ST JOSEPH'S UNIVERSITY

BENGALURU-27

DEPARTMENT OF ELECTRONICS

Curriculum for B.Sc.

as per

SJU- 2021

SYLLABUS FOR UNDERGRADUATE PROGRAMME

2021-2022 Onwards

Curriculum Structure

Semester	Title
	Major: Discipline Core
I Semester	**DSC 1: Basic Electronics**
II Semester	**DSC 2: Amplifiers, Oscillators and Op-Amps**
III Semester	**DSC 3: Digital Electronics and Verilog HDL**
IV Semester	**DSC 4: Data Acquisition and Instrumentation**
V Semester	**DSC 5: Power Electronics and Nanoscience**
V Semester	**DSC 6: Microprocessors**
VI Semester	**DSC 7: Electronic Communication**
VI Semester	**DSC 8: Intel 8051 Microcontroller and Embedded Systems**

Semester	Title
	Open Elective
I	**OE1.1 introductory Digital Concepts**
II	**OE2.1: Advanced Digital Electronics**
III	**OE3.1: Computer Fundamentals**
IV	**OE4.1: Renewable Energy and Management**

Semester- I

ELE-DSC 1: BASIC ELECTRONICS

Unit 1 **15 Hours**

Electronic Components: Electronic passive and active components, types and their properties, Concept of Voltage and Current Sources, electric energy and power. (Qualitative only). Ohms law and Kirchhoff's law, Voltage Divider Rule and Current Divider Rule, Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity Theorems. DC and AC analysis of RC and RL circuits, RLC series and parallel Resonant Circuits (no derivation).

PN junction diode: Ideal and practical diodes, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, Zener diode, Reverse saturation current, Zener and avalanche breakdown. Rectifiers-Half wave and Full wave (center tapped and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable).

Unit 2 **15 Hours**

Voltage regulator: Block diagram of regulated power supply, Line and Load regulation, Zener diode as voltage regulator – circuit diagram, load and line regulation, disadvantages. Clippers (shunt type) and clampers (Qualitative analysis only), Voltage Multipliers.

Bipolar Junction Transistor: Construction, types, CE, CB and CC configurations (mention only), V-I characteristics of a transistor in CE mode, Regions of operation (active, cut off and saturation), leakage currents (mention only), Current gains α, β and their inter-relations, dc load line and Q point. Applications of transistor as amplifier and switch - circuit and working. (Numerical examples wherever applicable).

Unit 3 **10 Hours**

Transistor biasing: Thermal runaway, stability and stability factor, Stabilization circuits- Fixed Bias and Voltage Divider Bias. Amplifier: Small signal analysis of single stage CE amplifier using re' model. Input and Output impedances, Current and Voltage gains. CC amplifier as a buffer amplifier. (Numerical problems wherever applicable).

Unit 4 **12 Hours**

Number System: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, Binary arithmetic; addition, 1's complement, subtraction by 2's complement method, BCD code, Excess-3, Gray code, error checking and correction codes (Only parity check).

Boolean Algebra: Constants, variables, operators, basic logic gates-AND, OR, NOT, Positive and negative logic, Boolean laws, Duality Theorem, De Morgan's Theorem, simplification of Boolean expressions. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. (Numerical examples wherever applicable).

Self-study **08 Hours**

Special semiconductor diodes: Varactor diode, Schottky diode, Tunnel diode, - construction, characteristics, working, symbol, and applications for each. LED, LCD and solar cell – construction, operation and applications, 7-segment display, concept of common anode and common cathode types, optocouplers.

Course Outcomes

At the end of this course, students will be able to

- Study and analyze basic networks using network theorems in a systematic manner.
- Build simple electronic circuits used in various applications.
- Describe the behaviour of basic semiconductor devices
- Reproduce the I-V characteristics of diode/BJT devices
- Describe the frequency response of BJT amplifiers.
- Explain the behaviour, characteristics and applications of Varactor diode, Schottky diode, Tunnel diode, LED, LCD and solar cells.
- Apply standard device models to explain/calculate critical internal parameters of semiconductor devices.
- Understand and represent numbers in powers of base and converting one from the other, carry out simple arithmetic operations.
- Understand the basic knowledge of Digital system building blocks, effectively can construct simple digital designs with the knowledge of Boolean algebra.

