**SUMMARY**

In order to study Biomedical Instrumentation paper, a prior knowledge of Operational Amplifiers is required, which is taught in Semester IV, hence it was decided to shift the Biomedical Instrumentation paper from III semester to V semester. Measurement and Technology paper has replaced the Biomedical Instrumentation paper in semester III. Also minor changes have been suggested in the syllabus of two Discipline Specific Elective (DSE) papers and one Skill Enhancement Course (SEC), namely:

a) Advanced Biomedical Instrumentation (DSE)
b) Advanced Analytical Instrumentation (DSE)
c) Virtual Instrumentation (SEC)

In order to give more choices to the students it has been decided to introduce seven Generic Elective Papers:

a) Standardization and Quality Control
b) MATLAB and its applications
c) Introduction to Programming
d) General Instrumentation
e) Applied Mathematics
f) Microcontrollers and its Applications
g) Microprocessors

Also two Generic Elective papers and one DSE paper has been removed from the existing syllabus namely:

a) Electromechanical Instruments (GE)
b) Machine Intelligence (GE)
c) Concepts of Chemistry (DSE)

Some minor changes in the syllabus of following CORE COURSE papers have been suggested in order to match the standard for respective papers:

a) Basic Electronics and Network Analysis
b) Analog Devices and Circuits
c) Applied Physics
d) Biomedical Instrumentation
e) Digital Electronics and VHDL
f) Engineering Mathematics
g) Operational Amplifiers and Applications
h) Analytical Instrumentation
i) Electronic Instrumentation
j) Microprocessor
k) Power Electronics
l) Control Systems

# Revision of B.Sc (H) Instrumentation Syllabus

| **Applied Physics :Core** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | NA | ***Carnot Engine, Cycle and theorem***. |
| Unit2 | | No change |
| Unit3 | NA | ***Radioactivity and decay***. |
| Unit4 | | No change |

| **Basic Circuit Theory and Network Analysis : Core** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | | No change |
| Unit2 | Star-Delta Conversion | ***delta star conversion*** |
| Unit3 | | No change |
| Unit4 | | No change |

| **Analog Devices and Circuits: Core** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | | No change |
| Unit2 | regions of operation | |
| Unit2 | | Transistor biasing |
| Unit2 | Q point | Operating point |
| Unit2 | | thermal runaway |
| Unit2 | Self bias arrangement of CE | Fixed bias without and with RE, collector to base bias, voltage divider bias, circuit diagrams and their working |
| Unit3 | | |
| Unit4 | Junction Field Effect Transistor (JFET): | Field Effect Transistor (FET): |
| Unit4 | MOSFET amplifier | REMOVED |
| Unit4 | | Power Amplifiers- Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons |

| **Transducers and Sensors :Core** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | random errors twice mentioned | random errors |
| Unit2 | | *limiting errors* |
| | 08 Lectures | 09 Lectures |
| Unit3 | Diaphragm | *Capacitive transducers using change in area of plates, change in distance between plates, variation of dielectric constant for displacement measurement* |
| | 20 Lectures | 19 Lectures |
| Unit4 | *semiconductor* | *semiconductor photodiode* |
| **Transducers and Sensors Lab** | | |
| | 1. Measurement of pressure, strain and torque using strain gauge. | 1. Measurement of pressure, strain and torque using strain gauge***/load cells***. |
| | 6. Measurement using load cells. | REMOVED |

| **Digital Electronics and VHDL(Core)** | Existing | Revised |
|---|---|---|
| Unit1 | Introduction to Boolean Algebra and Boolean operators | |
| | Truth Tables of OR, AND, NOT | Truth Tables of OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates |
| | Truth tables, construction and symbolic representation of XOR, XNOR, Universal (NOR and NAND) gates. | |
| | TTL and CMOS families and their comparison | comparison of TTL and CMOS families |
| | Lectures:11 | Lectures:12 |
| Unit2 | Lectures:13 | Lectures:14 |
| Unit3 | master slave flip flop | |
| | Counters (synchronous and asynchronous and modulo-N) | Counters (synchronous and asynchronous, ring and modulo-N) |
| | Ring counter and Johnson counter | |
| | **Programmable Logic Devices:** Basic concepts-ROM, PLA, PAL, CPLD, FPGA | |
| | Lectures:18 | Lectures:16 |
| Unit4 | | **Programmable Logic Devices:** Basic concepts-ROM, PLA, PAL, CPLD, FPGA |
| | VHDL terms, describing hardware in VHDL, entity, architectures, concurrent signal assignment, event scheduling, statement concurrency, structural designs, sequential behavior, process statements, process declarative region, process statement region, process execution, sequential statements, architecture selection, | Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Expressions, Operands, Operators, types of Expressions |

| | | |
|---|---|---|
| | configuration statements, power of configurations. | |
| | **Behavioral Modeling**: Introduction to behavioral modeling, inertial delay, transport delay , inertial delay model, transport delay model, transport vs inertial delay, simulation delta drivers, driver creation, generics, block statements, guarded blocks. **Sequential Processing:** Process statement, sensitivity list, signal assignment vs variable assignment, sequential statements, IF, CASE ,LOOP, NEXT, ,EXIT and ASSERT statements, assertion BNF, WAIT ON signal, WAIT UNTIL expression, WAIT FOR time expression, multiple wait conditions, WAIT Time-Out, Sensitivity List vs WAIT Statement Concurrent Assignment, Passive Processes **Data types:** Object types- signal, variable, constant, Data types –scalar types, composite types, incomplete types, File Type caveats, subtypes, Subprograms and functions | **Gate level modeling** - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits) |

| **Engineering Mathematics : (Core)** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | Ordinary differential Equations | First Order Ordinary Differential Equations: Separable Ordinary Differential Equations, Linear Ordinary Differential Equations |
| | Linear Differential Equations of Second Order with Variable Coefficients, Second Order Differential Equations with Constant Coefficients: Homogeneous, Non-Homogeneous Equations, | Linear Differential Equations of Second Order with Constant Coefficients and Variable Coefficients: Homogeneous and non-homogeneous |
| | Differential Equation with Variable Coefficients: Reducible to Equations with Constant Coefficients, | |
| | Lectures:18 | Lectures:16 |
| Unit2 | Partial Differential Equation of First Order, Linear Equations of First Order, Non-linear Partial Differential Equations of First Order | Partial Differential Equation of First Order: Linear and Non-linear |
| | Convolution theorem, Impulse Function and Unit Step function, solutions to ordinary differential equations. Initial and Final value theorem | |
| | | Modeling a Vibrating string and the Wave Equation. |
| Unit3 | system of differential equations, Laplace transforms. Modeling a Vibrating string and the Wave Equation,Separation of Variables | |
| | Lectures:12 | Lectures:14 |

| | | |
|---|---|---|
| Unit4 | Functions of any period, | Period of any function |
| | even and odd Functions | Fourier Series: even and odd Functions |
| | Complex Fourier Series Fourier Integral | Fourier Integral |
| | Fourier Sine and Cosine Transforms. , Fourier Transforms | Fourier Transforms : Fourier Sine and Cosine Transforms. |
| | Discrete and Fast Fourier Transforms. Fourier integrals, Modeling a Vibrating string and the Wave Equation, Separation of Variables and Use of Fourier series | |

| **Operational Amplifiers and Applications (Core course)** | Existing | Revised |
|---|---|---|
| Unit1,2,3 | NO Change | - |
| Unit4 | - | **Added:** ***Instrumentation Amplifier*** |
| **Operational Amplifiers and Applications Lab** | | Added: ***Design Schmnitt Trigger*** |
| | | |
| **Analytical Instrumentation (Core course)** | Existing | Revised |
| Unit1 | - | - |
| Unit2 | **Atomic Spectroscopy**: Principle, comparison of atomic and molecular spectroscopy, atomic transitions, atomic absorption, atomisation process, types of flames- fuel/ oxidant combinations, instrumentation of spectrophotometers; | **Atomic *Emission* Spectroscopy**: ***Flame photometer: principle, its instrumentation, atomisation process, types of flames- fuel/ oxidant combinations, Interferences: spectral, chemical and ionization, applications, analysis using standard addition method*** ***Atomic AbsorptionSpectroscopy (AAS): Principle, its instrumentation and applications.*** |

| | | |
|---|---|---|
| | Interferences: spectral, chemical and ionization; applications. Atomic emission spectroscopy (AES): Flame photometer and its instrumentation, analysis using standard addition method, applications. | |
| Unit3 | - | - |
| Unit4 | - | - |
| **Analytical Instrumentation Lab** | Removed:<br>6. Analysis of various ions using atomic absorption system. | Added:<br>1. ***Determination of concentration of solutes in a mixture using colorimeter.***<br>2. ***Verification of Beer's Law and determination of concentration of the unknown solution using colorimeter.***<br>3. ***To study the effect of organic solvent on membrane permeability of beet root using spectroscopy.***<br>4. ***Paper chromatographic separation of samples from different origin (Biological/pharmaceutical/food).*** |
| | | |
| **Electronic Instrumentation (Core course)** | Existing | Revised |
| Unit1,2,4 | | **No Change** |
| Unit3 | - | Added:<br>***"and Dual Beam Oscilloscope"*** |
| **Electronic Instrumentation Lab** | | **No changes have been made** |
| | | |
| **Biomedical Instrumentation (Core course)** | Existing | Revised |

| | | |
|---|---|---|
| Unit1 | - | **No Change** |
| Unit2 | - | **No Change** |
| Unit3 | Ventilators: Basic principles of ventilators, different generators, inspiratory phase and expiratory phase, types of ventilators | **Removed** |
| Unit4 | - | **No Change** |
| **Biomedical Instrumentation Lab** | | **No changes have been made** |
| | | |
| **Microprocessor (Core course)** | Existing | Revised<br>**1. An experiment has been replaced.** |
| Unit1 | Lectures: 18 | - |
| Unit2 | Lectures: 10 | Lectures: 12 |
| Unit3 | Lectures: 18 | Lectures: 17 |
| Unit4 | Lectures: 14 | Lectures: 13 |
| **Microprocessor Lab** | Removed:<br>14. To implement basic 8086 interrupts using assembler | Added:<br>***1. Interfacing 8085 with chips 8155, 8255 and 8253*** |
| | | |
| **Power Electronics (Core course)** | Existing | Revised |
| Unit1 | Lectures: 14 | Lectures: 14 |
| Unit2 | Lectures: 18 | Lectures: 16 |
| Unit3 | Lectures: 18 | Lectures: 18 |
| Unit4 | Lectures: 10 | Lectures: 12 |
| **Power Electronics Lab** | | Added:<br>***1. Study of Load characteristics of Servomotor.***<br>***2. Study of no-load and blocked rotor test on single phase Inductor motor.*** |
| | | |
| **Control Systems (Core course)** | Existing | Revised: |

| | | |
|---|---|---|
| Unit1 | **Basic Control Actions: Proportional, integral and Derivative controls** | Removed |
| Unit2 | response with P, PI and PID Controlle | Removed |
| Unit3 | - | - |
| Unit4 | **Compensation Techniques & State Space Analysis Compensation Techniques: Concept of compensation, Lag, Lead and Lag-Lead networks State Space Analysis: Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.** | **State Space Analysis:** Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties. ***Controllers and*** **Compensation Techniques:** ***Basic Control Actions: Proportional, integral and Derivative controls. Response with P, PI and PID Controllers.*** Concept of compensation, Lag, Lead and Lag-Lead networks |
| **Control Systems Lab** | | **No change** |

| **Signal and Systems(DSE)** | **Existing** | **Revised** |
|---|---|---|
| Unit1 | Lectures: 18 | Lectures: 15 |
| Unit2 | Discrete time LTI systems, Continuous time LTI systems | **Replaced with-** Continuous & discrete time LTI systems<br><br>**Added-**LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response of System, Differential and Difference equation formulation, Block diagram representation of first order systems. |
| Unit3 | Properties of LTI System: LTI | Laplace Transform: Laplace |

| | | |
|---|---|---|
| | systems with and without memory, Invariability, Causality, Stability, Unit Step response, Differential and Difference equation formulation, Block diagram representation of first order systems.<br><br>Lectures: 15 | Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.<br><br>Lectures: 14 |
| Unit4 | Lectures: 12<br>Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits. | Lectures: 16<br>Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of Continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series.<br>Fourier Transform: Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs. |
| | | |
| **Advanced Analytical Instrumentation(DSE)** | | |
| Unit1 | FT-NMR and its advantages, applications.<br><br>Mass Spectroscopy: Theory, fragmentation modes, instrumentation: inlet systems, magnetic and electrostatic analysers, detectors. Isotopic abundances, metastable ions and applications. | **Deleted**<br><br>Mass Spectroscopy: Theory, instrumentation: gaseous ion source, sample inlet system, magnetic sector mass analyzer, electron multiplier detector, fragmentation, Isotopic abundances, metastable ions and applications. |

| | | |
|---|---|---|
| Unit2 | Electro Analytical Methods of Analysis: Potentiometry: Introduction, reference electrode, indicator electrodes, ion-selective electrodes and their applications, instrumentation, direct potentiometry, potentiometric titrations, applications. | Electro Analytical Methods of Analysis: Introduction, reference electrode, indicator electrodes, ion-selective electrodes: glass electrode and liquid membrane electrode, their applications, potentiometric titrations. |
| Unit3 | -- | No Change |
| Unit4 | Polarography: Basic principle, direct current polarography, different kinds of currents, reversible and irreversible waves, pulse and ac polarography, applications.<br>Automated Methods of Analysis: Types of automated systems, Flow Injection Analysis, Microfluidics, Discrete automatic system. | Thermo-Analytical Methods: Thermal detectors. Thermo-gravimetry, Differential Thermal analysis, Differential scanning calorimetry. Principle, Instrumentation: thermo-balance. Interpretation of thermograms.<br>Applications. Comparison and advantages of each technique. |
| | References<br>10. Frank Settle, editor, Hand book of Instrumental Techniques for Analytical Chemistry, Prentice Hall.<br>11. Galen W. Ewing, Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company | Refrences<br>10. R.S Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill.<br>11. B.K Sharma, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media. |
| **Communication System (DSE)** | | |
| Unit1 | Lectures: 07 | Lectures: 08 |
| Unit2 | -- | No change |
| Unit3 | -- | No change |
| Unit4 | Lectures: 19 | Lectures: 19 |
| | | |
| **Advanced Biomedical Instrumentation (DSE)** | | |

