

# Electronic Circuit Analysis and Design–II [ECAD-II]

S.E. Sem. IV [BIOM]

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | 2 Hrs. | 50    |
| Oral Exam             | –      | –     |
| Term Work             | –      | 25    |

## SYLLABUS

### 1. Feedback and Stability

Introduction to Feedback, Basic Feedback Concepts, Ideal Close–Loop Gain, Gain Sensitivity Bandwidth Extension, Noise Sensitivity, Reduction of Non–Linear Distortion, Ideal Feedback Topologies, Series–Shunt, Shunt–Series, Series–Series, Shunt–Shunt Configurations, Voltage (Series–Shunt) Amplifiers, Current (Shunt–Series) Amplifiers, Trans–Conductance (Series –Series) Amplifiers, Trans–Resistance (Shunt–Shunt) Amplifiers, Loop Gain, Stability of Feedback Circuit, The Stability Problem, Bode Plots, One–Pole, Two–Pole and Three–Pole Amplifiers, Nyquist Stability Criterion, Phase and Gain Margins, Frequency Compensation Basic Theory, Closed Loop Frequency Response, Miller Compensation.

### 2. Output Stage and Power Amplifiers

Power Amplifier, Power Transistors–Power B.J.T’S Power MOSFETs, Heat Sinks, Design of Heat sinks, Classes of Amplifiers, Class–A Operation, Class–B Operation, Class AB Operation, Class C Operation, Class–A Power Amplifiers, Class –AB Push Pull Complementary Output Stages., Power amplifier designing.

### 3. Operational Amplifiers

Basics of operational amplifiers, open loop and closed loop response, Application of op–amps (Non–linear applications): viz, inverting and non inverting amplifiers, voltage follower, adder, subtractor, differentiator and integrator, Comparators, clippers and clampers, Schmitt triggers, precision rectifiers, peak detectors, Log and Antilog amplifiers, gyrator, Current to voltage and voltage to current converters, Instrumentation and isolation amplifiers, transducer Bridge amplifiers. General op–amp circuit design and detailed circuit description.

### 4. Sinusoidal Oscillators Using Opamps

Phase shift oscillators, Wein bridge oscillators, Tuned circuit oscillators, Colpitts oscillators and Hartely oscillators.

### 5. Voltage References and Voltage Regulators

Basics and types of voltage regulators. Performance specifications, voltage references voltage reference applications, linear regulators and their applications, IC 78XX, 79XX, LM317, IC 723, switching regulators and monolithic switching regulators Switching mode power supply, DC to DC convertors.

### References :

1. Electronic Circuit Analysis and Design (*Donald A. Neamen*)
2. Electronic Devices and circuits (*R. Bolystead*)
3. Op–Amps and linear integrated circuits (*R. Gayakwad*)
4. Integrated Electronics (*Millman Halkias*)
5. Opamps and linear integrated circuits, Theory and Applications (*James Fiore*)



# Transducers in Biomedical Instrumentation [TBMI]

S.E. Sem. IV [BIOM]

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | –      | –     |
| Oral Exam             | –      | 25    |
| Term Work             | –      | 25    |

## SYLLABUS

- 1. Generalized Instrumentation System, General Properties of Input Transducer**  
**Static characteristics :** Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance.  
**Dynamic characteristics :** First Order and Second Order characteristics, Time Delay, Error Free Instrument, Transfer Functions. Design Criteria, Generalized Instrument Specifications.
- 2. Displacement and Pressure Measurement : (with applications)**  
Resistive: Potentiometers, Strain Gauges and Bridge Circuits. Inductive: Variable Inductance and LVDT. Capacitive type, Piezoelectric Transducers. Types of Diaphragms, Bellows, Bourdon Tubes.
- 3. Temperature Measurement :**  
Thermistor, Thermocouple, Resistive Temperature Detector, IC based Temperature Measurement.
- 4. Electro chemistry and Biopotential Electrodes :**  
Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non Polarizable, Electrodes, Calomel Electrode, Electrode Circuit Model, Electrode Skin –Interface and Motion Artifact. Body Surface Electrodes. Internal Electrodes: Needle and Wire Electrodes (Different Types). Microelectrodes: Metal, Supported Metal Micropipette (Metal Filled Glass And Glass Micropipette Electrodes)
- 5. Chemical Sensors :**  
Blood gas and Acid–Base Physiology Potentiometric Sensors, Ion Selective Electrodes, ISFETS. Amperometric Sensors, Clark Electrode with examples – pH, pO<sub>2</sub>, pCO<sub>2</sub> Electrodes, Transcutaneous Arterial Oxygen Tension, Carbon Dioxide measurements: capnostat, electrolyte sensors, O<sub>2</sub> cell.
- 6. Biosensor :**  
Classifications: Biological phenomenon, transduction phenomenon i.e. Enzyme sensor and Electrode based: affinity sensors (Catalytic Biosensors), Two examples of each biosensors and Immunosensors.
- 7. Fiber optic sensor :**  
Design Principles in fabrication of fiber optic sensors – Temperature, Chemical, Pressure.
- 8. Radiation Sensors and Applications**

