
1.3 Mechanical components and Electrical components: mass, spring, damper, Inductance, capacitance, resistance, sources, motors, techno meters, transducers, operational amplifier circuits.
1.4 Fluid and fluidic components, Thermal system components
1.5 Mixed systems
1.6 Linearized approximations

2. Transfer Functions and Responses **8**

2.1 Components to physical systems
2.2 Block diagram and system reduction
2.3 Mason's loop rules
2.4 Laplace transforms analysis of systems with standard input functions-steps, ramps, impulses, sinusoids
2.5 System state: initial and final steady-state
2.6 Effects of feedback on steady-state gain, band-width, error magnitude, dynamic responses

3. Stability **4**

3.1 Heuristic interpretation for stability of a feed back system
3.2 Characteristic equation, complex plane interpretation of stability, root locations and stability
3.3 Routh-Hurwitz criterion, eigenvalue criterion
3.4 Setting loop gain using the R-H criterion
3.5 Relative stability from complex plane axis shifting

4. Root locus method **6**

4.1 Relationship between root locus and time responses of systems
4.2 Rules for construction of root locus diagram
4.3 Computer programs for root locus plotting, polynomial root finding
4.4 Derivative feedback compensation design with root locus
4.5 Setting controller parameters using root locus, parameter change sensitivity analysis by root locus

5. Frequency Response Methods **4**

5.1 Frequency domain characterization of systems
5.2 Bode amplitude and phase plotys, Effects of bain time constants on Bode diagrams, Stability from the Bode diagram
5.3 Nyquist plots, Correlation between Nyquist diagrams and real time response of systems: stability, relative stability, gain and phase margin, damping ratio

6. Computer Simulation of Control System **4**

6.1 Role of simulation studies
6.2 Linear and non-linear simulations

7. Performance Specifications for Control Systems **2**

7.1 Time domain specifications: steady-state errors, response rates, error criteria, hard and soft limits on responses, damping ratio, log decrement.
7.2 Frequency domain specifications: bandwidth, response amplitude ratio.

8. Compensation and Design **8**

8.1 Root locus, frequency response and simulation in design
8.2 Feed back compensation
8.3 Lend, lag, and lead-lag compensation, PID controllers

9. Digital Control System **2**

9.1 Introduction of Digital Control System
9.2 Components of Digital Control System
9.3 Designing criteria of Digital Control System

<u>Laboratory</u>

1. Identification of Control System Components
2. Open and Closed Loop Performance of Servo Position Control System
3. Simulation Study of Feedback System Using TUTSIM or MALTAB
4. Design of a PID Controller
5. Non-Electrical Control System

<u>Reference Book</u>

1. K. Ogata, "Modern Control Engineering" , 2nd Edition, Prentice hall, Englewood Cliffs, New Jersey, 1990.