

**Semester VI****Third Year**

Code	Subject	L-T-P	Credit
EECL 305B	Digital Signal Processing	3-1-0	4
EECL 306B	Electronic Instrumentation & Measurement	3-0-0	3
EECL 307B	Control Systems	3-0-0	3
EECL 308B	Optical Fiber Communication	3-0-0	3
EECL 309B	Digital System Design using VHDL	3-1-0	4
MBUL 351B	Project Management for Engineers	2-0-0	2
EECP 310B	VHDL Lab	0-0-2	1
EECP 308B	Optical Communication Lab	0-0-2	1
EECP 304B	Instrumentation & Control Lab	0-0-3	1.5
EECP 306B	Digital Signal Processing Lab	0-0-2	1
EECD 302B	Mini Project-II (ECE)	0-0-2	1
	Total Credits	<b>17-2-11</b>	24.5

**Digital Signal Processing****EECL 305B****3 - 1 - 0 = 4**

**Discrete-time Signals & Systems:** Advantages of digital over analog signal processing; discrete-time signals and sequences: representation of sequences and elementary operations; classifications of discrete-time systems. Resolution of discrete-time signals into impulses; Analysis of discrete-time LTI systems: Response to arbitrary inputs, the convolution sum, properties of LTI systems and their interconnections, causality and stability. Linear constant coefficient difference equations and their solutions; Impulse response of LTI recursive system. Response to complex exponential and sinusoidal signals-the frequency response function. Random signals & their statistical properties; Wide-sense stationary random signals.

**Transform Analysis of LTI Systems:** Analysis of LTI system in the Z-domain, Sampling of continuous-time signals – periodic sampling; frequency domain representation of sampling; reconstruction of a band limited signal from its samples; decimation and interpolation. System functions –: poles and zeros, rational system function, causality and stability; frequency response of LTI systems-phase distortion and delay; frequency response for rational system functions for single zero or pole systems.

**Structures For Discrete-time Systems:** Block diagram representation of linear constant coefficient difference equations - their interconnection schemes; direct form-I, direct form-II, cascade form and parallel form structures. Finite word-length effect-number representation, analysis of effect of coefficient quantization and rounding of noise; zero input limit cycles in fixed-point realizations of IIR digital filters.

**Filter Design Techniques:** Characteristics of practical frequency selective filter; design of FIR filters by windowing. Characteristics of Butterworth &

Chebyshev filters-frequency transformation; design of IIR filters from continuous-time filters-Impulse invariance & bilinear transformation methods.

**Discrete Fourier Transforms:** Frequency domain sampling; the DFT and properties of DFT; circular convolution; linear convolution using DFT.

**Efficient Computation of DFT:** Computational complexity; FFT algorithms - the decimation-in-time and decimation-in-frequency; signal flow graph-Butterfly computations, in-place computations; analysis of computational complexity.

### **Suggested Readings:**

- Discrete-time Signal Processing , Oppenheim & Schaffer , PHI
- Digital Signal Processing , Proakis & Manolakis, PHI
- Digital Signal Processing , Sanjit K. Mitra

## **Electronic Measurement & Instrumentation**

**EECL 306B**

**3 – 0 – 0 = 3**

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**Measurement and error:** Sensitivity, resolution, accuracy and precision, significant figures, absolute and relative errors, types of errors, probability of errors and limiting errors, linearity, Calibration and standard.

**Analog & Digital instruments:** Multimeter, A.C. voltmeter using rectifiers, wave analyzer, harmonic distortion analyzer. Digital voltmeter, digital multimeter, digital LCR measurements, digital frequency meter and applications .Shielding and grounding, Q-meter, vector impedance meter. Block diagram of CRT, probes, deflection amplifier and delay line, source and coupling for trigger generator, automatic time base, Dual trace oscilloscopes, sweep modes, Measurement of voltage, frequency and phase, pulse measurements. CRT storage target characteristic, sampling oscilloscopes, digital storage oscilloscope, spectrum analyzer, Logic Analyzer

**Transducers:** Classification and characteristics of Transducers, Digital, Electrical, Ultrasonic, Electronic Weighing System, AC / DC Bridge measurement and their applications, techniques for measuring temperature, pressure, flow, pH, conductivity, humidity etc.

**Data acquisition system:** Servo recorders, magnetic tape recorders (analog and digital), specialized recorders (analog & digital), multi-point strip chart recorder. Analog signal processing, data loggers, sensor based digital systems, evolution of DCS & SCADA system, differences between CCU, SCADA & DCS System. Digital Data acquisition, introduction to special function add on cards – resistance cards, input & output cards, counter, text & time of card & digital equipment construction with modular designing, Intelligent and programmable instruments using computers.