**References :**

1. Medical Instrumentation–Application and Design (*John G. Webster*)
2. Transducers for Biomedical Measurements : Principles and Applications (*Richard S.C. Cobbold, John Wiley & Sons*) 1974
3. Biomedical sensors – fundamentals and application (*Harry N. Norton*)
4. Principles of applied Biomedical Instrumentation (*La Geddes and L.E. Baker*)
5. Instrument Tansducer – An Intro to their performance and design (*Hermann K.P. Neubert*)
6. Biomedical Instrumentation and measurement (*Leslie Cromwell, Fred J. Weibell and Pfeiffer*)
7. Principles of Biomedical Instrumentation and Measurement (*Richard Aston*) Merril Publishing Co., Columbus, 1990.
8. Measurement Systems, Application and Design (*Ernest O. Doebelin*) McGraw–Hill, 1985
9. Handbook of Modern Sensors – Physics, Design and Application (*Jacob Fraden*) AIP press.



# Electronic Instruments [EI]

S.E. Sem. IV [BIOM]

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | –      | –     |
| Oral Exam             | –      | –     |
| Term Work             | –      | 25    |

## SYLLABUS

- 1. Fundamental Concepts of Measurement & performance characteristics of an Instrumentation System**  
System Configuration –Block Diagram of a generalized measurement system, Zero Order System, First Order System – Response of a system to Step, Ramp, Impulse Inputs & Frequency Response. Second Order System–Response of a system to Step, Ramp & Frequency Response. Dead Time Element, Dynamic Response of a Measurement system.
- 2. Electronic meter**  
Principle of Operation, ammeter, ohmmeter, voltmeter, Advantages over Conventional type Analog Voltmeter, Factors involved in selection of Voltmeter, FET Voltmeter, Peak Responding, Average Responding, and True RMS responding voltmeter, Multimeter.
- 3. Digital Voltmeter**  
Methods of Analog to Digital and Digital to Analog Conversion. Principle of working of Ramp Type, Dual, Slope Type, Successive Approximation Type Digital Voltmeter. Resolution & Sensitivity of digital voltmeter.
- 4. Frequency Meter And Phase meter**  
Analog and Digital frequency meter. Analog and Digital Phase meter
- 5. Oscilloscopes**  
Block Diagram study of C.R.O. Description of Panel Layout & Implementation of controls, Requirements of Time base, Delayed Time Base, Lissajous Patterns, Intensity modulation, Velocity modulation, use of these in phase & frequency measurements, Dual trace. Double beam, Sampling, Storage, Digital readout oscilloscope, Use of CRO in tracing Diode & transistor characteristics.
- 6. Signal Generator**  
Requirement of a good laboratory type Signal Generator, A.F. Signal Generator, Function Generator.
- 7. Data Acquisition**  
Data Acquisition System – Generalized DAS, Multi channel DAS, PC based DAS.
- 8. Writing System**  
Ink jet, Potentiometric, UV, Thermal, Light gate, Magnetic, Laser optics and Instrumentation tape recorders.
- 9. Medical Display System**  
Oscilloscope for biomedical measurements, Single & multichannel Display, Non-fade Display System, LCD Display System & Touch Screen Display System.

**References :**

1. Electronic Instrumentation & Measurement Techniques (*Cooper W.D. & Helfrick A.D.*)
2. Electronic Instrumentation (*Kalasi H.S.*)
3. Electronic Instrumentation (*Carr and Brown*) Pearson Publication
4. Instrumentation devices and system (*Rangan, Sharma and Mani*)
5. Electrical & Electronic Measurement & Instrumentation (*A.K.Sawhney*)
6. Handbook of biomedical instrumentation (*R.S.Khandpur*)



## Engineering Mathematics – IV [EM-IV]

S.E. Sem. IV [BIOM]

### EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 5 Hrs. | 100   |
| Practical & Oral Exam | –      | –     |
| Oral Exam             | –      | –     |
| Term Work             | –      | –     |

### SYLLABUS

#### 1. Vector Analysis:

Scalar and vector point functions, curl, gradient and divergence, conservative, irrotational and Solenoidal fields.