| | | |
|---|---|---|
| Unit1 | . | **Added-**Ventilators: Basic principle of ventilators, inspiratory phase and expiratory phase, types of ventilators<br><br>**Removed**spectrophotometer, flame photometer. |
| Unit2 | Lectures: 17 | Lectures: 16 |
| Unit3 | -- | No change |
| Unit4 | Lectures: 13<br>Diathermy: Infrared radiation (IR) diathermy, ultraviolet (UV) diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy, Surgical Diathermy. | Lectures: 14<br>Diathermy: Working principle, construction, Types of Diathermy (Infrared radiation (IR) diathermy, ultraviolet (UV) diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy, Surgical Diathermy), applications. |
| **Advanced Analytical Instrumentation Lab** | | Added Practical<br>10. Study of thermo-analytical instruments (Demo). |
| **Embedded System and Robotics (DSE)** | | |
| Unit1 | -- | No change |
| Unit2 | -- | No change |
| Unit3 | -- | No change |
| Unit4 | -- | No change |
| | | |
| **Process Control Dynamics (DSE)** | | |
| Unit1 | -- | No change |
| Unit2 | -- | No change |
| Unit3 | -- | No change |
| Unit4 | -- | No change |
| | | |
| **Reliability and Quality Control** | | |

| **Techniques (DSE)** | | |
|---|---|---|
| Unit1 | -- | No change |
| Unit2 | -- | No change |
| Unit3 | -- | No change |
| Unit4 | -- | No change |

| **Virtual Instrumentation :SEC** | **Existing** | **Revised** |
|---|---|---|
| Unit 1,2,3,4 | | No change |
| | | |

| **Programming using MATLAB :SEC** | **Existing** | **Revised** |
|---|---|---|
| Unit 1 | | No change |
| Unit 2 | | No change |
| Unit 3 | | No change |
| Unit 4 | **Digital Signal Processing**To study about the basic application of DSP, write program for modulation and Demodulation, write program for time scaling and amplitude Scaling,<br><br>Generate various functions and implement on image.<br><br>Image Processing: To study about the basic image processing tools, write program for Histogram processing, Write program for image segmentation, Write program image restoration. | **Digital Signal Processing*Basic application of DSP, program for modulation and Demodulation, program for time scaling and amplitude Scaling,***<br><br>***Generation and implementation of various functions on image.***<br><br>***Image Processing: Basic image processing tools, Basic programs for Histogram processing,image segmentation and image restoration.*** |

| **Sensors and its *Applications* (Generic)** | Existing<br>**Sensors and Actuators** | Revised<br>**1. Title has been changed from Sensors and Actuators to Sensors and its Applications** |
|---|---|---|
| | | |
| Unit1 | - | - |
| Unit2 | - | - |
| Unit3 | - | - |
| Unit4 | - | - |
| | | |
| **Instrumentation & Control (Genric)** | **Existing** | **Revised** |
| Unit1 | - | - |
| Unit2 | - | - |
| Unit3 | - | - |
| Unit4 | - | - |
| | | |
| **Analytical Instrumentation (Generic)** | **Existing** | **Revised** |
| Unit1 | - | - |
| Unit2 | - | - |
| Unit3 | - | - |
| Unit4 | ion selective electrodes and their applications. | ***glass electrodes and potentiometric titrations***. |
| Analytical Instrumentation Lab | Removed:<br><br>6. Qualitative and quantitative analysis of various compounds using atomic absorption Spectroscopy. | Added:<br><br>1. Determination of concentration of solutes in a mixture using colorimeter.<br>2. Verification of Beer's Law and determination of concentration in the unknown solution using colorimeter.<br>3. To study the effect of organic solvent on membrane permeability of beet root using spectroscopy.<br>7. Paper chromatographic separation of samples from different origin (Biological/pharmaceutical/food).<br>12. To study the potentiometric titration of strong acid and strong base.<br>13. To study the potentiometric titrations of weak acid and weak base. |
| **Suggested Books:** | | Added:<br><br>***5. R.S Khandpur, Handbook of*** |

| | | |
|---|---|---|
| | | ***Analytical Instruments, Tata McGraw-Hill.***<br>***6. B.K Sharma, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media.*** |
| **Nuclear & Biomedical Instrumentation (Generic)** | **Existing** | **Revised** |
| Unit1 | - | - |
| Unit2 | - | - |
| Unit3 | - | - |
| Unit4 | - | - |
| | | |

# Syllabus of

# B.Sc. (Honours) Instrumentation

# under

# (Choice Based Credit System)

As approved by FIAS meeting held on dated 03/07/2018

As approved by Committee of Courses on 02/07/2018

B.Sc. (H) Instrumentation Revised Syllabus as approved by Academic Council on XXXX, 2018 and Executive Council on YYYY, 2018

**Scheme for Choice Based Credit System in**
**B.Sc.(Honours) Instrumentation**

| | **CORE - COURSE (14)** | **Ability Enhancement Compulsory Course (AECC) (2)** | **Skill Enhancement Course (SEC) (2)** | **Elective: Discipline Specific DSE (4)** | **Elective: Generic (GE) (4)** |
|---|---|---|---|---|---|
| I | Basic Electronics and Network Analysis<br>Applied Physics | (English/ MIL Communication)/ Environmental Science | | | GE-1 |
| II | Analog Devices and Circuits<br>Transducers and Sensors | Environmental Science/(English/ MIL Communication) | | | GE-2 |
| III | ***Measurement Technology***<br>Digital Electronics and VHDL<br>Engineering Mathematics | | SEC -1 | | GE-3 |
| IV | Operational Amplifiers and Applications<br>Analytical Instrumentation<br>Electronic Instrumentation | | SEC -2 | | GE-4 |
| V | ***Biomedical Instrumentation***<br>Microprocessor | | | DSE-1<br>DSE -2 | |
| VI | Power Electronics<br>Control Systems | | | DSE -3<br>DSE -4 | |

**SEMESTER-WISE SCHEDULE FOR B.Sc. (HONOURS) INSTRUMENTATION**

| Semester | Course Opted | Course Name | Credits |
|---|---|---|---|
| I | Ability Enhancement Compulsory Course-I | English/MIL communications/ Environmental Science | 2 |
| | Core course-I | Basic Electronics and Network Analysis | 4 |
| | Core Course-I Practical/Tutorial | Basic Electronics and Network Analysis Lab | 2 |
| | Core course-II | Applied Physics | 4 |
| | Core Course-II Practical/Tutorial | Applied Physics Lab | 2 |
| | Generic Elective -1 | GE-1 | 4/5 |
| | Generic Elective -1 Practical/Tutorial | | 2/1 |
| II | Ability Enhancement Compulsory Course-II | English/MIL communications/ Environmental Science | 2 |
| | Core course-III | Analog Devices | 4 |
| | Core Course-III Practical/Tutorial | Analog Devices Lab | 2 |
| | Core course-IV | Transducers and Sensors | 4 |
| | Core Course-IV Practical/Tutorial | Transducers and Sensors Lab | 2 |
| | Generic Elective -2 | GE-2 | 4/5 |
| | Generic Elective -2 Practical/Tutorial | | 2/1 |
| III | Core course-V | ***Measurement Technology*** | 4 |
| | Core Course-V Practical/Tutorial | ***Measurement Technology Lab*** | 2 |
| | Core course-VI | Digital Electronics and Verilog | 4 |
| | Core Course-VI Practical/Tutorial | Digital Electronics and Verilog Lab | 2 |
| | Core course-VII | Engineering Mathematics | 4 |
| | Core Course-VII Practical/Tutorial | Engineering Mathematics Lab | 2 |
| | Skill Enhancement Course-1 | SEC-1 | 2 |
| | Generic Elective -3 | GE-3 | 4/5 |
| | Generic Elective -3 Practical/Tutorial | | 2/1 |
| IV | Core course-VIII | Operational Amplifiers and Applications | 4 |
| | Core Course-VIII Practical/Tutorial | Operational Amplifiers and Applications Lab | 2 |
| | Core course-IX | Analytical Instrumentation | 4 |
| | Core Course-IX Practical/Tutorial | Analytical Instrumentation Lab | 2 |
| | Core course-X | Electronic Instrumentation | 4 |
| | Core Course-X Practical/Tutorial | Electronic Instrumentation Lab | 2 |
| | Skill Enhancement Course-2 | SEC-2 | 2 |
| | Generic Elective -4 | GE-4 | 4/5 |

| | | | |
|---|---|---|---|
| | Generic Elective -4 Practical/Tutorial | | 2/1 |
| V | Core course-XI | ***Biomedical Instrumentation*** | 4 |
| | Core Course-XI Practical/Tutorial | ***Biomedical Instrumentation Lab*** | 2 |
| | Core course-XII | Microprocessor | 4 |
| | Core Course-XII Practical/Tutorial | Microprocessor Lab | 2 |
| | Discipline Specific Elective-1 | DSE-1 | 4 |
| | Discipline Specific Elective-1 Practical/Tutorial | DSE-1 Lab | 2 |
| | Discipline Specific Elective-2 | DSE-2 | 4 |
| | Discipline Specific Elective-2 Practical/Tutorial | DSE-2 Lab | 2 |
| VI | Core course-XIII | Power Electronics | 4 |
| | Core Course-XIII Practical/Tutorial | Power Electronics Lab | 2 |
| | Core course-XIV | Control Systems | 4 |
| | Core Course-XIV Practical/Tutorial | Control Systems Lab | 2 |
| | Discipline Specific Elective-3 | DSE-3 | 4 |
| | Discipline Specific Elective-3 Practical/Tutorial | DSE-3 Lab | 2 |
| | Discipline Specific Elective-4 | DSE-4 | 4 |
| | Discipline Specific Elective-4 Practical/Tutorial | DSE-4 Lab | 2 |
| | | **Total Credits** | 140 |

**CORE COURSE(C): (Credit: 06 each)** (1 period/week for tutorials or 4 periods/week for practical)

1. Basic Electronics and Network Analysis (4+4)
2. Applied Physics (4+4)
3. Analog Devices and Circuits (4+4)
4. Transducers and Sensors (4+4)
5. ***Measurement Technology*** (4+4)
6. Digital Electronics and Verilog (4+4)
7. Engineering Mathematics (4+4)
8. Operational Amplifiers and Applications (4+4)
9. Analytical Instrumentation (4+4)
10. Electronic Instrumentation (4+4)
11. ***Biomedical Instrumentation (4+4)***
12. Microprocessors (4+4)
13. Power Electronics (4+4)
14. Control Systems (4+4)

**Discipline Specific Electives (DSE): (Credit: 06 each) (4 papers to be selected) - DSE 1-4**

1. Signal and Systems (4+4)
2. Advanced Analytical Instrumentation (4+4)
3. Communication System (4+4)
4. Advanced Biomedical Instrumentation (4+4)
5. Embedded System and Robotics (4+4)
6. Process Control Dynamics (4+4)
7. Reliability and Quality Control Techniques (4+4)
8. Dissertation (4+4)

**Skill Enhancement Course (SEC) (02 papers) (Credit: 02 each) - SEC1 to SEC2**

1. Programming in C (4)
2. VLSI Design and Verification (4)
3. Testing and Calibration (4)
4. PLC and SCADA (4)
5. Virtual Instrumentation (4)
6. Programming using MATLAB (4)

**Other Discipline - GE 1 to GE 4**

1. Mathematics
2. Computer Science
3. Physics
4. Biomedical Science
5. Chemistry
6. Electronics
7. Commerce

Any other discipline of Choice

**Generic Elective Papers (GE) (Minor-Instrumentation) (any four) for other Departments/Disciplines: (Credit: 06 each)**

1. Sensors and ***its Applications*** (4+4)
2. Instrumentation & Control (4+4)
3. Analytical Instrumentation (4+4)
4. Nuclear & Biomedical Instrumentation (4+4)
5. ***Standardization and Quality Control (4+4)***
6. ***Microprocessors (4+4)***
7. ***Microcontrollers and Applications (4+4)***
8. ***MATLAB and its Applications (4+4)***
9. ***Introduction to Programming (4+4)***
10. ***General Instrumentation (4+4)***
11. ***Applied Mathematics (4+4)***

**Core course-I**
**Basic Electronics and Network Analysis**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (12 Lectures)

**Basic Circuit Concepts**: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel.
Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of resistance and inductance using multimeter.
Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multimeter.

**Unit- 2** (14 Lectures)

**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion, ***delta star conversion***.
**DC Transient Analysis:** Initially Charged RC Circuit, RL Circuit with Initial Current, Time Constant, RL and RC Circuits With Sources, DC Response of Series RLC Circuits.

**Unit-3** (18 Lectures)

**AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance, Power in AC Circuits: Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Mesh Analysis, Node Analysis and Network Theorems for AC Circuits.
Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.

**Unit-4** (16 Lectures)

**Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.
Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.

**Suggested books:**

1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005)
3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005)
5. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)

**Basic Electronics and Network Analysis Lab (Hardware and Circuit Simulation Software)**
**60 Lectures**

1. Familiarization with
a) Resistance in series, parallel and series – Parallel.
b) Capacitors & Inductors in series & Parallel.
c) Multimeter – Checking of components.
d) Voltage sources in series, parallel and series – Parallel
e) Voltage and Current dividers
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.

**Core course-II**
**Applied Physics**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** (13 Lectures)

**Thermodynamics:** Heat and Temperature, Zeroth law of thermodynamics: thermal equilibrium, thermometry and temperature scales, First law of thermodynamics, Thermodynamic systems and processes, Internal energy and heat capacity, adiabatic processes. Second law of thermodynamics, Reversible and irreversible processes, ***Carnot Engine, Cycle and theorem***.

**Unit 2** (22 Lectures)

**Interference:** Interference of light, Bi prism experiment, displacement of fringes, interference in thin films- wedge shaped film, Newton's rings.
**Diffraction** - Single, Double & N- Slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating.
**Polarization**- Phenomena of double refraction, Nicol prism, Production and analysis of plane, circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.
**Laser**: Basic principle, Spontaneous and stimulated emission of radiation, Einstein's Coefficients, Laser applications.
**Fibre Optics**: Principles and applications

**Unit 3** (12 Lectures)

**Nuclear Physics:** Nucleus, constituent of nucleus, Properties of Nucleus size, mass, density, energy, charge, binding energy, nuclear angular momentum, Nuclear force, ***Radioactivity and decay***.

**Unit 4** (13 Lectures)

**Fluid Mechanics:** Fluid properties; Surface Tension, Viscosity, equation, Bernoullis equation; Navier-Stokes Equations; Differential form of Energy equation. Reynold number, Incompressible and compressible Flow, Laminar and turbulent flows, Flow through pipes

**Suggested books**

1. Ajoy Ghatak –Optics, fourth Edition, McGraw-Hill
2. M.W. Zemansky and R.H. Dittman- Heat and Thermodynamics (Mc-Graw Hill)
3. Nuclear physics by Cohen
4. Fox and Mc Donald- Introduction to Fluid Mechanics
5. Aurthur Beiser -Concepts of Modern Physics - (Mc-Graw Hill)
6. Anuradha De. -Optical Fibre & Laser ( New Age )
7. Resnick, Halliday & Walker -Fundamental of Physics - (Wiley )

8. R.A. Serway & J.W. Jewett -Principles of Physics
9. H.Callen-Thermodynamics and an Introduction to Thermo statistics (Wiley, New York).

