Category I

BSc. (Hons.) Electronics

DISCIPLINE SPECIFIC CORE COURSE-4 (DSC-4) – : Basic Instrumentation and Measurement Techniques

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Instrumentation and Measurement Techniques	4	3	0	1	Class 12th Pass with PCM or Physics, Comp. Sc. & Maths.	Nil

Learning Objectives

The Learning Objectives of this course are as follows:
The objective of this subject is to provide insight into electronic instruments being used in the industries and labs. It details the basic working and use of different instruments used for measuring various physical quantities. Also, it details the identification, classification, construction, working principle and applications of various transducers used for displacement, temperature, pressure and intensity measurement.

Learning outcomes

After completion of the course, students will be able to-

Describe the working principle of different measuring instruments.

Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.

Understand the significance of different measuring instruments including oscilloscopes.

SYLLABUS OF DSC-4

UNIT – I Fundamentals of Electronic Measurements (12 Hours)

Qualities of Measurement: SI system of units. Specifications of instruments, their static and dynamic characteristics. Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis.

Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement (rectifier type, electro dynamo meter), Watt meter. Digital voltmeter systems (integrating and non-integrating types), digital multimeter,

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

UNIT – II Impedance Measurement and Power Supplies (12 Hours)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's bridge method, Medium Resistance by Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Anderson's bridge, Measurement of Capacitance, De Sauty's bridge, Measurement of frequency, Wien's bridge.

Regulated Power Supplies: Power Supply characteristics, Fixed power supply (78XX based), Dual power supplies (78XX and 79XX based), Variable power supply (LM317 based), current limiting, short-circuit shut down. Introduction of switch mode power supply (SMPS)

UNIT – III Oscilloscopes and Signal Generators (12 Hours)

Electronic Displays: The Cathode Ray Oscilloscope (CRO): Block diagram of a General Purpose Oscilloscope and its basic operation. Measurement of voltage, frequency and phase by oscilloscope. Oscilloscope probes. Sampling Oscilloscope. Digital storage oscilloscope (DSO), advantages and applications, Oscilloscope specifications (bandwidth, sensitivity, rise time).

Signal Generators: Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators.

UNIT – IV Transducers and Sensors (09 Hours)

Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area, air gap and permittivity Type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Practical component (if any) – Basic Instrumentation and Measurement Techniques Lab – 30 Hours

1. Design of ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge.
3. Measurement of Capacitance by De Sauty's bridge.
4. Measurement of Inductance by Anderson's bridge.
5. To determine the characteristics of resistance transducer - Strain Gauge.
6. To determine the characteristics of an LVDT.
7. To study the variations of thermo-emf of a thermocouple. (Type J/Type K)
8. To study the I-V characteristics of Solar Cell.
9. To study the Characteristics of LDR, Photodiode
   (i) Variable Illumination (ii) Linear Displacement.
10. Characteristics of one Solid State sensor/ Fiber optic sensor.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than eight.

Essential/recommended readings

1. H. S. Kalsi, Electronic Instrumentation, 3rd Edition, Tata Mcgraw Hill, (2006).
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
3. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, 3rd Edition, Pearson Education (2005).
4. David A. Bell, Electronic Instrumentation and Measurements, 3rd Edition, Oxford University Press (2013).
5. R. A. Witte, Electronic Test Instruments, Analog and Digital Measurements, 2nd Edition, Pearson Education (2004).
6. A. K. Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpatrai and Sons (2007).

   K. Lal Kishore, Electronic Measurements and Instrumentation, 1st edition, Pearson Education India (2009).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5 (DSC-5): Digital Electronics

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Digital Electronics	4	3	0	1	Class 12th Pass with PCM or Physics, Comp. Sc. & Maths.	Nil

Learning Objectives

The Learning Objectives of this course are as follows:

- To represent information in various number systems.
- To convert data from one number system to another and do various arithmetic operations.
- To analyze logic systems and to implement optimized combinational circuits using Karnaugh Map.
- To analyze and implement sequential circuits using state machines.
- To analyze various memories and programmable logic devices.
- To analyze and understand the working of data converters.