(a) **Line Integral**, Greens theorem for plane regions and properties of the integral, Stoke's theorem, Gauss's Divergence theorem (without proof) related identities and deductions.

#### 2. Matrices

(a) **Types of matrices**, adjoint of a matrix, inverse of a matrix, rank of a matrix, linear dependence and independence of rows and columns of a matrix over a real field, reduction to normal form and partitioning of a matrix.

(b) **Systems of homogeneous** and non-homogeneous equations, their consistency and solutions.

(c) **Brief revision** of vectors over real fields, inner product, norm, linear independence and orthogonality of vectors.

(d) **Characteristics Polynomial**, characteristic equation, characteristic roots, and characteristic vectors of square matrix, properties of characteristic roots and vectors of different types of matrices such as orthogonal matrix, Hermitian matrix, skew-Hermitian matrix, Diagonal matrix, Cayley-Hamilton theorem (without proof), functions of square matrix, minimal polynomial and derogatory matrix.

(e) **Quadratic forms**, Congruent and orthogonal reduction of quadratic form, rank, index, signature and class value of quadratic form.

#### 3. Probability and Statistics:

Concept of probability, conditional probability. Baye's theorem (without proof).

(a) **Random variable** : Probability distribution for discrete and continuous random variables. Density function and distribution function. Expected value, variance, moments, moment generating function, binomial, Poisson, normal distributions for detailed study with proof,

(b) **Curve fitting** : Correlation, Karl Pearson coefficient and Spearman's rank correlation coefficient (without proof), regression, lines of regression.

#### References :

1. Textbook of Applied Mathematics (*Wartikar P.N./Wartikar J.N.*) Pune Vidyarthi Griha Prakashan, 1981
2. Advanced Engineering Mathematics (*Kreyszig Erwin*) 8<sup>th</sup> Edition, Wiley Student Edition, New Delhi, 2006
4. Engineering Mathematics (*Shastri S.S.*) Prentice Hall
5. Matrices (*Shantinarayan*) S. Chand & Co.
6. Mathematical Statistics (*Gupta Kapoor*)
7. Advanced Modern Engineering Mathematics (*Glyn James*) 3<sup>rd</sup> edition, Pearson Education Ltd., 2004.
8. (*Potter Merle C.,Goldberg J.L., Aboufadel Edward F.,*) 3<sup>rd</sup> edition, Oxford University Press, New Delhi, 2005.



# Biomechanics, Prosthetic & Orthotics [BPO]

S.E. Sem. IV [BIOM]

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | –      | –     |
| Oral Exam             | –      | 25    |
| Term Work             | –      | 25    |

## SYLLABUS

### Biomechanics :

#### 1. Force system

Classification of force system. Equilibrium of force system.

#### 2. General principles of Biomechanics

Analysis of biological sub system from the biomechanical view and rise modeling. Instrumentation.

#### 3. Tissue Biomechanics

Direct shear, bending and torque actions and the corresponding stresses and strains in biological tissues. Stress relaxation and creep, stability and instability, Biomechanical characterization of bone and the soft connective (skin, tendon, ligaments, etc.) covering structure function, and physiological factors.

#### 4. Movement Biomechanics

Force analyses in the joints, Gait Analysis, body and limb mass and motion characteristic actions. Forces transmitted by joints. Joint forces results in the normal and disabled human body. Normal and fast gait on the level. Strain and ramp ascent and descent. Joint replacements.

#### 5. Joint analysis

**Instrumentation for gait analysis :** Measurement devices–footswitches, instrumented walkway, Motion analysis – interrupted light photography, film/video, VICON, Selspot, Goniometers.

### Prosthetics and Orthotics :

#### 6. Principles in designing orthosis and prostheses

Principles of three point pressure, total contact, partial weight relieving.

#### 7. Positions of anatomical axis

Positioning and corresponding movements of the body part international conventions with respect to above.