Reference Books:

1. Robert L Boylestad, "Introductory circuit analysis", 5th edition., Universal Book 2003.
2. R.S.Sedha, "A Text book of Applied Electronics", 7th edition., S. Chand and Company Ltd. 2011
3. A.P. Malvino, "Principles of Electronics", 7th edition. TMH, 2011.
4. Electronic devices and circuit theory by Boylestad, Robert Nashelsky
5. David A. Bell "Electronic Devices and Circuits", 5th Edition, Oxford Uni. Press, 2015
6. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)
7. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
8. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
9. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
10. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
11. M. Nahvi& J. Edminister, "Electrical Circuits", Schaum's Outline SeriesTMGH2005
12. S. A. Nasar," Electrical Circuits", Schaum's outline series, Tata McGraw Hill, 2004
13. J. Millman and C. C. Halkias, "Integrated Electronics", Tata McGraw Hill, 2001
14. A.S. Sedra, K.C. Smith, A.N. Chandorkar "Microelectronic circuits", 6th Edn., Oxford University Press, 2014
15. J. J. Cathey, "2000 Solved Problems in Electronics", Schaum's outline Series, TMG1991

Practical I

EL 1P1: Practical **(11 sessions 4 hours/week)**

List of experiments

Study of resistance color code, soldering practice, test and measuring instruments and Ohm's Laws (1 practical class)

1. Charging and discharging of capacitor
2. Superposition Theorem
3. Thevenin's Theorem
4. Maximum Power Transfer Theorem
5. Semiconductor diode and Zener diode characteristics
6. Center tap full wave rectifier with and without capacitor filter
7. Voltage tripler using diodes
8. Zener regulator- Line and Load regulation
9. Fixed bias circuit with emitter resistor
10. Voltage divider bias circuit
11. CE amplifier- Frequency response
12. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using respective ICs. Realization of XOR and XNOR using basic gates.
13. Universal property of NAND and NOR gates.
14. Binary to Gray and Gray to Binary code conversion and parity checker using XOR gates IC 7486.

ELE-OE1.1 INTRODUCTORY DIGITAL CONCEPTS

Unit I: Introduction **05 Hours**

Digital and Analog Quantities, Digital waveforms, Binary Digits, Logic Levels and Digital Waveforms. Basic Logic Functions. Combinational and Sequential Logic Functions. Introduction to Programmable Logic. Fixed-Function Logic Devices. Positive and negative logic. Pulse characteristics.

Unit II: Number Systems, Operations and Codes **20 Hours**

Decimal Numbers, Binary Numbers, Radix Representation of Numbers, Decimal to Binary Interconversion, Binary Arithmetic, Complements of Binary Numbers, Signed Numbers, Arithmetic Operations with signed Numbers, Octal Numbers, Hexadecimal Numbers. Codes: 8421, BCD, Excess-3, Gray, Alphanumeric, Bar code, QR code

Unit III: Logic Gates **20Hours**

The Inverter, The AND gate, The OR gate, The NAND gate, The NOR gate, The Exclusive-OR and Ex-NOR gate, Programmable Logic and Fixed-Function Logic gates. Logic families- mention only.

Boolean Algebra and Logic Simplification: Boolean Operations and Expressions, Laws and Rules of Boolean Algebra. De Morgan's Theorems. Boolean Analysis of Logic Circuits. Logic Simplification using Boolean Expressions.

Books Recommended:

1. Digital fundamentals: T.L.Floyd , Universal Book Stall,8th edition,2005.
2. Modern digital electronics R.P Jain –TMH publication, 3rd edition, 2003.

Reference books:

1. Fundamentals of digital circuits: A Anand Kumar, PHI, 3rd edition 2004
2. Experiments in Digital Electronics: Malvino and Leach – TMH, 2000
3. Digital Lab Primer- K A Krishnamurthy, Pearson education 2003

Prerequisites: *The course is open for students of all the streams. No special prerequisite is required for this course other than interest in learning Binary and other number systems, Boolean algebra and Logic Gates which form the basis of any electronic circuit and is fun to learn. The course develops a hobby in Electronics.*

Semester- II

ELE-DSC 2: Amplifiers, Oscillators and Op-Amps

UNIT 1: Amplifiers **16 Hours**

Multistage Amplifiers: Need & use of multistage amplifiers, overall gain, cascade Vs cascode. RC coupled amplifier. Darlington amplifier – circuit, current gain, Zi, Zo, advantages.
Power amplifiers: Voltage Vs Power amplifiers, need for power amplifiers,
Classification Class A, Class C (mention only)
Class B: push pull amplifier, working, efficiency (derivation), cross over distortion, harmonic distortion, complimentary symmetry (transformer less). Comparison.
Tuned amplifiers: need for single tuned and double tuned, working, frequency response curve, advantages & disadvantages, note on coupling.