**Applied Physics Lab**
**60 Lectures**

1. To determine the thermal conductivity of a good conductor by Searl's method.
2. Determination of J, mechanical equivalent of heat by calendar and Barne's method.
3. To determine the temperature coefficient of PRT (Platinum Resistance Thermometer).
4. To determine the dispersive power of prism using spectrometer and mercury source.
5 .To determine the refractive index of a prism using spectrometer
6. To determine the wavelength of sodium light by Newton's Ring.
7. To find the wavelength of He-Ne Laser using transmission diffraction grating.
8. To find the thermal conductivity of poor conductors by Lee Disc Method

**Core course-III**
**Analog Devices and Circuits**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit-1** (15 Lectures)

**Semiconductor Basics:** Introduction to semiconductor materials, intrinsic & extrinsic semiconductors. p-n junction diode**:** Ideal diode, Formation of depletion layer, space charge at a junction, Diode Circuits: clipper circuits, clamping circuits. Half wave rectifier, Center tapped and bridge full wave rectifiers, calculation of efficiency and ripple factor. DC power supply: Block diagram of a power supply, Zener diode as voltage regulator, temperature coefficient of Zener diode.

**Unit-2** (14 Lectures)

**The BJT**: ***Basic transistor action, Transistor current components and amplification. Transistor configurations: Common Base (CB), Common Emitter (CE) and Common Collector (CC), I-V characteristics and hybrid parameters. Transistor biasing, DC load line, operating point, thermal runaway Fixed bias without and with RE, collector to base bias, voltage divider bias, circuit diagrams and their working. CE amplifier: dc and ac load line analysis, Hybrid equivalent of CE, frequency response of CE amplifier.***

**Unit- 3** (16 Lectures)

**Feedback Amplifiers**: Concept of feedback, negative and positive feedback, Negative feedback: advantages and disadvantages of negative feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, derivation of gain, input and output impedances for feedback amplifiers. Positive feedback: Barkhausen criteria for oscillations, Study of phase shift oscillator, Colpitts oscillator and Crystal oscillator.

**Unit-4** (15 Lectures)

**Field Effect Transistor (FET)**: ***Junction Field Effect Transistor (JFET): Construction of JFET, idea of channel formation, pinch-off and saturation voltage, current-voltage output characteristics. Metal Oxide Field Effect Transistor (MOSFET): The ideal MOS diode, accumulation, depletion and inversion, Basic Construction of MOSFET and working, I-V characteristics, enhancement and depletion modes. Complimentary MOS (CMOS), UJT- construction, working and applications.***
***Power Amplifiers- Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons.***

**Suggested books:**

1. R. L. Boylestad, L. Nashelsky, K. L. Kishore, Electronic Devices and Circuit Theory, Pearson Education (2006).
2. N Bhargava, D C Kulshreshtha and S C Gupta, Basic Electronics and linear circuits, Tata McGraw-Hill (2007)
3. J. Millman and C. Halkias, Integrated Electronics, Tata McGraw Hill (2001).

4. David A. Bell, Electronic Devices & Circuits, Oxford University Press, Fifth edition
5. Mottershed, Electronic Devices, PHI Publication, 1st Edition.
6. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002).
7. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010).
8. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002).
9. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991).

**Analog Devices and Circuits Lab**
**60 lectures**

1. To study the Half wave rectifier and Full wave rectifier.
2. To study power supply using C filter and zener diode.
3. To study Fixed Bias and Voltage divide Feedback configuration for transistor.
4. To design a Single Stage CE amplifier.
5. To study Class A, B and C Power Amplifier.
6. To study clipping circuits
7. To study clamping circuits
8. To study the Colpitt's Oscillator.
9. To study the Phase Shift Oscillator.
10. To study the frequency response of Common Source FET amplifier.

**Core course-IV**
**Transducers and Sensors**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (16 Lectures)

**Basic concepts of Instrumentation:** generalized instrumentation systems block diagram representation, scope of instrumentation in Industrial organization.
**Measurement systems**: static (accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, dead band, backlash, drift), impedance matching and loading, dynamic characteristics (types, fidelity, speed of response, dynamic error).

**Unit-2** (09 Lectures)

**Definition of errors-** systematic errors, instrumental errors, environmental errors, random errors, loading errors, ***limiting errors***, source of errors in measuring instruments, Uncertainties types, propagation of uncertainties)

**Unit- 3** (19 Lectures)

**Transducers** - Classification, Active, Passive, Mechanical, Electrical, their comparison. Selection of Transducers, Principle and working of following types: Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge) Capacitive ( ***Capacitive transducers using change in area of plates, change in distance between plates, variation of dielectric constant for displacement measurement*** ), Inductive (LVDT-Principle and characteristics, Hall effect sensors, magneto-strictive transducers).
**Unit- 4** (16 Lectures)

Piezoelectric (Element and their properties, Piezo Electric coefficients. Equivalent circuit and frequency response of P.E. Transducers), light (photo-conductive, photo emissive, photo voltaic, ***semiconductor photodiode***, LDR), Temperature (electrical and non-electrical). Pressure (force summing devices, load cell)

**Suggested Books:**

1. Doeblin& Manek, Measurement Systems, 4/e, McGraw Hill, New York, 1992,5th edition
2. Nakra & Choudhary ,Instrumentation Measurements and Analysis , Tata McGraw-Hill, 2nd edition
3. A.K. Sawhney , Electrical & Electronic Measurements & Instrumentation, 19th revised edition
4. Rangan, Sarma, and Mani, Instrumentation- Devices and Systems ,Tata-McGraw Hill 2nd edition
5. H.S Kalsi, Electronic Instrumentation ,McGraw Hill, 4th edition
6. DVS Murthy, Measurement & Instrumentation, PHI
7. D. Patranabis, Sensors and Transducers, PHI, 2nd edition
8. Arun K. Ghosh, Introduction to Measurements and Instrumentation, PHI, 4th edition

**Transducers and Sensors** Lab
**60 Lectures**

1. Measurement of pressure, strain and torque using strain gauge***/load cells***.
2. Measurement of speed using Electromagnetic transducer.
3. Measurement of speed using photoelectric transducers
4. Measurement of angular displacement using Potentiometer.
5. Measurement of displacement using LVDT.
6. Measurement using capacitive transducer.
7. Measurement using inductive transducer.
8. Measurement of Temperature using Temperature Sensors/RTD.
9. Characteristics of Hall effect sensor.
10. Measuring change in resistance using LDR.

**Core course-V**
**Measurement Technology**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (20 Lectures)

**Flow Measurement:** Introduction, definitions and Units, classification of flow meters, Mechanical type flowmeters, Theory of fixed restriction variable head type flow meters, orifice plate, venturi tube, flow nozzle, dall tube, installation of head flow meters Quantity meters, area flow meters and mass flow meters, Positive displacement flow meters, constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters, inferential meter, turbine flow meter, rotameter, thermal mass flow meter, volume flow meter plus density measurement, Electrical type flow meter, Principle and constructional details of electromagnetic flow meter, different types of excitation , schemes used different types of ultrasonic flow meters, laser doppler anemometer systems , rortex shedding flow meter, target flow meter, solid flow rate measurement , guidelines for selection of flow meter.

**Unit- 2** (16 Lectures)

**Measurement of Speed and Acceleration**: Tachometers, Mechanical, Electric, Contact less, Frequency, Ignition, Stroboscopic tachometers. Accelerometers, Elementary, Seismic and Practical accelerometers.
**Recorders :**Types, strip chart, circular, X,Y, oscillographic, magnetic tape, printers, dot matrix, ink jet, laser

**Unit 3** (10 Lectures)

**Measurement of Humidity and Moisture:** Basic principles, hygrometers, psychrometers , humidity charts , dew point, measurement systems for humidity., Infrared moisture measuring systems , radioactive moisture measuring systems.

**Unit 4** (14 Lectures)

**Pressure measurement:** Units of pressure, manometers, different types, elastic type pressure gauges, Bourde type bellows, diaphragms, measurement of vacuum, McLeod gauge, Pirani and Ionisation Gauge, thermal conductivity gauges, Ionization gauge cold cathode and hot cathode types – testing and calibration of pressure gauges, dead weight tester. Vacuum pumps, Rotary and Diffusion.

**SUGGESTED BOOKS**

1. Process Measurement and Analysis, 4th Edition (1995), Liptak B. G., Chilton Book Company, Pennsylvania.
2. Principles of Industrial Instrumentation, 2nd Edition (1997), D.Patranabis, Tata McGraw Hill Publishing Co., New Delhi.
3. A Course in Electrical and Electronic Measurements and Instrumentation, (2005), A.K. Sawhney, Dhanpat Rai & Co.
4. Mechanical and Industrial Measurements, Tenth Edition (1996), R.K. Jain, Khanna Publishers.
5. Measurement Systems: Application and Design, Fourth Edition (1992), Doeblin E. O, McGraw Hill, Singapore.

**Measurement Technology Lab**
**60 Lectures**

1. Flow rate measurement using orifice plate flowmeter.
2. Calibration of pressure gauge using dead weight calibrator.
3. Experiment on working of thermocouple.
4. Experiment on control of various functions using RTD.
5. To find out level of water using level transmitters.
6. Measurement of conductivity of test solutions using electrical conductivity meter.
7. EM flowmeter and ultrasonic flowmeter.
8. Ratio control in combustion laboratory Unit.
9. AC/DC meter calibrator.
10. To study of Circular chart recorder

**Core course-VI**
**Digital Electronics and VHDL**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit-1** (12 Lectures)

**Number System and Codes**: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, octal and hexadecimal arithmetic (addition, subtraction by complement method, multiplication), representation of signed and unsigned numbers, Binary Coded Decimal code.
**Logic Gates and Boolean algebra**: Truth Tables of OR, AND, NOT, XOR, XNOR, Universal (NOR and NAND) Gates, Basic postulates and fundamental theorems of Boolean algebra.
**Digital Logic families**: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, comparison of TTL and CMOS families.

**Unit-2** (14 Lectures)

**Combinational Logic Analysis and Design**: Standard representation of logic functions (SOP and POS), Karnaugh map minimization, Encoder and Decoder, Multiplexers and Demultiplexers, Implementing logic functions with multiplexer, binary Adder, binary subtractor, parallel adder/subtractor.

**Unit-3** (16 Lectures)

**Sequential logic design**: Latches and Flip flops , S-R Flip flop, J-K Flip flop, T and D type Flip flops, Clocked and edge triggered Flip flops, Registers, Counters (synchronous and asynchronous, ring and modulo-N), State Table, State Diagrams, counter design using excitation table and equations.

**Unit-4** (18 Lectures)

**Programmable Logic Devices:** Basic concepts- ROM, PLA, PAL, CPLD, FPGA
**Introduction to VHDL:** A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Introduction to Simulation and Synthesis Tools, Test Benches. VHDL Modules, Delays, data flow style, behavioral style, structural style, mixed design style, simulating design.
Introduction to Language Elements, Keywords, Identifiers, White Space Characters, Comments, format, Integers, reals and strings. Logic Values, Data Types-net types, undeclared nets, scalars and vector nets, Register type, Parameters. Expressions, Operands, Operators, types of Expressions
**Gate level modeling** - Introduction, built in Primitive Gates, multiple input gates, Tri-state gates, pull gates, MOS switches, bidirectional switches, gate delay, array instances, implicit nets, Illustrative Examples (both combinational and sequential logic circuits)

**Suggested Books:**

1. M. Morris Mano Digital System Design, Pearson Education Asia,( Fourth Edition )
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
4. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

5. A Verilog HDL Primer – J. Bhasker, BSP, 2003 II Edition.
6. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

**Digital Electronics and VHDL Lab (Hardware and Circuit Simulation Software)**
**60 lectures**

1. To verify and design AND, OR, NOT and XOR gates using NAND gates.
2. To convert a Boolean expression into logic gate circuit and assemble it using logic gate IC's.
3. Design a Half and Full Adder.
4. Design a Half and Full Subtractor.
5. Design a seven segment display driver.
6. Design a 4 X 1 Multiplexer using gates.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
8. Design a counter using D/T/JK Flip-Flop.
9. Design a shift register and study Serial and parallel shifting of data.

**Experiments in VHDL**

1. Write code to realize basic and derived logic gates.
2. Half adder, Full Adder using basic and derived gates.
3. Half subtractor and Full Subtractor using basic and derived gates.
4. Clocked D FF, T FF and JK FF (with Reset inputs).
5. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
6. Decoder (2x4, 3x8), Encoders and Priority Encoders.
7. Design and simulation of a 4 bit Adder.
8. Code converters (Binary to Gray and vice versa).
9. 2 bit Magnitude comparator.
10. 3 bit Ripple counter.

**Core course-VII**
**Engineering Mathematics**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (16 Lectures)

***Ordinary Differential Equations: First Order Ordinary Differential Equations: Separable Ordinary Differential Equations, Linear Ordinary Differential Equations. Linear Independence and Dependence, Linear Differential Equations of Second Order with Constant Coefficients and Variable Coefficients: Homogeneous and non-homogeneous. Method of Variation of Parameters, Electric Circuits, System of Simultaneous Linear Differential Equations with Constant Coefficients.***

**Unit- 2** (14 Lectures)

***Partial Differential Equations: Formation of Partial Differential Equation, Partial Differential Equation of First Order: Linear and Non-linear. Classification of Partial Differential Equations of Second Order, Method of Separation of Variables .Modeling a Vibrating string and the Wave Equation.***

**Unit- 3** (14 Lectures)

***Laplace Transform: Laplace Transform and its properties, Convolution theorem, Impulse Function and Unit Step function, solutions to ordinary differential equations. Initial and Final value theorem, Inverse Laplace transforms and its properties.***

**Unit- 4** (16 Lectures)

***Fourier series and Transforms: Period of any function, Fourier Series: even and odd Functions, half range expansions, Forced Oscillations ,Fourier Integral, Fourier Transforms : Fourier Sine and Cosine Transforms.***

**Suggested Books:**

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008), 8th Edition
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007), 6th reprint
3. Michel D Greenberg; Advanced Engineering Mathematics, Pearson International
4. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007), 3rd edition
5. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
6. A.S.Willsky, Oppenheim, Signals and System, Prentice Hall, 2nd edition
7. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers

**Engineering Mathematics lab** (**using Scilab /MATLAB/ any other Mathematical Simulation software**) **60 Lectures**

1. Solve the linear differential equation of second order with variable coefficients.

2. Solve the linear differential equation of second order with constant coefficients.

3. Plot curves like sin x, cos x, tan x, log x, exp(x), x^2, x^3, x+x^2+exp(x).

4. Computing Fourier of a given signal.

5. Laplace Transform of a given signal.

**Core course-VIII**
**Operational Amplifiers and Applications**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (18 Lectures)

**Basic Operational Amplifier:** Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741)
**Op-Amp parameters**: input offset voltage, input offset current, input bias current, differential input resistance, input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.

**Unit- 2** (18 Lectures)

**Op-Amp Circuits:** Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter.
**Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger.
**Signal generators:** Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator(IC 566).