#### 8. Purpose for providing prostheses and orthoses variation aspects regarding diagnosis, prognosis, stature and socio-economic conditions etc.

#### 9. Classification in Prosthetics and Orthotics

Lower Extremity orthoses and prostheses, Upper Extremity orthoses and prostheses, Spinal orthoses. Recent development in prosthesis and orthotics. Transducers in Prosthetics & Orthotics.

### References :

1. Basic Biomechanics (*Susan J. Hall*) MC Graw Hill
2. Human Limbs and their substitutes (*Atlas, C.V.Mosby*)
3. American Atlas of Orthopedics (*Prosthetics, C.V.Mosby*)
4. American Atlas of Orthopedics (*Orthotics, C.V.Mosby*)
5. Biomechanics (*Prof. Ghista*) Private Publication UAE
6. Biomechanics (*White and Puyator*) Private Publication UAE



# Logic Circuits [LC]

S.E. Sem. IV [BIOM]

## EVALUATION SYSTEM

|                       | Time   | Marks |
|-----------------------|--------|-------|
| Theory Exam           | 3 Hrs. | 100   |
| Practical & Oral Exam | 2 Hrs. | 25    |
| Oral Exam             | –      | –     |
| Term Work             | –      | 25    |

## SYLLABUS

### 1. Introduction

Number system, Binary, Octal, Hexadecimal and other. Conversion from one system to another, Binary, BCD and Hexadecimal.

### 2. Binary Code

Weighted Reflective, Sequential, Gray, Error detecting codes, Odd, Even parity, Hamming Codes, Alphanumeric, Morse, Teletypewriter ASCII, EBCDIC codes, Converting Binary to Gray and Gray to Binary and XS3.

### 3. Boolean Algebra Logic Gates

AND, OR, NOT, XOR, XNOR, operation NAND, NOR use of the universal gate for performing different operation. Laws of Boolean algebra. De-Morgan's theorems, Relating a truth table to a Boolean expression, Multi level circuits.

### 4. Combinational Circuits

K-Maps and their use in specifying Boolean expressions, Minterm, Maxterm SOP and POS implementation. Implementation a logic function using universal gates. Variable entered maps for five and six variable functions Quine Mc-Clusky tabular techniques.

### 5. Combination Logic Circuit Design

Designing code converter circuits e.g., Binary to Gray, BCD to Seven Segments, Parity Generator, Binary Arithmetic circuits : Adders, Subtractors (Half and full) BCD adder-subtractor, carry Lookahead adder, Serial adder, Multiplier Magnitude Comparators, Arithmetic Logic units.

### 6. Use of Multiplexers in Logic Design

Multiplexer (ULM) Shannon's theorem. ULM trees, De-multiplexers, designing using ROMs and ULMs. Hazards in combinational circuits.

### 7. Sequential Logic Circuit

Comparison of Combinational and Sequential Circuits, Multi-vibrators (Astable, Monostable and Bistable) Flip-Flops, SR, T, D, JK, Master Slave JK, Converting one Flip-Flop to another, Use of Denounce switch. Counter Modulus of a counter, Ripple counter, Up/Down Counter, Designing sequential counters using gate IC and counter IC by drawing state transition Diagram and state transition table. Ring counter, Johnson counter, twisted ring counter, Pseudo Random number generator, Unused states and locked conditions.

### 8. Registers

Serial input serial output, serial input parallel output. Left right shift register, use of register ICs for sequence generator and counter.

### 9. Memories

RAM, ROM the basic cell IC bipolar, CMOS RAM dynamic RAM cell. Magnetic core NVRAM, bubble memory, CCD, PAL, PLA.



## 10. Logic Families

RTL, DTL, TTL, schotkey clamped TTL, Tristate gate ECL, IIL, MOS device CMOS Comparison of logic families, interfacing different families. TTL with CMOS, NMOS, TTL, ECL and TTL, IIL and TTL.

### References :

1. Modern Digital Electronics (*R.P.Jain*) Tata McGraw Hill
2. Digital Design (*M.Morris Mono*) Prentice Hall International
3. Digital Principal and Applications (*Malvino & Leach*) Tata McGraw Hill, 1991.
4. Digital Electronics (*Malvino*) Tata McGraw Hill, 1997
5. Digital Electronics (*James Bignell & Robert Donovan*) Delmar, Thomas Learning, 2001.
6. Introduction to Logic Design (*Alan b. Marcovitz*) McGraw Hill International 2002.