JFET–Types - p-channel and n-channel, working and I-V characteristics - n-channel JFET, parameters and their relationships, Comparison of BJT and JFET. CS Amplifier, MOSFET: E&D, **MOSFET** – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, CMOS logic, CMOS – inverter, circuit and working, CMOS characteristics,

UNIT 2: FEEDBACK AMPLIFIERS AND OSCILLATORS **10 Hours**
Feedback: Types of Feedback Positive and Negative, Block Diagrams, Effect of Feedback on Av, BW, Zi, and Zo (only for Voltage Series Feedback Amplifier Circuit).
Need for oscillators; positive feedback, Tank circuit – oscillations, resonant frequency. Barkhausean criterion for oscillation, LC tuned oscillator - Colpitts and Hartley's oscillator, frequency of oscillation (no derivation), minimum gain, advantages & disadvantages, RC Oscillators - phase shift & Wein bridge oscillator, frequency and minimum gain, crystal oscillator, piezoelectric effect, equivalent circuit, series & parallel resonant circuits, Q factor.
Non-Sinusoidal oscillators: Astable Multivibrator, Working waveforms, frequency formula (mention only), Monostable multivibrator, bistable multivibrator (flip flop concept).

Unit 3: Integrated circuits **06 Hours**
IC555 block diagram & pin diagram. IC555 Application – Astable, Monostable (derivation), Voltage controlled oscillator. Schmitt trigger. IC Regulators: LM317, IC78XX, 79XX series (block diagram)

UNIT 4: OP. Amp. Theory and Applications **20 Hours**
Differential amplifier: Circuit configurations – working, dc & ac analysis of dual input balanced output differential amplifier – Av, Ri & Ro, Common mode gain, CMRR, current mirror – circuit & working differential amplifier with current mirror.
Op Amp block diagram, pin diagram IC741, specifications, characteristics of ideal and practical op amp parameters-input bias current, input offset voltage, output offset voltage, CMRR, slew rate SVRR, offset null, open loop op amp. limitations, Closed loop op. amp. Block Diagram of negative series feedback amplifier, Inverting and non-inverting feedback circuit-negative gain, R_{if}, R_{of}, Virtual ground, unity gain bandwidth.

Applications: Adder inverting and non-inverting, subtractor, scale changer, buffer, integrator, differentiator (ideal and practical). Comparator, zero crossing detector, Active filters-Butterworth first order low pass, high pass, band pass, band stop, all pass filters. Second order Filters (mention only).

Self-study : **08 Hours**
IC fabrication techniques.

Recommended Text Books
1, Operational amplifier and linear circuits, Ramakanth Gayakwad PHI, 5th Edition, 2015.
2. A Text Book of Applied Electronics, R.S. Sedha

Reference Books

1. Electronic Devices and circuits, T.F. Bogart and Beasley, Pearson Education, 6th Edition, 2004.
2. Electronics Principle-AP Malvino, Tata McGraw-Hill, 6th edition, 2005.
3. Electronic Devices and Circuits, T. L. Floyd, PHI, 5ht Edition 2005.
4. Microelectronics Circuits, Sedra and Smith, 5th Edition, Oxford University Press
5. Basic Electronics- A Text Lab Manual, Paul B Zbar, A.P. Malvino, TMH, 7th Edition,1995.

Practical II

EL2P1: PRACTICALS **(11 sessions 4 hours/week)**

List of experiments

1. Colpitts Oscillator
2. Construction of regulated power supply using IC 7805 and IC 7905
3. Op-amp Adder, subtractor and scale changer
4. Phase-shift oscillator using IC 741
5. Wien-Bridge oscillator using IC 741
6. Op-amp comparator
7. Hartley Oscillator
8. Astable multivibrator using transistors
9. Current and voltage regulation using IC LM 317
10 Op – amp as inverting and non-inverting amplifier.
11 Crystal oscillator
12. Astable multivibrator using IC555.
13. Tuned amplifier.
14. FET CS amplifier

ELE- OE2.1: Advanced Digital Electronics

Unit 1: Introduction to Digital Electronics and Combinational Logic Circuits **20 Hours**