**Unit- 3** (12 Lectures)

**Multivibrators (IC 555):** Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565.
**Fixed and variable IC regulators:** IC 78xx and IC 79xx -concepts only, IC LM317- output voltage equation

**Unit- 4** (12 Lectures)
**Signal Conditioning circuits:** Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers. ***Instrumentation Amplifier***

**Suggested Books:**

1. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
2. R. F. Coughlin and F. F. Driscoll, Operational amplifiers and Linear Integrated circuits, Pearson Education (2001)
3. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001)
4. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003)
5. K.L.Kishore,OP-AMP and Linear Integrated Circuits, Pearson(2011)

**Operational Amplifiers and Application Lab (Hardware and Circuit Simulation Software)**
**60 Lectures**

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op-amp.
3. Designing of analog adder and subtractor circuit.

4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.
11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series
12. ***Design Schmnitt Trigger***

**Core course-IX**
**Analytical Instrumentation**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (20 Lectures)

**Molecular Spectro-analytical Methods of Analysis**: Colorimetry and Spectrophotometry: Introduction, theory: molecular energy levels, types of molecular transitions, Lambert-Beer's Law and limitations, types of sources, monochromators and detectors, Instrumentation of single beam and double beam instrument.
**Infrared Spectroscopy:** Theory, diatomic molecules as a simple harmonic oscillator, instrumentation, sample handling techniques. Fourier Transform Infrared Spectroscopy (FTIR): advantages, instrumentation qualitative and quantitative applications, interpretation of Infrared (IR) spectra.

**Unit- 2** (10 Lectures)

**Atomic *Emission* Spectroscopy**: ***Flame photometer: principle, its instrumentation, atomisation process, types of flames- fuel/ oxidant combinations, Interferences: spectral, chemical and ionization, applications, analysis using standard addition method***
***Atomic Absorption Spectroscopy (AAS): Principle, its instrumentation and applications***.

**Unit- 3** (14 Lectures)

**Separation methods**: Theory of chromatography; instrumentation and applications of ***Paper Chromatography and*** Thin layer chromatography (TLC). **Column chromatography**: Principle, process of elution through a column, chromatogram, band broadening, capacity factor, selectivity factor , Column efficiency, number of plates, plate height, column resolution.

**Unit- 4** (16 Lectures)

**Gas Chromatography (GC):** carrier gases, different type of injection systems, columns, stationary phases and detectors. Isothermal mode, temperature programming mode, analysis by internal standard method, applications. **High Performance Liquid Chromatography (HPLC):** mobile phase, isocratic and gradient elution, pumps, injection systems, columns, stationary phases, normal phase and reverse phase chromatography, detectors and their application.

**Suggested Books:**

1. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York
2. H.H.Willard, Instrumental Methods of Analysis, CBS Publishers.
3. D.C. Harris, Quantitate Chemical Analysis, W.H.Freeman
4. Christian G.D, Analytical Chemistry, John & Sons, Singapore
5. Skoog, West and Holler, Analytical Chemistry, Saunders College Publications, New York
6. Vogel's Textbook of Qualitative Chemical Analysis, ELBS
7. J.A. Dean, Analytical Chemistry Notebook, McGraw Hill
8. John H. Kennedy, Analytical Chemistry: Principles, Saunders College Publication
9. W. Kemp, Organic Spectroscopy, ELBS
10. Hand book of Instrumental Techniques for Analytical Chemistry, Frank Settle, editor, Prentice Hall

**Analytical Instrumentation Lab**
**60 Lectures**

1. ***Determination of concentration of solutes in a mixture using colorimeter.***
2. ***Verification of Beer's Law and determination of concentration of the unknown solution using colorimeter.***
3. ***To study the effect of organic solvent on membrane permeability of beet root using spectroscopy.***
4. ***Paper chromatographic separation of samples from different origin (Biological/pharmaceutical/food).***
5. Determination of pKa value for a dye using double beam spectrophotometer.
6. Spectrometric determination of iron in water sample using double beam spectrophotometer.
7. Determination of concentrations of sodium, calcium, lithium and potassium in sample using flame photometer.
8. Determination of concentration of potassium ions in sample by standard addition method using flame photometer
9. Spectrum interpretation using FT-IR.
10. Thin layer chromatographic (TLC) separation of samples from different origin (Biological / Pharmaceutical / Food).
11. Qualitative analysis of samples using Gas chromatography
12. Qualitative analysis of samples using High Performance Liquid Chromatography.

**Core course-X**
**Electronic Instrumentation**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (18 Lectures)

**DC and AC Measurement**: DC and AC indicating Instruments: Accuracy and precision - Types of errors, Basic Measurement Instruments-DC Bridges and applications: Wheatstone ***and*** Kelvin ***bridge***, AC Bridges: General form of AC bridge balance, comparison bridges, Maxwell, Hay***s***, Schering ***&*** Wien ***bridge***, Wagner ground condition.

DC measurement: DC voltmeter, ammeter, ohmmeter, multimeter, AC measurement: voltmeter, ammeter. Digital type voltmeters, digital multimeter. Digital frequency meter: Elements of frequency meter, universal counter and its different modes, measurement errors and extending the frequency range.

**Unit- 2** (14 Lectures)

**Signal Generators-**Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators, Sweep generator. Probes and Connectors: Test leads, shielded cables, connectors, low capacitance probes, high voltage probes, RF demodulator probes, special probes for IC's, current probes.

**Unit- 3** (16 Lectures)

**Electronic Displays:** Cathode Ray Oscilloscope (CRO) and applications: Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, screens for CRT and graticules, CRT Connections, CRO probes. Types of CRO's: dual trace oscilloscope ***and Dual Beam Oscilloscope***, digital storage oscilloscope,Sampling oscilloscope. Amplitude, Frequency, Phase measurements, Lissajous Figures.

**Unit- 4** (12 Lectures)

**Spectrum Analyser and Wavemeter:** Frequency Spectrum, Distortion and wave measurement - Spectrum analyzer, Harmonic distortion analyzer, Intermodulation distortion analyzer, wave analyzer and distortion factor meter, wave meter, Different type of wave meters: Lumped and cavity wavemeters, Q-meter and its applications.

**Suggested books**

1. H. S. Kalsi, Electronic Instrumentation, Tata McGraw Hill (2006)
2. Joseph J Carr, Elements of electronic instrumentation and measurement, Pearson Education (2005)
3. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata McGraw Hill (1998)
4. H. Cooper, Modern electronic instrumentation and measurement techniques, Pearson Education (2005)

5. 5. R. A. Witte, Electronic test instruments: Analog and digital measurements, Tata McGraw Hill (2004)
6. 6. S. Wolf and R. F. M. Smith, Student Reference Manual for Electronic Instrumentation Laboratories, Pearson Education (2004)

**Electronic Instrumentation Lab**
**60 Lectures**

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies, CRO.
2. Study the generation of Lissajous figures to find unknown frequency and phase shift.
3. Frequency measurement using Wein Bridge.
4. Study of R, L, C and Q meter.
5. Study of DSO-Measurement of response time of relay using DSO.
6. Measurements of L, C, R using bridges.
7. To study bridge based loop tests.
8. Study of Universal Counter

**Core course-X1**
**Biomedical Instrumentation**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit-1** (16 Lectures)

**Biopotentials, Bioamplifiers and Bioelectrodes:** Introduction to bio-electric potential, bio-amplifier, components of man Instrument system, types of biomedical systems, design factors and limitations of biomedical instruments, terms and transducers to measure various physiological events, types of bio-potential electrodes (Body surface electrodes, Internal electrodes, Micro electrodes), electrolyte interface, electrode circuit model, impedance and polarization, Properties of electrodes .

**Unit- 2** (16 Lectures)

**Cardiac vascular system & measurements**: ECG: origin, Instrumentation, bipolar system lead system I, II, III, Einthovan's triangle, Augmented lead system, unipolar chest lead system, types of display. Blood pressure measurements: direct, indirect. Defibrillators: AC, DC. Pacemakers- Internal, External. Blood Flow meters: Electromagnetic blood flow meter, ultrasonic blood flow meter. Oximeters: Different types of oximetry systems, pulse oximeter.

**Unit- 3** (15 Lectures)

**Respiratory Measurement Systems:** Types of volume, types of measurements, Instrumentation of respiratory system, principle & types of pneumograph, Spirometer, pneumotachometers, nitrogen wash out technique.

**Unit- 4** (13 Lectures)

**Nervous system:** Action potential of brain, brain wave, Instrumentation of Electroencephalography (EEG), electrodes used for recording EEG analysis.
**Medical Imaging system**: -Thermal imaging system, working, IR detectors, applications. Radiography-conventional X-ray, properties, generation of X-ray, Fluoroscopy

**Suggested Books:**

1. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Second edition, Prentice Hall (2010), 2nd edition
2. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education Inc (2010), 2nd edition
3. Khandpur R.S., Handbook of Biomedical Instrumentation, Second edition, Tata McGraw-Hill Publishing (2009), 2nd edition
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, IEEE Press (2000), 2nd edition, Volume 1.
5. Richard Aston, Principles of Biomedical Instrumentation & Measurement, Merrill Publishing Company, (1990), 1st edition
6. Mandeep Singh, Introduction to Biomedical Instrumentation, PHI learning private limited (2010), 1st edition

**Biomedical Instrumentation Lab**
**60 Lectures**

1 .Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator
3. Measurement of heart sound using electronic stethoscope. Study on ECG heart rate monitor /simulator
4 .Study of pulse rate monitor with alarm system
5. Determination pulmonary function using spirometer (using mechanical system).
6. Measurement of respiration rate using thermister /other electrodes.
7. Study of Respiration Rate monitor/ apnea monitor
8. Study on ultrasound transducers based on medical system
9. Study of a Pacemaker.
10. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.

**Core course-XII**
**Microprocessor**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (18 Lectures)

Introduction to 8085 Microprocessor, Pin description of 8085, Architecture, register of 8085, addressing mode. Instruction Type and Instruction Set, Machine Cycle, Instruction Cycle, Timing Diagram.
Memory System, internal and external memory and concept of Virtual Memory. Hardware Interfacing or Types of I/O addressing-Interfacing Memory and Peripheral (I/o Mapped I/O and memory mapped I/O).

**Unit-2** (12 Lectures)

Assembly Language Programming Stacks and Subroutine, Interrupts of 8085-Hardware and Software interrupts. Difference between RICS and CISC Processor

**Unit- 3** (17 Lectures)

Interfacing ICs, Programmable Peripheral Interface: Intel 8155, 8253, 8255, programmable Interrupt Controller: Intel 8259

**Unit- 4** (13 Lectures)

Application of Microprocessor 8085 in Instrumentation-Interfacing of Stepper Motor, keyboard Basics of 8086(16 bit Microprocessor), Architecture of 8086, Concept of parallel processing in 8086

**Suggested Books:**

1. Ramesh Gaonkar, Microprocessors architecture, programming and Applications, Wiley Eastern Ltd. (2002), 2nd Edition
2. P.K Ghosh& P.R Sridhar, 0000 to 8085 microprocessor, John Wiley & Sons, 2nd Edition
3. Liu Gibson, Microprocessor Systems: The 8086/8088 family Architecture, Programming& Design, PHI, 1999, 2nd Edition
4. R. Thegarajan and S. Dhanpal, Microprocessor and its Application, New Age International Private Ltd, 1st Edition
5. K. Udaya Kumar & B.S. Uma Shankar, The 8085 Microprocessor: Architecture, Programming and Interfacing", Pearson Education
6. Barry B. Brey and C R Sarma, The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80526,
7. Pentium and Pentium Pro-Processor Architecture, Programming and Interfacing, Pearson Education, (2005)
8. Walter Triebel &Avtar A.Singh, 8088 and 8086 Microprocessors: Programming, Interfacing, Software Hardware and Applications, Pearson Education, 4th edition
9. D. V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill (2005), revised 2nd edition

**Microprocessor Lab**
**60 Lectures**

1. To write an assembly language program to perform basic mathematical operations (addition, subtraction, multiplication, division)
2. To write an assembly language program to generate first N terms of an A.P. / G.P. series
3. To write an assembly language program to generate first N terms of Fibonacci series
4. To write an assembly language program to arrange the given list of number in ascending / descending order
5. To write an assembly language program to calculate N!
6. To write an assembly language program to separate prime numbers in a given list of number
7. To write an assembly language program to convert a number from one number system to another.
8. To write an assembly language program to design a clock 36
9. To write an assembly language program to calculate a mathematical expression (for e.g. 2N/N!)
10. To write an assembly language program to calculate value of sin(x)
11. ***Interfacing 8085 with chips 8155, 8255 and 8253***

**Core course-XIII**
**Power Electronics**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (14 Lectures)

**Basic Power Devices and Circuits:** SCR, Diacs and Triacs, Two transistor model of SCR, Resistive and RC triggering circuits. Applications of SCR: Basic series inverter circuit, Chopper circuit – Basic concept, step up and step down choppers.

**Unit- 2** (16 Lectures)

**Types of motors and Motor Drives:** Constructional features and characteristics of DC Motors, AC Motors, Induction Motors, Single and three phase Motors, Synchronous Motors, Stepper Motors, and Servo Motors. Motor driving and speed control circuits and their applications, motor starters.

**Unit- 3** (18 Lectures)

**Generators and AC machines:** AC and DC generators, comparison between generator and motor action (without constructional comparison). AC Machines: Types of transformers, Transformer Construction, E.M.F. equation, Transformer Losses, Condition for maximum efficiency, all day efficiency, Auto transformers.

**Unit- 4** (12 Lectures)

**Supplies:** Regulated power supply, Uninterrupted power supply (UPS) and Switched mode power supply (SMPS).

**Suggested Books**

1. Power Electronics, 2nd Edition (2006), M. D. Singh, K. B.Khanchandani, Tata McGraw Hill.
2. Electrical Technology, 23rd Edition (2005), B. L. Thareja and A. K. Thareja, S. Chand & Sons.
3. Electronic Principles, 7th Edition (2007), A. Malvino, D. J. Bates, Tata McGraw Hill.
4. Power Electronics, 4th Edition (2002),P. S. Bimbhra, Khanna Publishers.
5. Electrical Machines, 2nd Edition (1997), I. J. Nagrath and D. P. Kothari, Tata McGraw Hill (1997).

**Power Electronics Lab**
**60 Lectures**

1. Study of I-V characteristics of SCR.
2. Study of I-V characteristics of DIAC.
3. Study of I-V characteristics of TRIAC.
4. Load characteristics of D.C. motor.
6. Speed control of D.C. motor.
7. Break test of D.C. motor.
8. Break test of induction motor.
9. ***Study of Load characteristics of Servomotor.***
***10. Study of no-load and blocked rotor test on single phase Inductor motor.***

**Core Course-XIV**
**Control Systems**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** (16 Lectures)

**Introduction to Control System:** Introduction of open loop and closed loop control systems, mathematical modelling of physical systems (Electrical, Mechanical and Thermal), derivation of transfer function, Armature controlled and field controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula. Effect of feedback on control systems.