**Single conditioning :** Instrumentation Amplifier, Transducer bridge, V/I controller, I/V controller , V/F controller , F/V controller , Two wire 4 to 20 mA Transmitter , Linearization Technique , Filtering antialiasing filter ,Active filter ,switch capacitor filter. Noise reduction- Capacitive , Inductive and Conductive noise coupling ,Improvement of Signal to Noise ratio by synchronous detection and signal averaging.

**Isolation Techniques :** Transformer isolation, Optical isolation , Hall sensors Measurement of voltage ,current and power using Hall sensors.

**Suggested Readings:**

- "Industrial Electronics", 3rd Edition, Thomas E. Kissell, PHI
- "Instrument Technology", Vol. 3, Jones B.E., BW& C. Publishers
- "Process Control Instrument", Curtis Johnson
- "Digital Instrumentation", Bouwens A.J., M.C. Grawhill

**Control Systems****EECL 307B****3 - 0 - 0 = 3**

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General schematic diagram of control system, Open loop and closed loop systems, Concept of feedback, Modeling of continuous time systems, Laplace transform properties, application in solution of differential equations, transfer function, block diagrams, signal flow graph, Mason's gain formula, Block diagram reduction using direct techniques and signal flow graphs, examples, Derivation of transfer function of simple systems from physical relations, low pass RC filter, RLC series network, spring mass damper, Definitions of poles, zeros, order and type.

Analysis of continuous time systems, Time domain solution of first order systems, time constant, Time domain analysis of second order systems, determination of response for standard inputs using transfer functions, steady state error, concept of stability. Routh-Hurwitz techniques, construction of bode diagrams, phase margin, gain margin, Construction of root locus, polar plots and theory of Nyquist criterion, theory of lag, lead and lag-lead compensators.

Modeling of discrete time systems, sampling, mathematical derivations for sampling, sample and hold, Z-transforms and properties, solution of difference equations using Z-transforms, examples of sampled data systems.

Introduction to the state variable concept, state space models, homogeneous and non-homogeneous cases (upto second order only), properties of state transition matrix.

**Suggested Readings:**

1. Modern Control Engineering, Ogata K, Prentice Hall India
2. Modern Control Systems, Dorf R.C. & Bishop R.H. Addison Wesley
3. Digital Control Systems, Kuo B.C. Oxford University Press
4. Discrete Time Control Systems Ogata K, Pearson Education Asia.
5. Control System Engineering, Nagarath I.J & Gopal M. Wiley Eastern Ltd.

**Optical Fiber Communication****EECL 308B****3-0-0 = 3**

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**Introduction**

Introduction to Telecommunications and Fiber Optics, The Evolution of Fiber Optic Systems, Basic Optical Laws and Definitions, Propagation of light inside fiber, Critical-Angle, Numerical-Aperture, Acceptance-Angle, Cut-off wavelength, V-Number, Mode Field Diameter, Leaky Modes, Single and Multi-Mode Fibers, Fiber Types, Waveguide Equations, Step-Index Fiber Structure, Graded-Index Fiber Structure, Splicing Techniques and Connectors, Elements

of an Optical Fiber Transmission Link. Merits and Demerits of Fiber Optics over conventional copper wire systems

### **Losses and Dispersion**

Attenuation, Absorption Losses, Scattering Losses, Bending Losses, Core and Cladding Losses, Total combined Losses.

Dispersion, Group-Delay, Material Dispersion, Waveguide Dispersion, Intermodal Distortion.

### **Optical Sources and Detectors**

Light-Emitting Diodes (LEDs), LED Structures, Characteristics of LEDs, Laser Diodes, Laser Diode Modes and Threshold Conditions, Laser Diode Structures, Characteristics of Laser Diodes, Comparison between LED and Laser Diode. Physical Principles of Photodiodes, PIN Photodetector, Avalanche Photodiodes (APD), Photodetector-Noise, Noise-Sources, Signal-to-Noise Ratio, Comparison of Photodetectors. Optical Receiver.

### **Optical Fiber Network and its Components**

Point-to-Point Links, System Considerations, Link Power Budget, Rise-Time Budget. Single and Multi-Hop Networks, SOA, EDFA, WDM-MUX/DEMUX, Optical-Switches, Couplers, Splitters, Photonic Switching.

### **Economics and Potential Applications of Optical Fiber Communication Systems**

Economics with Optical Fiber Communication Systems, Prospects for Optical Fiber Communication, Fiber-Optic Applications, Applications of Integrated Optics.