Introduction to Digital Electronics: Number Systems. Digital Electronic Signals and Switches, Basic Logic Gates AND, OR, and NOT, Universal Logic Gates NAND and NOR
Boolean Algebra and Reduction Techniques. Boolean Algebra, De Morgan's Theorem Exclusive OR and Exclusive-NOR gates, Arithmetic Operations. Simplification of logic circuits and vice versa, Half Adder, Full Adder, Half Subtractor, Full Subtractor, Introduction to Multiplexers and Demultiplexers, encoders and decoder, BCD to 7 segment decoder

Unit 2: Logic Design and Sequential Logic Circuits **18 Hours**

Logic Families and Their Characteristics, Flip-Flops: S-R Flip-Flop, D Flip-Flop, J-K Flip-Flop and Registers: Shift Registers. Serial/Parallel Data Conversions.
Sequential Logic, Counter Circuits. Asynchronous Counters, Synchronous Counter, Ripple counter, ADC and DAC converters.

Unit 3: Data Storage **07 Hours**

Semiconductor Memory Basics, The Random-Access Memory (RAM), The Read Only Memory (ROM), Programmable ROMs and its types. The Flash Memory. Memory card, External hard disc, SSD- concept. PLA mention only.

Books Recommended:

1. Digital fundamentals: T.L.Floyd , Universal Book Stall,8th edition,2005.
2. Modern digital electronics R.P Jain –TMH publication, 3rd edition, 2003.

Reference books:

1. Fundamentals of digital circuits: A Anand Kumar, PHI, 3rd edition 2004
2. Experiments in Digital Electronics: Malvino and Leach – TMH, 2000
3. Digital Lab Primer- K A Krishnamurthy, Pearson education 2003

Prerequisites:

1. Basics of Digital Electronics like number system and logic gates.
2. *Willingness and desire to learn about Digital Circuits and their applications in modern day technology.*

Semester III

ELE-DSC3: Digital Electronics and Verilog HDL

Unit 1: Logic families & Pulse characteristics **08 Hours**

Review of Logic gates. SOP, POS and K-map (simplification), Logic families – classification of logic families. TTL NAND gate. TTL IC terminology (74HXX,74LXX) & characteristics. MOS logic, CMOS inverter gate. CMOS characteristics, interfacing CMOS to TTL & vice versa. Pulse characteristics: ideal & non ideal pulses. Characteristics of pulses, rise time, fall time, pulse duration in non-ideal pulses.

Unit 2: Combinational logic circuits **08 Hours**

Half adder, half subtractor, full adder, full subtractors. Two bit and 4-bit magnitude comparators, IC 7485- pin diagram, Multiplexers-4: 1, 8:1 and 16:1 multiplexer, logic diagram and truth table of each, applications, Demultiplexers-1: 4, 1:8 and 1:16 de-multiplexers & IC's associated with them. (74150/74154) Decoder – 7446/47 BCD to seven segment decoder/driver, Encoder, priority encoder, Decimal to BCD encoder-circuit & priority encoder IC. Logic diagram, explanation & truth table.

Unit 3: Sequential logic circuits **10 Hours**

Latches & Flip- flops(NAND and NOR latches), Clock pulses, edge triggered versus level triggered. RS, D, JK. JK master slave, T flip flops. Circuits, working & truth table. Preset & clear functions in flip flops, timing diagram. IC7476, IC7473.
Registers: SISO, SIPO, PISO & PIPO circuit, working, truth table, timing diagram. IC7476/73.
Counters: Asynchronous counters; mod 4, mod 8, mod 16, Decade Counters, glitches, truncated counters like mod 3, 5, 6, 7 Asynchronous up – down counters. IC7490, mod 4, 8, 16, decade counters, Synchronous counters (3-bit counter).
Advantages & disadvantages between asynchronous & synchronous counters, Johnson & Ring counters.

Unit 4: Introduction to Verilog and Gate Level Modeling **14 Hours**

Introduction, design flow, Use of Verilog, hierarchical modeling concepts, design methodology, Introduction to modules, instances, Basic Concepts: Lexical Conventions, data types: value set, nets, registers, vectors, arrays, parameters, memories, strings. System tasks and compiler directives.
Introduction to modules, instances, Modules and Ports, hierarchical names.
Gate level modeling: Gate types- AND/OR, BUF/NOT, multiplexer, full adder, Gate delays: Rise, Fall, Turn off delays, min/typ/max values.