**Unit- 2** (16 Lectures)

**Time Domain Analysis:** Time – Domain Analysis:-Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, performance indices.
**Concept of Stability:** Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

**Unit-3** (16 Lectures)

**Frequency Domain Analysis:** Frequency Domain Analysis: Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles.

**Unit-4** (12 Lectures)

**State Space Analysis:** Definitions of state, state variables, state space, representation of systems, Solution of time invariant, homogeneous state equation, state transition matrix and its properties.
***Controllers and*** **Compensation Techniques:** ***Basic Control Actions: Proportional, integral and Derivative controls. Response with P, PI and PID Controllers.*** Concept of compensation, Lag, Lead and Lag-Lead networks.

**Suggested books**

1. J. Nagrath & M. Gopal, Control System Engineering, New Age International, 2000, 2nd Edition
2. K. Ogata, Modern Control Engineering, PHI 2002, 4th Edition.
3. B. C. Kuo , "Automatic control system", Prentice Hall of India, 2000, 7th Edition
4. I. J. Nagrath& M. Gopal, Control System Engineering, New Age International, 2000, 2nd Edition
5. N.K Jain, Automatic Control System Engineering, Dhanpat Rai Publication,2005, 2nd Edition
6. B. S. Manke, Linear Control Systems, Khanna Publishers, Delhi, 7th Edition

**Control Systems Lab**

**60 Lectures**

1. To study characteristics of :
   a. Synchro transmitter receiver
   b. Synchro as an error detector
2. To study position control of DC motor
3. To study speed control of DC motor
4. To find characteristics of AC servo motor
5. To study time response of type 0,1 and 2 systems
6. To study frequency response of first and second order systems
7. To study time response characteristics of a second order system.
8. To study effect of damping factor on performance of second order system
9. To study frequency response of Lead and Lag networks.
10. Study of P, PI and PID controller.

**DSE-1**

**Signals and Systems**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(15 Lectures)**

**Signals and Systems**: Continuous and discrete time signals, Transformation of the independent variable, Exponential and sinusoidal signals, Impulse and Unit step functions, Continuous-Time and Discrete-Time Systems, Basic System Properties.

**Unit 2** **(15 Lectures)**

**Linear Time-Invariant Systems (LTI):** ***Continuous & discrete time LTI systems, Convolution Sum, Convolution integral, Properties of LTI Systems-Commutative, Distributive, Associative, LTI systems with and without memory, Invariability, Causality, Stability, Unit Step response of System, Differential and Difference equation formulation, Block diagram representation of first order systems.***

**Unit 3** **(14 Lectures)**

**Laplace Transform**: Laplace Transform, Inverse Laplace Transform, Properties of the Laplace Transform, Laplace Transform Pairs, Laplace Transform Methods in Circuit Analysis, Impulse and Step response of RL, RC and RLC circuits.

**Unit 4** **(16 Lectures)**

***Fourier Series Representation of Periodic Signals: Continuous-Time periodic signals, Convergence of the Fourier series, Properties of continuous-Time Fourier series, Discrete-Time periodic signals, Properties of Discrete-Time Fourier series.***
***Fourier Transform: Aperiodic signals, Periodic signals, Properties of Continuous-time Fourier transform, Convolution and Multiplication Properties, Properties of Fourier transform and basic Fourier transform Pairs.***

**Suggested Books:**

1. H. P. Hsu, Signals and Systems, Tata McGraw Hill(2007)
2. S. T. Karris, Signal and Systems: with MATLAB ,Computing and Simulink Modelling, Publications (2008)
3. W. Y. Young, Signals and Systems with MATLAB, Springer (2009)
4. M. Roberts, Fundamentals of Signals and Systems, Tata McGraw Hill (2007)

**Signals and Systems Lab**

**60 Lectures**

1. Learning Scilab/MATLAB (Experiments based on available system)
2. Explorations of Signals and Systems using Scilab/MATLAB
   a. Generation of Signals: continuous time
   b. Generation of Signals: discrete time
   c. Convolution of Signals
   d. Solution of Difference equations.
   e. Introduction to SIMULINK and calculation of output of systems represented by block diagrams

**DSE-2**

**Advanced Analytical Instrumentation**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(20 Lectures)**

**Nuclear Magnetic Resonance (NMR) Spectroscopy**: Theory, chemical shift and spin-spin splitting, coupling constant, environmental effects- shielding deshielding effects due to electronegativity on NMR spectra, instrumentation of NMR.

**Mass Spectroscopy**: ***Theory, instrumentation: gaseous ion source, sample inlet system, magnetic sector mass analyzer, electron multiplier detector, fragmentation, Isotopic abundances, metastable ions and applications.***

**Unit 2** **(14 Lectures)**

**Electro Analytical Methods of Analysis**: ***Introduction, reference electrode, indicator electrodes, ion-selective electrodes: glass electrode and liquid membrane electrode, their applications, potentiometric titrations***.

**Unit 3** **(14 Lectures)**

**Radiochemical methods**: X-ray spectroscopy- Principle, absorption, emission and diffraction of X-rays, Bragg's Law, Instrumentation: sources, X –ray tube, crystal monochromators, X-ray detectors (Ionization, proportional and GM counter, γ camera), applications.

**Unit 4** **(12 Lectures)**

***Thermo-analytical Methods: Thermal detectors. Thermo-gravimetry, Differential Thermal analysis, Differential scanning calorimetry. Principle, Instrumentaion: thermobalance. Interpretation of thermograms. Applications. Comparison and advantages of each technique.***

**Suggested Books:**

1. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York
2. H.H.Willard, Instrumental Methods of Analysis, CBS Publishers.
3. D.C. Harris, Quantitative Chemical Analysis, W.H.Freeman
4. Gary D. Christian, Analytical Chemistry, John & Sons, Singapore
5. Skoog, West and Holler, Analytical Chemistry, Saunders College Publications, New York
6. Vogel's Textbook of Qualitative Chemical Analysis, ELBS
7. J.A. Dean, Analytical Chemistry Notebook, McGraw Hill
8. John H. Kennedy, Analytical Chemistry: Principles, Saunders College Publication
9. W. Kemp, Organic Spectroscopy, ELBS
10. R.S Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill.
11. B.K Sharma, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media.

**Advanced Analytical Instrumentation Lab**

**60 Lectures**

1. Quantitative Analysis of organic compounds using Gas chromatography
2. Quantitative Analysis of organic compounds using HPLC.
3. Study of NMR (Simulation based/Demo).
4. Study of Mass spectrometer (Demo).
5. Study of X ray spectrometer (Demo).
6. Potentiometric titrations: (i) Strong acid with strong base (ii) weak acid with strong base and (iii) dibasic acid with strong base
7. Potentiometric titration of Mohr's salt with potassium dichromate
8. pH metric titrations of (i) strong acid and strong base (ii) weak acid and strong base
9. Group Projects based on analytical techniques.
10. Study of thermo-analytical instruments (Demo).

**DSE-3**

**Communication systems**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(8 Lectures)**

**Basic communication system**: Block diagram, Information source and input transducer, Transmitter medium, Noise, Receiver, Destination, Necessity for modulation, Types of communication systems.

**Unit 2** **(18 Lectures)**

**Amplitude Modulation, Frequency and phase modulation:** Definition - AM waveforms - Frequency spectrum and hand width - Modulation index - DSB - SC, SSB, Independent SB, Vestigial SB - Comparison and application of various AM schemes, Definition-Relationship between FM & PM - Frequency deviation - Spectrum and transmission BW of FM, comparison of AM and FM systems.

**Unit 3** **(16 Lectures)**

**Radio Transmitter and Receiver**: AM transmitters-High level and low level transmitters - SSB transmitters - FM transmitters - Block diagram - stereo FM transmitter.
AM receivers-operation - performance parameters - Communication Transceivers - Block diagram - SSB receiver - FM receivers - Block diagram.

**Unit 4** **(18 Lectures)**

**Digital Communication:** Pulse Analog Modulation**:** Sampling theorem, Errors in Sampling. Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM). Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM). Generation and detection of PAM, PWM, PPM,
**PCM**- Need for digital transmission, Quantizing, Uniform and Non-uniform
Quantization, Quantization Noise, Companding, Coding, Digital Formats. Decoding, Regeneration, Transmission noise and Bit Error Rate

**Suggested Books:**

1. G. Kennedy and B. Davis, Electronic Communication Systems, Tata McGraw Hill (1999)
2. R. P. Singh and S. D. Sapre, Communication Systems: Analog and Digital, Tata McGraw Hill (2007)
3. L. E. Frenzel, Communication Electronics: Principles and Applications, Tata McGraw Hill (2002)
4. L. W. Couch II, Digital and Analog Communication Systems, Pearson Education (2005)
5. T. G. Thomas and S. Chandra Sekhar, Communication Theory, Tata McGraw Hill (2006)
6. L. Temes and M. E. Schultz, Schaum's outline of theory and problems of Electronic Communication (1997)
7. H. Taub and D. Schilling, Principles of Communication Systems, Tata McGraw Hill (1999)
8. W. Tomasi, Electronic Communication Systems: Fundamentals through Advanced, Pearson Education (2004)
9. L. E. Frenzel, Communication Electronics, Principles and Applications, Tata McGraw Hill (2002)

10. L. W. Couch II, Digital and Analog Communication Systems, Pearson Education (2005)
11. H. P. Hsu, Analog and Digital Communications, Tata McGraw Hill (2006)
12. S. Haykin, Communication Systems, Wiley India (2006)

**Practicals based on Communication Systems**

**60 Lectures**

1. Study of Amplitude Modulation and Demodulation
2. Study of Frequency Modulation and Demodulation
3. Study of Single Side Band Modulation and Demodulation
4. Study of AM Transmitter and Receiver
5. Study FM Transmitter and Receiver
6. Study of Pulse Amplitude Modulation
7. Study of Pulse Width Modulation
8. Study of Pulse Position Modulation
9. Study of Pulse Code Modulation

**DSE-4**

**Advanced Biomedical Instrumentation**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(15 Lectures)**

***Ventilators: Basic principle of ventilators, inspiratory phase and expiratory phase, types of ventilators*** **Anaesthesia Machine**: Need of anesthesia, anesthesia delivery system, breathing circuits. **Clinical Laboratory Instruments:** General principle and working of Blood Gases Analyzer, Auto-analyzer, Blood Cell Counters, ELISA reader.

**Unit 2** **(16 Lectures)**

**Medical Imaging System**: Ultrasound, properties, its generation & detection, types of transducers, diagnostic application – A Scan, B Scan, M Scan, real time ultrasonic imaging, linear array scanners, X-ray computed tomography (CT Scanner) and computer-aided tomography (CAT)-principle, contrast scale, scanning system, processing Unit, viewing, storage.
**Magnetic Resonance Imaging**: Basic principle, working and construction.

**Unit 3** **(15 Lectures)**

**Nuclear Medicine System**: radioactive emissions, rectilinear scanner, gamma camera, imaging system, ECT (emission coupled tomography), positron emission tomography (PET), Single-photon emission computed tomography (SPECT), safety measures.

**Unit 4** **(14 Lectures)**

**Surgical Scopy and Diathermy Equipments:** Fibre Optics- Endoscopes -light sources, video processors, camera, and fiber optic cable, Principles and applications.
**Diathermy**: ***Working principle, construction, Types of Diathermy (Infrared radiation (IR) diathermy, ultraviolet (UV) diathermy, short wave diathermy, microwave diathermy, ultrasonic diathermy, Surgical Diathermy), applications.***

**Suggested Books:**

1. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education Inc (2010), 2nd edition
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Second edition, Tata McGraw-Hill Publishing (2009), 2nd edition
3. Joseph D. Bronzino, The Biomedical Engineering Handbook, IEEE Press (2000), 2nd edition, Volume 1.
4. Richard Aston, Principles of Biomedical Instrumentation & Measurement, Merrill Publishing Company, (1990), 1st edition

5. Mandeep Singh, Introduction to Biomedical Instrumentation, PHI learning private limited (2010), 1st edition.
6. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Second edition, Prentice Hall (2010), 2nd Edition.

**Advanced Biomedical Instrumentation Lab**

**60 Lectures**

1. Study of ultrasound transducers based on medical system.
2. Differentiating arteries and veins using ultrasound transducers.
3. Measurement of respiration rate using thermistor /other electrodes.
4. Measurement of pulse rate using photoelectric transducer & pulse counting for known period.
5. Study of X ray/CT machine (through demonstration).
6. Study of nuclear imaging techniques (through demonstration).
7. Study of mammograms and CT scan images.
8. Analysis of blood sample using Auto-analyzer
9. To check blood gases using blood gas analyzer
10. To estimate different parameters of blood using blood cell counter.
11. Estimation of serum total protein using spectrometer.
12. Estimation of sodium and potassium in blood serum or urine sample.

**DSE-5**

**Embedded System and Robotics**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(18 Lectures)**

**Introduction to RISC microcontrollers**: Von- Neumann and Harvard architectures, Introduction to 8051 family microcontrollers, 8051 architecture, Register banks and Special Function Registers**,** Block Diagram, Addressing Modes, Instruction Set, Timers, Counters, Stack Operation, Programming using PIC microcontroller.

**Unit 2** **(16 Lectures)**

**Introduction to Embedded Systems**: Overview of Embedded Systems, Features, Requirements and Applications of Embedded Systems, Recent Trends in the Embedded System Design, Common architectures for the ES design, Embedded Software design issues, Communication Software, Introduction to Development and Testing Tools

**Unit 3** **(14 Lectures)**

**8051 Interfacing**: 8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor, Introduction to AVR family and its architecture. **Interfacing and Communication Links Serial Interfacing**: SPI / Micro wire Bus, I2C Bus, CAN Bus

**Unit 4** **(12 Lectures)**

**Robotics**: Overview of Robotics, Pattern recognition and robots, Use of Embedded Systems in Robotics, Robots and Computer Vision

**Suggested Books**

1. Fundamentals of Embedded Software – where C and Assembly Meet by Daniel W. Lewis (Pearson Education).
2. Design with PIC Microcontrollers by John B. Peatman (Pearson Education).
3. Embedded C Programming and the Microchip PIC by Richard Barnett, Larry O'Cull and Sarah Cox (Thomson Learning).
4. Microprocessors: From Assembly Language to C using PIC18Fxx2 by Robert B. Reese (Shroff Publishers and Distributors Pvt Ltd)
5. Robotic Engineering – An Integrated Approach by Richard D Klafter, Thomas A. Chmielewski and Michael Negin (PHI).
6. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (1999), 2nd Edition.