Learning outcomes

After completion of the course, students will be able to-
Understand the concept of the number system with emphasis on binary numbers, its algebra and minimization techniques.
Understand basic logic gates, concepts of Boolean algebra and techniques to reduce/simplify Boolean expressions.
Analyze and design combinational as well as sequential circuits.
Understand the concepts related to Memories and PLD's.
Understand the working of analog to digital converters, digital to analog converters.

SYLLABUS OF DSC- 5

UNIT – I Introduction to Digital Electronics (09 Hours)

Number System and Codes: Decimal, Binary, Hexadecimal and Octal number systems, base conversions, Binary, Octal and Hexadecimal arithmetic, Addition, subtraction by Complements (1's and 2's) method, Binary Multiplication by computer method, Signed numbers, Binary Codes (BCD, 84-2-1, excess-3, Gray) BCD addition, Error detecting/correcting code (Parity, Hamming).

Logic Gates and Boolean Algebra: Truth table and symbolic representation of logic gates and their implementation using Universal gates, Basic postulates and fundamental theorems of Boolean algebra.

UNIT – II Combinational Circuit Design (12 Hours)

Canonical and Standard forms, Standard representation of logic functions (SOP and POS), Simplification of Boolean functions (up to 5 variables) using (i) Kmap (ii) Tabulation method, Binary Adder, Binary subtractor, parallel adder/subtractor, BCD adder, Code convertors.

Encoder, Decoder, Multiplexer, Demultiplexer, Implementing logic functions with Decoder and multiplexer.

UNIT – III Sequential Circuits (12 Hours)

Sequential logic design: Latches and Flip flops, S-R, D, J-K, master slave, T Flip flops and their characteristic equation, Clocked and edge triggered Flip flops, conversion between flip flops, Shift Registers, Universal Shift register, Bidirectional Shift Register, Ring counter and Johnson counter, Counters (synchronous, asynchronous and modulo-N) and their timing sequence.

Synchronous Sequential circuit synthesis: State Tables, State Transition Diagrams, minimization, state assignments, realization with T, D and JK flip flops, Finite state machine- Mealy and Moore model

UNIT – IV Signal Conversion, Memories and Logic Families (12 Hours)

A-D and D-A Conversion: 4 bit binary weighted resistor type D-A conversion, circuit and working. Circuit of R-2R ladder. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Memories: ROM, PROM, EPROM, EEPROM, Bipolar RAM, static and dynamic RAM, Memory Expansion (Word size and Word Capacity).

Programmable Logic Devices: Combinational circuit Implementation using PROM, PLA and PAL.

Digital Logic families: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product, TTL and CMOS families and their comparison

Practical component (if any) - Digital Electronics Lab *(Hardware and Circuit Simulation Software)* – 30 Hours

1. To verify and design AND, OR, NOT, XOR and XNOR gates using NAND gates.
2. To convert a Boolean expression into a 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. Implement a Boolean function using 4 X 1 multiplexer.
7. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type, JK, JK Master slave).
8. Design a SISO, SIPO shift register.
9. Design an asynchronous/ synchronous Up/Down counter using D/T/JK Flip-Flop.
10. Design a non sequential counter using D/T/JK Flip flop.
11. Design a R-2R DAC.
12. Design an ADC circuit using ADC0804.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than ten.

Essential/recommended readings

1. M. Morris Mano, "Digital System Design," Pearson Education Asia.
2. Thomas L., "Flyod, Digital Fundamentals," Pearson Education Asia.
3. W. H. Gothmann, "Digital Electronics: An Introduction To Theory And Practice," Prentice Hall of India.
4. Millman & Grabel, "Microelectronics," Tata McGraw Hill.
5. Donald D. Givone, " Digital Principles and Design," Tata McGraw- Hill.
6. R. P. Jain, "Modern digital Electronics," Tata McGraw- Hill.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE– 6 (DSC-6): Analog Electronics-I

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Analog Electronics-I	**4**	**3**	**0**	**1**	**Class 12th Pass with PCM or Physics, Comp. Sc. & Maths.**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- Understand diodes (pn diode and Zener diode) and its applications in clipping and clamping circuits, rectifiers and voltage regulation (using Zener diodes) and concept of Power Supply.
- Understand frequency response of BJT and MOSFET amplifiers.
- Understand the concept of feedback and design feedback amplifiers and oscillators.
- Understand different power amplifiers and single tuned amplifiers.