### **Text & Reference Books:**

- Keiser, "Optical fiber communication", Tata McGraw Hill
- John M Senior, "Optical Fiber Communication-Principles and Practice ", Prentice Hall International
- Joseph C Patios, "Fiber Optical Communications", Prentice Hall International
- John Gowar, "Optical Communication System", Prentice Hall International
- Sharma, "Fiber Optics in Telecommunication", Tata Mc Graw Hill
- M K Liu, "Principles and applications of optical communication ", Tata Mc Graw Hill

## **Digital System Design & Introduction to VHDL**

**EECL 309B**

**3 - 0 - 0 = 3**

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**Review:** Review of concepts of combinationa and Sequential logic circuit design, design of digital systems with help of state machine charts and their realization through Gates, Multiplexers and other discrete digital ICs. Review of State tables, state diagrams, State Assignment, Digital system design with state Diagrams.

**Introduction to VHDL:** Basic language elements & behavioral modeling, Data flow modeling – structural, Generics and configurations - Subprogram and overloading – Packages and Libraries – Model simulation.

Design of Hardware using VHDL as examples – code converters, multiplexer, de-multiplexer, binary adders and multipliers, counters. Design of sequential circuits using VHDL, counters, shift registers

FPGA programming, design and implementation of digital system, ASIC design using CAD tools. Overview of ASM's realization through PLDs and design of FSM / simple microprocessor through Algorithmic State Machine concept.

**Text & Reference books:**

- Daniel Gajski: Principles of Digital Design
- Bhasker: A VHDL Primer 3/e
- Pedroni: Circuit Design with VHDL
- Perry: VHDL: Programming by examples
- Palnitkar: Verilog HDL, 2/e

**Optical Fiber Communication Lab**

**EECP 308B**

**0-0-2 = 2**

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1. To Study and Verify Optical Communication Analog Link.
  2. To Study and Verify Optical Communication Digital Link
  3. Measurement of Numerical Aperture.
  4. Measurement of Characteristics of Light-Emitting Diodes (LEDs).
  5. Measurement of Characteristics of Laser Diodes.
  6. To Study and Verify FDM & TDM.
  7. To Study and Verify OTDM
  8. Measurement of Bending Losses
  9. Measurement with OTDR
  10. To Study and Analyse Various Connectors and Splicing Mechanisms.

**Measurement, Instrumentation & Control Lab**

**EECP 304B**

**0 - 0 - 3 = 1.5**

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Note: Five practical from each section to be performed

**Measurement & Instrumentation Practicals**

1. To measure the harmonic distortion in output of function generator.
2. To measure strain using strain simulators.
3. Measurement of temperature with various types of sensors.
4. Measurement of Linear displacement using LVDT.
5. Measurement of frequency and phase of input signal in CRO using Lissajous pattern
6. Study of various transducers for measurement of common physical parameters like pH, conductivity, pressure, flow whichever possible

**Control Systems Practicals**

1. Transient response of second order system comprising of R,L,C to find maximum overshoot, rise time, settling time, damping factors/ratio, natural undamped frequency.
2. Frequency response of first and second order system comprising RL, RLC. Draw Nyquist and Bode plots.
3. Transient response of first order, second order and higher order pneumatic servo system
4. Transient response of first order, second order and higher order hydraulic system
5. To find torque speed, torque voltage characteristics of servomotor and determine its transfer function.
6. Study of synchronous transmitter, receiver and control transfer.

7. To simulate a second and higher order system on analog simulator and find its transient response to step, ramp and other input functions.
8. Study of open and closed loop servo system loop comprising of error detector, amplifier and a motor cum load with techno feedback.
9. Study of phase lag and phase lead networks.

### **Digital Signal Processing Lab**

**EECP 306B**

**0 – 0 – 3 = 1.5**

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1. Using MATLAB
2. Representation of time-series; computation of convolution
3. Response of a difference equation to initial conditions; stability
4. DFT computation
5. Computational experiments with digital filtering
6. Using DSP processor
7. Sampling & Waveform generation
8. FIR & IIR Filters Implementation
9. Fast Fourier transforms
10. Quantization Noise
11. Adaptive Filters
12. Multirate Signal Processing

### **Project Management for Engineers**

**MBUL 351B**

**2 – 0 – 0 = 2**

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Introduction: Project Management – An Overview, need, goals and form of project management, Generation and screening of ideas, Marketing and demand analysis, Technical Analysis, Financial analysis , economic Analysis, Formulation of Detailed Project Reports. Project planning and scheduling; Planning Time Scales – Network Analysis (PERT and CPM method), Cost estimation and Budgeting, Managing risk in the project. Project evaluation, reporting and termination: Project management information system, project evaluation, Project reporting, Project termination. Project organization: Project organization structure, Role and responsibilities of project manager.

### **Digital Design & VHDL Lab**

**EECP 402B**

**0 – 0 – 2 = 1**

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Implementation of simple digital designs using state machines principle  
Implementation of ASM chart based circuit design  
Implementation of combinational circuits using VHDL tool.  
Implementation of sequential circuit components using VHDL tool.