**Embedded System and Robotics Lab (**Using 8051 or any other microcontroller**)**
**60 Lectures**

1. Write a program to multiply two 16 bit unsigned numbers.
2. Write a program to add N 8 bit unsigned integer numbers.
3. Write a program to arrange the unsigned integer numbers in ascending/descending order.
4. Interface a display to the micro controller and display number sequentially in a regular interval.
5. Write a program for LED blinking in a predetermined fashion using 8051 * and PIC microcontrollers.
6. Write a Program to OUT an 8 – bit value on a 8051 and PIC microcontrollers.
7. Write a program for a simple counter, where the count has to be displayed on a 7 – segment LED display.
8. Write a program for interfacing LCD display using 8051 and PIC microcontrollers.
9. Write a program to convert an analog voltage to digital bits using 8051 and PIC microcontrollers
10. Write a program to convert a digital signal to analog signal using 8051 and PIC microcontrollers
11. Write a program for temperature sensor interfacing through serial port on 8051 and PIC microcontroller kits.
12. Write a program for P W M control of DC motor using 8051 and PIC microcontrollers.
    Write a program to drive a stepper motor using 8051 and PIC microcontrollers.

**DSE-6**
**Process Control Dynamics**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(18 Lectures)**

**Introduction**: Dynamics of Processes, Dead time processes. Inverse response behavior of processes. Dynamic Behavior of first and second order systems. Interacting and non-interacting Systems. Batch & Continuous Process, concept of self-regulation, Controller Principle, discontinuous, continuous and composite controller modes/actions (P, I, D, PI, PD and PID). Pneumatic, Hydraulic, Electronic controllers. Need for controller tuning, Evaluation criteria, Types of controller tuning

**Unit 2** **(17 Lectures)**

**Controls**: Cascade control, Selective control, Ratio Control, Split range control, feed forward control, Feed forward combined with feedback control, Inferential Control, dead time and inverse response compensators, selective control, Adaptive control, Examples from Distillation columns, Chemical Reactors, Heat Exchangers and Boiler, Multivariable Control, Interaction, Tuning of Multivariable systems, relative gain analysis, Decoupler design.

**Unit 3** **(14 Lectures)**

**Discrete-State process control**: Variables, process specification and event sequence description, Sampling and reconstruction, Transform analysis of sampled-data systems: z transform and its evaluation, inverse z transform, pulse transfer function, stability analysis in z-plane, implementation of digital controller. PLC Block Diagram, Scan cycle, memory organization, addressing, programming. Introduction to distributed control systems (DCS)

**Unit 4** **(11 Lectures)**

**Converters and Actuators**: I/P, P/I converters, Final control elements, Pneumatic and electric actuators. Types of control valves, Valve positioner and its importance, Inherent and Installed characteristics of control valves.

**Suggested Books**:

1. Eckman. D.P, Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993, Original Edition
2. Johnson C.D., Process Control Instrument Technology, Prentice Hall Inc. 1988, 7th Edition
3. Bequette B. W. , Process Control Modelling, Design and Simulation, PHI Learning, Original Edition
4. Ogata K., Discrete Time Control Systems, Pearson Education, 2nd Edition
5. Kuo B. C. , "Automatic control system", Prentice Hall of India, 2000, 7th Edition
6. Nagrath I. J. and Gopal M., Control System Engineering, New Age International,2000, 2nd Edition
7. Stephanopoulis G., Chemical Process Control, Prentice Hall of India, New Delhi, 1990, Original Edition
8. Liptak B.G., Instrument Engineers Handbook, Process Control, Chilton Book Company, 3rd Edition
9. Harriott P., Process Control, Tata McGraw Hill, Edition 1972.
10. Anderson N.A., Instrumentation for Process Measurement and Control, Chilton company 1980, 3rd Edition
11. Pollard A., Process Control, Heinemann educational books, London, 1971, Original Edition

12. Smith C.L. and Corripio A. B., Principles and Practice of Automatic Process Control, , John Wiley and Sons, New York, 2nd Edition
13. Shinskey, Process Control Systems, McGraw Hill, Singapore, 1996, 4th Edition.

**Process Control Dynamics lab**

**60 Lectures**

1. Study of PID controller response and it's tuning
2. Study of ON-OFF and Proportional controller responses on temperature loop.
3. Analysis of Flow loop/Level loop/Temperature loop/Pressure loop.
4. Tuning of controllers on a pressure loop.
5. Control valve characteristics with and without positioner.
6. Study of cascade control
7. Study of ratio control/selective control
8. Study of feed forward control
9. Study of pneumatic/ hydraulic controllers
10. Problem solving/Ladder Programming in PLC.
11. Mathematical modeling and simulation of CSTR & STH systems

**DSE-7**

**Reliability and Quality Control Techniques**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(15 Lectures)**

**Quality Concepts**: Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Control and Quality Assurance, Evaluation of Quality control, Quality Improvement Techniques Pareto Diagrams, Cause-Effect Diagrams Quality Circles, Kaizen, six sigma.

**Unit 2** **(17 Lectures)**

**Control Charts**: Chance and assignable causes, Statistical Basis of the Control Charts (basic principles, choices of control limits, sample size and sampling frequency, rational subgroups, analysis of pattern on control charts, warning limits, ARL, sensitizing rules for control charts, Control Charts for X-bar& R (statistical basis, development and use, estimating process capability; interpretation, the effect of non-normality on the chart, the OC function, average run length and control chart for attribute (p, np, c)

**Unit 3** **(15 Lectures)**

**Acceptance Sampling**: Meaning, objective, and types of research, approaches, Principle of acceptance sampling, Producer's and consumer's risk. AOQL and LTPD, Sampling plans –single, double, O C curve

**Unit 4** **(13 Lectures)**

**Reliability**: Different types and modes of failure, causes of failure in electronic components, reliability theory, hazard rate, failure density function, availability, maintainability, mean time to failure and repair system structures: series, parallel, K-type, reliability evaluation, optional reliability and redundancy allocation, Fault tree analysis

**Suggested Books**

1. D. C. Montgomery , Introduction to Statistical Quality Control, John Wiley and sons, 4th edition.
2. Reliability Engineering by S.Shreenath, 4th Edition, East West Press

**Reliability and Quality Control Techniques Lab**

**60 Lectures**

**Use latest statistical software package like SPSS**

1. Descriptive statistics
2. Control charts for variable
3. Control charts for attribute
4. OC curve
5. Single sampling and double sampling
6. AOQ curve

**SEC**
**Programming in C**
**(Credits: 02)**

**Total Lectures 60**

**Unit 1** **(14 Lectures)**

**Introduction**: Algorithm / pseudo code, flowchart, program development steps, structure of C program, identifiers, basic data types and sizes, Constants, variables, Operators, expressions, Input-output statements, if and switch statements, loops- while, do-while and for statements, break, continue, goto and labels.

**Unit 2** **(12 Lectures)**

**Functions**: Parameter passing, storage Lectures- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files, C preprocessor, example C programs.

**Unit 3** **(17 Lectures)**

**Arrays and pointers:** Arrays concept, declaration, accessing elements, storing elements, arrays and functions, two dimensional and multi-dimensional arrays, applications of arrays. pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, Character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, C program examples.

**Unit 4** **(17 Lectures)**

**Derived types:** Structures declaration, Initialization, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, type def, bitfields, C program examples. Input and output - concept of a file, streams, standard I/o, Formatted I/O, file I/O operations, error handling, C program examples.

**Searching and sorting**: Searching - Linear and binary search methods, sorting - Bubble sort, selection sort, Insertion sort.

**Suggested Books**

1.Behrouz A. Forouzan and Richard F. Gilberg, Computer science - A structured programming approach using C, Third edition, Cengage Learning.

2.Byron S. Gottfried, Programming with C, 2nd Edition, McGraw-Hill Publishing

3.E Balagurusamy, Programming in ANSI C, 4th Edition, Tata McGraw-Hill Publishing

4.P. Padmanabham, C & Data structures, B.S. Publications.

5.B.W. Kernighan, Dennis M.Ritchie, The C Programming Language, Pearson Education

6.J.A. Jones & K. Harrow, C Programming with problem solving, Dreamtech Press

7.Stephen G. Kochan, Programming in C, III Edition, Pearson Education.

**SEC**
**VLSI Design and Verification**
**(Credits: 02)**

**Total Lectures 60**

**Unit 1** **(18 Lectures)**

**MOS Technology and Circuits:** MOS Technology and VLSI, Process parameters and considerations for BJT, MOS and CMOS, Electrical properties of MOS circuits and Device modeling, MOS Circuit Design Process, MOS Layers, Stick diagram, Layout diagram, Propagation delays, Examples of combinational logic design, Sealing of MOS circuits.

**Unit 2** **(10 Lectures)**

**Analog VLSI and High speed VLSI:** Introduction to Analog VLSI, Realization of Neutral Networks and Switched capacitor filters, Sub-micron technology and GaAs VLSI technology

**Unit 3** **(14 Lectures)**

**Hardware Description Languages:** VHDL background and basic concepts, structural specifications of hardware design organization and parameterization.

**Unit 4** **(18 Lectures)**

**VLSI Verilog:** Introduction, gate level modeling, modeling and concept of wire, creation, module instantiation, ports and their mapping , data flow modeling, various operators, Verilog language and data types, modeling delays-specparam, behavioral modeling.
**Simulation** - Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

**Suggested Books**

1. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design Systems and Circuits, Prentice Hall of India Pvt.Ltd.
2. Wayne Wolf, Modern VLSI Design, 2 Edition, Prentice Hall.
3. Amar Mukherjee, Introduction to NMOS and CMOS VLSI System Design, Prentice Hall.
4. Randall L Geiger and PE Allen, VLSI Design Techniques for Analog and Digital Circuits, McGraw Hill International Company.
5. Fabricious.E, Introduction to VLSI Design, McGraw Hill.
6. Navabi.Z, VHDL Analysis and Modeling of Digital Systems, McGraw Hill.
7. Mohammed Ismail and Terri Fiez, Analog VLSI Signal and Information Processing, McGraw Hill.
8. Peter J Ashenden, the Designer's Guide to VHDL, Harcourt Asia Private Limited & Morgan Kauffman.

**SEC**
**Testing and Calibration**
**(Credits: 02)**

**Total Lectures 60**

**Unit 1** **(18 Lectures)**

**Calibration and Standardization Practices Units:** Fundamental and Derived Units, Standards: Primary, Secondary and Tertiary standards, Standardizations and Technique: Standardizations of Electrical (voltage, current, frequency, RLC and others), Mechanical (mass, displacement, velocity, acceleration, torque, flow, level, temperature, pressure etc.) and other parameters.

**Unit 2** **(18 Lectures)**

**Advanced measurement and Calibration equipment:** Inductive voltage dividers, AC and DC comparators, Programmable synthetic signal sources and power supplies, Quad bridge, Automatic AC bridges, Phase sensitive detectors, Lock-in-amplifiers, Digital phase and frequency measurements

**Unit 3** **(12 Lectures)**

**Standardization and calibration modeling:** Standardization in Production Plants and manufacturing houses, Reliability studies and inspection, Product Standardization techniques, Calibration: Calibration of measuring Instruments, Theory and Principles (absolute and secondary or comparison method), Setup, Modeling.

**Unit 4** **(12 Lectures)**

**Various testing and calibration systems:** Sensor calibration and testing, Analytical methods in calibrating. Automated test and calibration systems: GPIB based systems, machine computation of errors and uncertainties in measurement

**Suggested Books**

**1.**Patrick O'Connor, Test Engineering: A Concise Guide to Cost-effective Design, Development and Manufacture (Quality and Reliability Engineering Series), Wiley-Blackwell.
**2.**Keith R. Cheatle, 2006, Fundamentals of Test Measurement Instrumentation, Illustrated Ed., ISA
**3.**B.G. Liptak 2003, Instrument Engineers Handbook - Process Measurement and Analysis, volume 1, 4th Ed., ISA.
**4.**Alan S. Morris, 2003, Measurement and Instrumentation Principles, 1st Ed., Butterworth-Heinemann.
**5.**N. E. Battikha, 2007, The Condensed Handbook of Measurement and Control, 3rd Ed., ISA

**SEC**
**PLC and SCADA**
**(Credits: 02)**

**Total Lectures 60**

**Unit 1** **(12 Lectures)**

Single loop control, Centralized control, Distributed control systems, Open systems, SCADA systems, Types of data available, Data communication components and protocols.

**Unit 2** **(18 Lectures)**

Programmable Logic Controllers (PLC), input/output systems, CPU, memory Unit, Programmer Units, Peripheral devices, Controller programming tools, Programming of PLCs, PLC Hardware Environment.

**Unit 3** **(11 Lectures)**

Distributed Control Systems (DCS), PLC vs. DCS systems, Local control Units, dedicated card controllers, Unit Operations controllers, DCS multiplexers, DCS system integration.

**Unit 4** **(19 Lectures)**

Supervisory Control and Data acquisition (SCADA) Systems, Types of supervisory systems, Distributed Digital Control Systems (DCS), Direct digital control (DDC), SCADA: Components of SCADA Systems, field data interface devices, communication network and other details, System Architecture: monolithic, distributed, networked, SCADA protocols in short, application of SCADA in industry; installation of SCADA Systems; security and weakness of SCADA Systems.

**Suggested Books**

1. S. Gupta, JP Gupta, “PC interface For Data Acquiring & Process Control”, 2nd Ed., Instrument Society of America.
2. John W. Web, Ronald A. Reis, “Programmable Logic Controllers” 5th Edition, PHI
3. Liptak, B. G. (E.d.), “Instrument Engineers Handbook”, vol. I to III, Chilton Book Co.
4. Bhatkar, Marshal, “Distributed Computer control & Industrial Automation”, Dekker Publication
5. Frank D. Petruzella, “Programmable Logic Controllers”, 3rd Edition, McGraw Hill

**SEC**
**Virtual Instrumentation**
**(Credits: 02)**

**Total Lectures 60**

***Unit 1*** ***(10 Lectures)***

***Introduction to Virtual Instrumentation: The LabVIEW Programming Environment: Controls/ Indicators, Auto indexing, Debugging, Timing issues (counters), Importing pictures, Simple programming structures and Timing Issues, Basic operations, controls and indicators.***

***Unit 2*** ***(20 Lectures)***

***Programming Techniques: VIS and sub-VIS, Debugging a VI and Sub-VI's, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input, Graphical programming in data flow.***

***Unit 3*** ***(14 Lectures)***

***Data Acquisition Basics: ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. GPIB/IEEE 608 concepts, and embedded system buses - PCI, EISA, CPCI, and USB& VXI.***

***Unit 4*** ***(16 Lectures)***

***Use of Analysis Tools: Fourier transforms, Power spectrum, Correlation methods, Windowing & flittering. Developing applications on LabVIEW: Process control, Waveform generator, Motion control using stepper motor, Image acquisition, Temperature data acquisition system, Processing using programming structure.***

**Suggested Books**

1.John Essick , Hands on Introduction to LabVIEW for Scientists and Engineers, 1st Edition

2.S. Gupta, J.P. Gupta, PC Interfacing for Data Acquisition and Process Control, ISA, 2nd Edition

3.Gary Johnson, LABVIEW Graphical Programming, McGraw Hill, 2nd Edition.