Learning outcomes

After completion of the course, students will be able to-

Illustrate about rectifiers, transistor and MOSFET amplifiers and its biasing. Also compare the performances of its low frequency models.

Describe the frequency response of MOSFET and BJT amplifiers.

Explain the concepts of feedback and construct feedback amplifiers and oscillators.

Summarizes the performance parameters of amplifiers with and without feedback

SYLLABUS OF DSC-6

UNIT – I Diode applications (09 Hours)

Diode Circuits: Ideal diode, piecewise linear equivalent circuit, dc load line, static and dynamic resistance, Quiescent (Q) point. Clipping and clamping circuits. Rectifiers: HWR, FWR (center tapped and bridge). Circuit diagrams, working and waveforms, ripple factor & efficiency, Voltage doubler

Filters: Circuit diagram and explanation of shunt capacitor filter with waveforms.

Voltage Regulator: Zener diode regulator circuit diagram and explanation for load and line regulation

UNIT – II BJT based Amplifiers and Oscillator (12 Hours)

Transistor: Input and Output Characteristics, Concept of Biasing and its significance, Concept of DC and AC analysis. Overview of Common Emitter BJT amplifier, Concept of Darlington pair

Power Amplifiers: Difference between voltage and power amplifier, classification of power amplifiers (Class A, Class B, Class AB, Class C, Class D), Concept of Class A single ended power amplifier, Transformer coupled Class A power amplifier and complementary symmetry Class B push pull power amplifier, overall efficiency, concept of crossover distortion, harmonic distortion and heat sinks.

Feedback Amplifiers: Concept of feedback, negative and positive feedback, voltage (series and shunt), feedback amplifiers gain, input and output impedances. Barkhausen criterion for oscillations, RC phase shift oscillator

UNIT – III MOSFET Fundamentals (12 Hours)

MOSFET: Operation of n-channel and p-channel MOSFETs, Overview of Depletion and Enhancement MOSFET, Transfer Characteristics, Drain Characteristics, MOSFET as a switch. short channel effects, non-ideal effects in MOS transistors: the finite output resistance in the saturation region, the body effect, subthreshold conduction, breakdown effects, and temperature effects.

MOSFET DC analysis: Biasing circuits- drain feedback, voltage divider, source feedback, bias stability, Graphical analysis, load line.

UNIT – IV MOSFET based Amplifiers (12 Hours)

MOSFET AC analysis: AC equivalent circuit of MOSFET, MOSFET parameters,

MOSFET Amplifiers: circuit and small signal model of Common Source amplifier, small signal parameters: input resistance, output resistance and voltage gain, circuits of Common Drain and Common Gate configurations. Comparison of BJT based (CE, CB and CC) and MOSFET based (CS, CD, CG) - Qualitative only.

Multistage MOSFET circuits: Cascaded circuits and Cascode circuits, effect of multistage circuits on gain and bandwidth.

MOSFET Application circuits: CMOS as inverter circuit, depletion mode n-MOSFET and p-MOSFET as load device

Practical component (if any) - Analog Electronics-I Lab – 30 Hours

(Hardware and Circuit Simulation Software)

1. Study of the half wave or full wave rectifier
2. Study of Zener diode as voltage regulator.
3. Study of any two types of
   (a) clipping circuits
   (b) clamping circuits.
4. Study of a Single Stage CE amplifier.
5. Study of Class A or Class B Power Amplifiers.
6. Study of Voltage divider bias for MOSFET
7. Study of the frequency response of Common Source MOSFET amplifier.
8. Study of MOSFET based Phase Shift Oscillator

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than seven.

Essential/recommended readings

1. Electronic Devices and circuit theory, Robert Boylestad and Louis Nashelsky, 9th Edition, 2013, PHI
2. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
3. Electronic devices, David A Bell, Reston Publishing Company
4. Giovanni Saggio, Principles of Analog Electronics, CRC Press (2014)
5. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
6. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
7. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.