4.Lisa K. Wells and Jeffrey Travis, LABVIEW for Everyone, PHI.

5.Skolkoff, Basic concepts of LABVIEW 4, PHI.

6.James K, PC interfacing and data acquisition.

7.Technical Manuals for DAS Modules of Advantech and National Instruments. L.T. Amy, Automation System for Control and Data Acquisition, ISA.

**SEC**

**Programming using MATLAB**

**(Credits: 02)**

**Total Lectures 60**

**Unit 1** **(15 Lectures)**

**Introduction to MATLAB:** Features, MATLAB Windows(Editor, Work Space, Command History, Command Window),Operations with Variables, Naming and Checking Existence, Clearing Operations, Introduction to Arrays, File Types

**Data and Data Flow in MATLAB:** Matrix Operations & Operators, Reshaping Matrices, Importing Exporting of Data, Arrays, Data types, File Input-Output, Communication with External Devices

**Unit 2** **(15 Lectures)**

**Editing and Debugging M Files:** Writing Script Files, Writing Functions, Error Correction, M-Lint Automatic Code Analyzer, Saving Files

**Programming:** Flow Control, Conditional Statements, Error Handling, Work with Multidimensional Array, Cell Array & Characters, Developing User Defined Function, Scripts and Other Functions

**Unit 3** **(12 Lectures)**

**MATLAB Graphics:** Simple Graphics, Graphic Types, Plotting Functions, Creating Plot & Editing Plot (2DGraphics Handles, GUI (Graphical User Interface)

**Unit 4** **(18 Lectures)**

**Digital Signal Processing:*Basic application of DSP, program for modulation and Demodulation, program for time scaling and amplitude Scaling, Generation and implementation of various functions on image.***

***Image Processing: Basic image processing tools, Basic programs for Histogram processing,image segmentation and image restoration.***

**Suggested Books**

1. Fausett, L. V., Applied Numerical Analysis Using MATLAB, Prentice Hall, Upper Saddle River, New Jersey.
2. Mathews, J.H. and K.D. Fink, Numerical Methods Using MATLAB - Third Edition, Prentice Hall, Upper Saddle River, New Jersey
3. Linfield, G. & Penny, J., Numerical methods using MATLAB, Ellis- Horwood.
4. Van Loan, C.F., Introduction to Scientific Computing - A Matrix-Vector Approach Using MATLAB, Prentice Hall, Upper Saddle River, New Jersey
5. Nakamura, S., Numerical Analysis and Graphic Visualization with MATLAB - Second Edition, Prentice Hall PTR, Upper Saddle River, New Jersey

**GE**

**Sensors and its *Applications***

**(Credits: Theory-04, Practicals-02)**

**Total Lectures 60**

**Unit 1** **(20 Lectures)**

Classification of transducers: Active, Passive, Mechanical, Electrical and their comparison. Selection of Transducers, Principle and working of following types: Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, Semi-conductor strain gauge) Capacitive, Inductive (LVDT-Principle and characteristics, Piezoelectric, light (photo-conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature (electrical and non-electrical), load cell

**Unit 2** **(14 Lectures)**

Flow meters, mechanical type -Theory of variable head type flow meters – orifice plate, venture tube, flow nozzle, Positive displacement flow meters

**Unit 3** **(12 Lectures)**

Rota meter: thermal mass flow meter, Principle and constructional details of electromagnetic flow meter, different types of ultrasonic flow meters

**Unit 4** **(14 Lectures)**

Tachometers - Mechanical, Electric, Contact less, Frequency, Stroboscopic tachometers. Elementary accelerometers, Manometers – different types – elastic type pressure gauges – Bourdon type bellows – diaphragms –measurement of vacuum

**Suggested Books:**

1. A.K Sawhney, A course in mechanical measurements and instrumentation, Dhanpat Rai & Co, 12th edition
2. R.K. Jain, Mechanical and Industrial Measurements, Tata McGraw Hill, New Delhi, 1996, 11th edition.
3. A.K. Sawhney , Electrical & Electronic Measurements & Instrumentation, 19th revised edition
4. Nakra & Choudhary ,Instrumentation measurements and analysis , Tata McGraw Hill, 2nd edition

**Sensors and its Applications Lab**

**60 lectures**

1. Measurement of pressure, strain and torque using strain gauge.
2. Measurement of displacement using LVDT.
3. Measurement using load cells.
4. Measurement using capacitive transducer.
5. Measurement using inductive transducer.

6. Measurement of Temperature using Temperature Sensors/RTD.
7. Characteristics of Hall effect sensor.
8. Measuring change in resistance using LDR
9. Discharge coefficient of orifice plate.
10. Calibration of RTD.
11. E.M. flow meter.
12. Ultrasonic flow meter.

**GE**

**Instrumentation & Control**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(15 Lectures)**

Basic concepts of instrumentation block diagram representation. Open loop and closed loop control systems, mathematical modeling of physical systems, transfer function, Armature controlled and field controlled DC servomotors, AC servomotors, block diagram representation & signal flow graph, Reduction Technique, Mason's Gain Formula.Effect of feedback on control systems.

**Unit 2** **(15 Lectures)**

**Time – Domain Analysis**:-Time domain performance criteria, transient response of first, second & higher order systems, steady state errors and static error constants, performance indices, response with P, PI and PID Controllers. **Concept of Stability:** Asymptotic stability and conditional stability, Routh – Hurwitz criterion, relative stability analysis, Root Locus plots and their applications.

**Unit 3** **(15 Lectures)**

**Frequency Domain Analysis:** Correlation between time and frequency response, Polar and inverse polar plots, frequency domain specifications, Logarithmic plots (Bode Plots), gain and phase margins, Nyquist stability criterion, relative stability using Nyquist criterion, constant M & N circles, Design of Compensators

**Unit 4** **(15 Lectures)**

**Controller Hardware:** Electronic pneumatic and hydraulic controller's implementation, single and composite modes of controllers. **Final Control Elements:** Control valves, types, actuators, Solenoid, I/P P/I converters, stepper motors.

**Suggested Books:**

1. K. Ogata, Modern Control Engineering, PHI 2002, 4th Edition
2. B. C. Kuo, "Automatic control system", Prentice Hall of India, 2000, 7th Edition
3. I. J. Nagrath& M. Gopal, Control System Engineering, New Age International, 2000, 2nd Edition
4. Nakra & Choudhary, Instrumentation Measurements and Analysis, Tata McGraw-Hill, 2nd Edition
5. Johnson .C.D., Process Control Instrument Technology, Prentice Hall Inc, 7th Edition

**Instrumentation and Control Lab**
**60 Lectures**

Some of the experiments mentioned above can be simulated on software (MATLAB/MathCAD/LabVIEW)

1. To study position control of DC motor
2. To study speed control of DC motor
3. To find characteristics of AC servo motor
4. To study time response of first and second order systems
5. To study frequency response of first and second order systems
6. To study effect of damping factor on performance of second order system
7. To study frequency response of Lead and Lag networks.
8. To Study of P, PI and PID controller
9. To study characteristics of
   a. Synchro transmitter receiver
   b. Synchro as an error detector

**GE**

**Analytical Instrumentation**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(18 Lectures)**

Molecular Spectroscopy: Ultraviolet-Visible (UV-Vis) spectroscopy: principle, instrumentation and applications. Infra-Red spectroscopy: principle, instrumentation and applications

**Unit 2** **(13 Lectures)**

Atomic spectroscopy: Theory, instrumentation and application of flame photometry and atomic absorption spectroscopy

**Unit 3** **(17 Lectures)**

Planar chromatography: Theory and application of paper and thin layer chromatography, Column chromatography: Principle, instrumentation and application of Gas Liquid Chromatography and High Performance Liquid Chromatography

**Unit 4** **(12 Lectures)**

Potentiometry, Introduction, reference and indicator electrodes, ***glass electrodes and potentiometric titrations***.

**Suggested Books:**

1. Skoog, Holler and Crouch, Instrumental Analysis,, Cengage Learning, India edition, 2007
2. Skoog & Lerry, Instrumental Methods of Analysis, Saunders College Publications, New York, 4th edition,
3. H.H.Willard et al., Instumental Methods of Analysis, CBS Publishers, 7th edition
4. Jeffery G.H. et al., Vogel's Text of Quantitative Chemical Analysis, , Longman Scientific and Technical, New York, 5th edition.
5. ***R.S Khandpur, Handbook of Analytical Instruments, Tata McGraw-Hill.***
6. ***B.K Sharma, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media.***

**Analytical Instrumentation Lab**
**60 Lectures**

1. ***Determination of concentration of solutes in a mixture using colorimeter.***
2. ***Verification of Beer's Law and determination of concentration in the unknown solution using colorimeter.***
3. ***To study the effect of organic solvent on membrane permeability of beet root using spectroscopy.***
4. ***Determination of pKa value for bromophenol blue using double beam spectrophotometer.***
5. ***Spectrometric determination of iron using double beam spectrophotometer.***
6. ***Determination of concentration of sodium, calcium, lithium and potassium in sample using flame photometer.***

7. ***Paper chromatographic separation of samples from different origin (Biological/pharmaceutical/food).***
8. ***Thin layer chromatographic (TLC) separation of samples from different origin (Biological/pharmaceutical/food)***
9. ***Spectrum analysis using FT-IR. a. Qualitative analysis b. Quantitative analysis***
10. ***Qualitative and quantitative analysis of organic compounds using Gas chromatography.***
11. ***Qualitative and quantitative analysis of organic compounds using HPLC.***
12. ***To study the potentiometric titration of strong acid and strong base.***
13. ***To study the potentiometric titrations of weak acid and weak base.***

**GE**

**Nuclear & Biomedical Instrumentation**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(08 Lectures)**

Introduction to bioelectric potential, bio-amplifier, components of man Instrument system, design factors of biomedical instruments, types of biopotential electrodes.

**Unit 2** **(20 Lectures)**

Cardiac vascular system: Origin of (Electrocardiography) ECG signals, Instruments of ECG, bipolar system lead system I, II, III, Eithoven triangle, Augmented lead system, unipolar chest lead system, types of display.
Respiratory system: Types of volume, types of measurements, Instrumentations of respiratory system, pneumograph, principle & types of pneumograph, Spirometer, ventilators, heart lung machine,
Nervous system: Action potential of brain, brain wave, Instrumentation – Electro encephalography (EEG), analysis

**Unit 3** **(19 Lectures)**

Medical Imaging system: Ultra sound, properties, beam width, its generation & detection, types of transducers, diagnostic application – A Scan, B Scan, M Scan.
Radiography- conventional X ray, properties, generation of X-ray, X ray computed tomography (CT scanner) and computer-aided tomography (CAT).

**Unit 4** **(13 Lectures)**

Introduction to nuclear medicine system: Nuclear detectors: Gas filled detectors: Ionization, Proportional, and Geiger Muller (GM) Counter, Scintillation counter – principle, operating condition.

**Suggested Books:**

1. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Prentice Hall, 2nd edition
2. Carr J. J, Brown J. M. Introduction to Biomedical Equipment Technology, Fourth edition, Pearson Education, Inc, 4th edition
3. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing, India, 2nd edition.
4. Joseph D. Bronzino, The Biomedical Engineering Handbook, 2nd Edition, Volume 1, IEEE Press.

**Nuclear & Biomedical Instrumentation Lab**

**60 Lectures**

1. Characterization of bio potential amplifier for ECG signals.
2. Study on ECG simulator
3. Recording of EEG
4. Measurement of heart sound using electronic stethoscope.
5. Study of pulse rate monitor with alarm system
6. Determination of pulmonary function.
7. Study on ultrasound transducers based on medical system

**GE**
**Standardization and Quality Control**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit 1** **(14 Lectures)**

**Quality Concepts**: Meaning of Quality, Dimensions of Quality, Quality Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Assurance, Evaluation of Quality control, Quality Improvement Techniques- Quality Circles, Kaizen, Six Sigma.

**Unit 2** **(16 Lectures)**

**Quality Control** :Graphical and Tabular representation of data, Measures of Central Tendency, Measures of Dispersion, Random Variables, Probability Density Distributions, Chance and assignable causes of variation,Quality Control Tools-Histogram, Pareto Chart, Cause-Effect Diagram, Control Charts. Control Chart for variables (X-bar& R),Control limits, Warning Limits,Process Capability, Sample Size and Sampling Frequency, Sensitizing rules for Control Charts,Rational subgroups, Control Chart for Attributes (p, np, c).

**Unit 3** **(16 Lectures)**

**Acceptance Sampling**: Advantages and Disadvantages of Sampling, Types of Sampling, Lot Formation. Principle of acceptance sampling,OC curve, Producer's and consumer's risk, Acceptable Quality Level, Lot Tolerance Percentage Defective, Sampling plans –single, double, Average outgoing Quality, AOQL.

**Unit 4** **(14 Lectures)**

**ISO 9001-2000 &14000Series of Standards-** History and Evolution of ISO 9000 Series, importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit. Environmental management concepts, and requirement of ISO 14001, benefits of environmental management Systems

**Suggested Books:**

1. D. C. Montgomery , Introduction to Statistical Quality Control, John Wiley and sons, 4th edition.
2. S.Dalela - ISO 9000 Quality System
3. E.L.Grant& R.S. Kearenworth-Statistical Quality Control.
4. Kaoru Ishikawa-Guide to Quality Control, Asian Productivity Organization, Series

**Standardization an Quality Control Lab**
**60 Lectures**

**Use latest statistical software package like SPSS**

1. Descriptive statistics
2. Histogram and Pareto Chart
3. Control charts for variables
4. Control charts for attributes
5. OC curve
6. AOQ curve

**GE**
**Microprocessors**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** **(18 Lectures)**

Introduction to Microprocessors, RISC and CISC architecture, 8085 pin diagram and architecture, system bus architecture, internal registers, fetch-decode-execute cycle, Addressing modes and instruction set.

**Unit-2** **(10 Lectures)**

Subroutines, stacks and its implementation, delay subroutines, hardware and software interrupts, programming based on above concepts

**Unit- 3** **(18 Lectures)**

Peripheral Devices: 8255- Programmable Peripheral Interface, 8253- Programmable interval Timer, 8259- Priority Interrupt Controller

**Unit- 4** **(14 Lectures)**

Application of Microprocessor 8085 in Instrumentation: Interfacing of Stepper Motor, Introduction to 8086 Microprocessor: keyboard Basics of 8086 (16 bit Microprocessor), Architecture of 8086, Concept of parallel processing in 8086.

**Suggested Books:**

1. Ramesh Gaonkar, “Microprocessors architecture, programming and Applications”, Wiley Eastern Ltd. (2002)
2. K. Udaya Kumar & B.S. Umashankar, “The 8085 Microprocessor: Architechture, Programming and Interfacing”, Pearson Education
3. D. V. Hall, “Microprocessors and Interfacing”, Tata Mc Graw Hill (2005)
4. P.K Ghosh& P.R Sridhar, 0000 to 8085 microprocessor, John Wiley & Sons, 2nd Edition
5. Liu Gibson, Microprocessor Systems: The 8086/8088 family Architecture, Programming& Design, PHI, 1999, 2nd Edition.
6. R. Thegarajan and S. Dhanpal, Microprocessor and its Application, New Age International Private Ltd, 1st Edition

**Microprocessors Lab**
**60 Lectures**

1. To write an assembly language program to perform basic mathematical operations (addition, subtraction, multiplication, division).
2. To write an assembly language program to generate first N terms of an A.P. / G.P. series.
3. To write an assembly language program to generate first N terms of Fibonacci series.
4. To write an assembly language program to arrange the given list of number in ascending / descending order.
5. To write an assembly language program to calculate N!
6. To write an assembly language program to separate prime numbers in a given list of number
7. To write an assembly language program to convert a number from one number system to another.
8. To write an assembly language program to design a clock 36.
9. To write an assembly language program to calculate a mathematical expression (for e.g. 2N/N!).
10. To write an assembly language program to calculate value of sin(x).
11. To implement basic 8086 interrupts using assembler.

**GE**
**Microcontrollers and its Applications**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** **(18 Lectures)**

Introduction to RISC & CISC microcontroller, Harvard & Von-Neumann CPU architecture, 8051 family microcontrollers Introduction, 8051 architecture, Register banks and Special Function Registers, Memory organization, Addressing modes, Instructions set: Data transfer, Arithmetic, Logical, Boolean and Branch instructions.

**Unit-2** **(10 Lectures)**

Oscillator and Clock Circuit, Input / Output Ports, Timers, Serial Interface, Interrupts, External Interrupts, 8051 Programing.

**Unit- 3** **(14 Lectures)**

8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor, RS232 and RS485 driver interfacing.

**Unit- 4** **(18 Lectures)**

**Overview of advance microcontrollers:** AVR microcontroller, PIC microcontroller, Microcontroller features: Reset (Power ON, Watchdog, Brown-out, External), Power Saving and Sleep Modes, Timer modes (Input capture, output compare, PWM), SPI, USART, I2 C and CAN bus.

**Suggested Books:**

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (1999).
2. Daniel W. Lewis, “Fundamentals of Embedded Software – where C and Assembly Meet”, Pearson Education (2002).
3. John B. Peatman, Design with PIC Microcontrollers, Pearson Education (1998).
4. Kenneth J Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Penram Publications.
5. Zdravko Karakehayov, Knud Smed Christensen and Ole Winther, Introduction by: Embedded Systems Design with 8051 Microcontrollers, Marcel Dekker Inc, (1999).
6. Dave Calcutt, Fred Cowan and Hassan Parchizadeh, 8051 Microcontroller :An applications based, Elsevier.
7. Myke Predco, Programming & Customizing the 8051 Microcontroller, Mc Graw Hill, (2000).
8. Design with PIC Microcontrollers by John B. Peatman (Pearson Education).
9. Microcontroller: internals, instructions, Programming and interface by Subrata Ghoshal, ,Pearson Education (2010).

**Microcontrollers and its applications Lab**
**60 Lectures**

1. Write a program to multiply two 16 bit unsigned numbers.
2. Write a program to add N 8 bit unsigned integer numbers.
3. Write a program to arrange the unsigned integer numbers in ascending/descending order.
4. Interface a display to the micro controller and display number sequentially in a regular interval.
5. Write a program for LED blinking in a predetermined fashion using 8051 microcontroller.
6. Write a Program to OUT an 8 – bit value on 8051 microcontroller.
7. Write a program for a simple counter, where the count has to be displayed on a 7 – segment LED display.
8. Write a program for interfacing LCD display using 8051 microcontroller.
9. Write a program to convert an analog voltage to digital bits using 8051 microcontroller.
10. Write a program to convert a digital signal to analog signal using 8051 microcontroller.
11. Write a program for temperature sensor interfacing through serial port on 8051 microcontroller.
12. Write a program for P W M control of DC motor using 8051 microcontroller.
13. Write a program to drive a stepper motor using 8051 microcontroller.

**GE**

**MATLAB and its Applications**

**(Credits: Theory-04, Practicals-02)**

**Total Lectures 60**

**Unit 1** **(10 Lectures)**

**Introduction to MATLAB:** MATLAB features, MATLAB Windows, defining variables, formatting output, types of operators, different operations on variables, Checking Existence, Clearing Operations, data type, precedence.

**Unit 2** **(20 Lectures)**

**Introduction to Arrays:** Defining Scalars, Vectors, Matrix, Multidimensional arrays, different operations on array, Reshaping Matrices, Importing Exporting of Data.

**Character and Strings:** Defining character and string, Accessing string character or substring, string concatenation and comparing, conversion between strings and number. Defining and working with Cell Array.

**Graphics and Visualization:** Types of plot, graph plot, multiple plots, labeling graph, line colors, style and marker.

**Unit 3** **(15 Lectures)**

**Script and Function M File:** M-file, Writing Script Files, Writing Functions, Error Correction, Saving Files. Flow Control statement: Conditional or selection, Error Handling, Loop control, program termination. Solution of Simultaneous Linear Equations.

**Unit 4** **(15 Lectures)**

**Signal Processing:** Generation of continuous time signal, discrete time signal, signals, time shift, time scale, amplitude scaling of signal. Generation of amplitude modulated signal, frequency modulated signal.

**Image processing:** Study of basic tools of Image Processing, Image segmentation, restoration, histogram processing, changing color of image.

**Suggested Books:**

1. Khanna, M., Bhatt, G. and Kumar, P., MATLAB Essentials for Problem Solving, PHI Learning, New Delhi.
2. Fausett, L. V., Applied Numerical Analysis Using MATLAB, Prentice Hall, Upper Saddle River, New Jersey.
3. Mathews, J.H. and K.D. Fink, Numerical Methods Using MATLAB - Third Edition, Prentice Hall, Upper Saddle River, New Jersey
3. Linfield, G. & Penny, J., Numerical methods using MATLAB, Ellis- Horwood.
5. Nakamura, S., Numerical Analysis and Graphic Visualization with MATLAB - Second Edition, Prentice Hall PTR, Upper Saddle River, New Jersey

**Programming through MATLAB Lab (any 10)**
**60 Lectures**

1. Write a program to delete/insert row/column in a given matrix.
2. Write a program to generate the AP and GP series.
3. Write a program to generate the Fibonacci series.
4. Write a program to check weather given number is odd or even or prime.
5. Write a program to generate the factorial of number.
6. Write a program to plot the square wave, triangular wave and sawtooth wave.
7. Write a program to plot the continuous time signal and discrete time signal and perform various operations.
8. Write a program to compare the string and display 1 for character match and 0 for mismatch.
9. Write a program to count the total no. of vowels in a given string.
10. Write a program to count the total no. of a given character in a given string.
11. Write a program to plot the discrete time signal and perform
12. Write a program to change the color of original image.
13. Write a program to stich up the multiple images.

**GE**
**Introduction to Programming**
**(Credits: Theory- 04, Practicals-02)**

**Total Lectures 60**

**Unit 1** **(10 Lectures)**

Structure of C program, steps in program development, identifiers, basic data types and their sizes, Constants, variables, Operators, expressions, managing Input and Output operations.

**Unit 2** **(15 Lectures)**

**Decision Making and Branching**: if and switch statements, , break, continue, goto and labels.
**Loops**- while, do-while and for statements
**Functions**: Parameter passing, storage classes- extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, header files

**Unit 3** **(20 Lectures)**

**Arrays**: concept, definition, declaration, accessing elements, storing elements, arrays and functions, applications of arrays.
**Structures**: declaration, initialization, accessing structures, nested structures, arrays of structures, structures and functions, self-referential structures, unions, typedef
**Pointers**: concept, initialization of pointer variables, pointers and function arguments, address arithmetic, pointers to pointers, pointers and arrays, array of pointers.

**Unit 4** **(15 Lectures)**

**File management in C**– concept of a file, Input and output operations on files, error handling during I/O operations, Dynamic memory managements functions.
**Searching and sorting**: Searching - Linear and binary search methods, sorting - Bubble sort, selection sort, Insertion sort

**Suggested Books**

1. Behrouz A. Forouzan and Richard F. Gilberg, Computer science - A structured programming approach using C, Third edition, Cengage Learning.
2. Byron S. Gottfried, Programming with C, 2nd Edition, McGraw-Hill Publishing
3. E Balagurusamy, Programming in ANSI C, 4th Edition, Tata McGraw-Hill Publishing
4. P. Padmanabham, C & Data structures, B.S. Publications.
5. B.W. Kernighan, Dennis M.Ritchie, The C Programming Language, Pearson Education
6. J.A. Jones & K. Harrow, C Programming with problem solving, Dreamtech Press
7. Stephen G. Kochan, Programming in C, III Edition, Pearson Education.

**Introduction to Programming Lab**
**60 Lectures**

Implement programs in C exemplifying:
1. Arithmetic operations
2. If-else construct
3. Switch construct
4. While, do while and for loop
5. Arithmetic operations for n x m matrices
6. Passing by reference and passing by value in functions
7. Inline parameter passing
8. Pointers and pointer arithmetic
9. String operations using pointers and arrays explicitly.
10. Structures

**GE**

**General Instrumentation**

**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** **(18 Lectures)**

**DC and AC indicating instruments:** Accuracy and precision - Types of errors, DC Bridges and applications: Wheatstone, Kelvin, AC Bridges: AC bridge balance condition, Maxwell, Hay, Schering, Wien bridge. DC measurement: DC voltmeter, ammeter, ohmmeter, AC measurement: voltmeter, ammeter. Digital type voltmeters, Digital frequency meter: Elements of frequency meter, universal counter and its different modes.

**Unit- 2** **(14 Lectures)**

**Signal Generators-**Audio oscillator, Function generators, Pulse generators, RF generator, Random noise generator, Sweep generator **Electronic Displays:** Cathode Ray Oscilloscope (CRO) and applications: Block diagram of a General Purpose Oscilloscope and its basic operation, electrostatic focusing and deflection, Types of CRO's: dual trace oscilloscope, digital storage oscilloscope.

**Unit- 3** **(10 Lectures)**

**Spectrum Analyser and Wavemeter:** Spectrum analyzer, Harmonic distortion analyzer, Intermodulation distortion analyzer, **Electrical measurements**: Clamper meter, megger meter, Q-meter and its applications.

**Unit- 4** **(18 Lectures)**

**Cardiovascular system and measurements:** ECG: origin, Instrumentation, bipolar system lead system I, II, III, Einthovan's triangle, Augmented lead system, unipolar chest lead system, types of display. Blood pressure measurements: direct, indirect. Defibrillators: AC, DC. Pacemakers- Internal, External **Nervous system and measurements:** Action potential of brain, brain wave, Instrumentation of Electroencephalography (EEG) **Medical Imaging System**: Ultrasound, properties, its generation & detection, types of transducers, diagnostic application.

**Suggested books:**

1. H. S. Kalsi, Electronic Instrumentation, Tata McGraw Hill (2006)
2. Joseph J Carr, Elements of electronic instrumentation and measurement, Pearson Education (2005)
3. C. S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata McGraw Hill (1998)
4. H. Cooper, Modern electronic instrumentation and measurement techniques, Pearson Education (2005)
5. R. A. Witte, Electronic test instruments: Analog and digital measurements, Tata McGraw Hill (2004)
6. S. Wolf and R. F. M. Smith, Student Reference Manual for Electronic Instrumentation Laboratories, Pearson Education (2004)
7. Khandpur R.S., Handbook of Biomedical Instrumentation, Second edition, Tata McGraw-Hill Publishing (2009), 2nd edition
8. Cromwell L., Wiebell F. J., Pfeiffer EA, Biomedical Instrumentation and Measurements, Second edition, Prentice Hall (2010), 2nd Edition

**General Instrumentation Lab**
**60 Lectures**

1. Study and operation of Multimeters (Analog and Digital), Function Generator, Regulated Power Supplies, CRO, DSO.
2. Study the generation of Lissajous figures to find unknown frequency and phase shift.
3. Frequency measurement using Wein Bridge.
4. Study of R, L, C and Q meter.
5. Measurements of L, C, R using bridges.
6. Study on ultrasound transducers based on medical system
7. ECG Measurements
8. Blood pressure measurements

**GE**
**Applied Mathematics**
**(Credits: Theory-04, Practicals-02)**

**Theory Lectures 60**

**Unit- 1** **(14 Lectures)**

**Linear Algebra**: Algebra of matrices, Linear system of equations, Linear Independence, Rank of a Matrix. Vector Space, Solutions of Linear Systems: Existence, Uniqueness, Eigenvalues, Eigenvectors, Symmetric, Skew-Symmetric, and Orthogonal Matrices, Applications of Eigenvalue Problems.

**Unit- 2** **(16 Lectures)**

**Differential Equations:** Ordinary differential Equations, Linear Independence and Dependence, Second Order Differential Equations with Constant Coefficients: Homogeneous, Non Homogeneous Equations, Differential Equation with Variable Coefficients: Reducible to Equations with Constant Coefficients. Formation of Partial Differential Equation, Partial Differential Equation of First Order, Classification of Partial Differential Equations of Second Order.

**Unit- 3** **(14 Lectures)**

**Laplace Transform:** Laplace Transform, Linearity, s-shifting, Unit Step function, Dirac's Delta Function, t-shifting, Inverse Laplace transforms and their properties, Solutions to ordinary differential equations. Initial and Final value theorem.

**Unit- 4** **(16 Lectures)**

**Fourier series and Transforms**: Periodic Function, Even and Odd Functions, Fourier Series, Fourier Series for Even and Odd Functions, Half range expansions: Fourier Sine and Cosine Series, Fourier Integral Theorem, Fourier Transform , Fourier Sine and Cosine Transforms.

**Suggested Books:**

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India (2008), 8th Edition
2. B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Limited (2007), 6th reprint
3. Michel D Greenberg; Advanced Engineering Mathematics, Pearson International
4. R. K. Jain, and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House (2007), 3rd edition
5. C .R. Wylie and L. C. Barrett, Advanced Engineering Mathematics, Tata McGraw-Hill (2004)
6. A.S.Willsky, Oppenheim, Signals and System, Prentice Hall, 2nd edition
7. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers

**Engineering Mathematics lab** (**using Scilab /MATLAB/ any other Mathematical Simulation software**) **60 Lectures**

1. Matrices: Addition, Scalar Multiplication, Matrix multiplication.
2. Solve the linear differential equation of second order with constant coefficients.
3. Plot the basic trigonometric functions, unit step and impulse function with shifting.
4. Compute the Fourier series Coefficients of the given Periodic Function.
5. Find the Laplace Transform of the given signal.
6. Find the Fourier transform of the given signal.