Data Flow

Data flow modeling: Continuous assignments, delays, expressions, operators and operands, operator types with examples.

Unit 5: Behavioral modeling **12 Hours**

Structural procedure, procedural assignments, Timing controls: Delay Based, Event Based, Level Sensitive, conditional statements, loops, sequential and parallel blocks
Tasks and Functions: Introduction to Tasks, Introduction to Functions, Differences between Tasks and Functions.

Self-Study **08 Hours**

Interfacing of TTL with sub families, Realization of Multiplexers 32:1 using 16:1, Demultiplexers 1:32, Tasks and Functions: Introduction to Tasks, Introduction to Functions, Differences between Tasks and Functions.

Books Recommended:

1. Digital fundamentals: T.L.Floyd , Universal Book Stall,8th edition,2005.
2. Modern digital electronics R.P Jain –TMH publication, 3rd edition, 2003.
3. Verilog HDL: A Guide to Digital Design and Synthesis – Samir Palnitkar

Reference books:

4. Fundamentals of digital circuits: A Anand Kumar, PHI, 3rd edition 2004
5. Experiments in Digital Electronics: Malvino and Leach – TMH, 2000
6. Digital Lab Primer- K A Krishnamurthy, Pearson education 2003

EL 3P1: Practical III

List of experiments **(11 sessions 4 hours/week)**

Part-A

1. Realization of Basic gates using diode and transistor
2. Realization of Basic gates using NAND gates using IC 7400
3. Realization of Basic gates using NOR gates using IC 7402
4. Half Adder and Half Subtractor using NAND gates
5. Full Adder using IC 7486 and IC 7400
6. Binary to Gray code and Gray code to Binary conversion
7. Clocked RS, D Flip-flops using NAND gates
8. 4 –bit binary ripple up counter using IC 7476/74107
9. Decade counter using IC 7490.
10. Study of De-Multiplexer using IC 74154
11. Study of Multiplexer using IC 74150

Part- B

1. Write a Verilog program to implement basic gates.
2. Write a Verilog program to implement 1-bit full adder.
3. Write a Verilog program to implement 4 bit ripple carry adder.
3. Write a Verilog program to implement 4 to 1 mux.
4. Write a Verilog program to implement 2 to 1 mux.
5. Write a Verilog program to implement two bit comparator.
6. Write a Verilog program to implement 1 to 4 demux.
7. Write a Verilog program to implement D- Flip Flop.
8. Write a Verilog program to implement JK- Flip Flop.
9. Write a Verilog program to implement 4 bit ripple carry counter.

ELE-OE 3.1: Computer Fundamentals

Unit 1: Knowing Computer **05 Hours**

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply.

Unit 2: Operating Computer using Operating System **05 Hours**

What is an Operating System; Basics of Popular Operating Systems; The User Interface, Using Mouse; Using right Button of the Mouse and Moving Icons on the screen, Use of Common Icons, Status Bar, Using Menu and Menu-selection, Running an Application, Viewing of File, Folders and Directories, Creating and Renaming of files and folders, Opening and closing of different Windows; Using help; Creating Short cuts, Basics of O.S Setup; Common utilities.

Unit 3: Understanding Word Processing and Using Spread Sheet **10 Hours**

Word Processing Basics; Opening and Closing of documents; Text creation and Manipulation; Formatting of text; Table handling; Spell check, language setting and thesaurus; Printing of word document.

Basics of Spreadsheet; Manipulation of cells; Formulas and Functions; Editing of Spread Sheet, printing of Spread Sheet.

Unit 4: Introduction to Internet, WWW and Web Browsers **07 Hours**

Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing softwares, Search Engines; Understanding URL; Domain name; IP Address; Using e-governance website

Unit 5: Basics of Power Point Presentation **03 Hours**

Basics of presentation software; Creating Presentation; Preparation and Presentation of Slides; Slide Show; Taking printouts of presentation / handouts.

SEMESTER IV

ELE-DSC 4: Data Acquisition and Instrumentation

Unit 1: SENSORS/TRANSDUCERS **16 Hours**

Introduction, Definition of Sensor/Transducer, classification of transducers- Passive, active, digital and analog types, definition and examples, Electrical transducers/sensors advantages. Selecting a transducer, Resistive transducers- Thermistor- construction, types, resistance- temp characteristics, applications, Resistance thermometer – construction, advantages, limitations, Thermocouple-Seebeck Effect, principle of operation, advantages and disadvantages, Inductive transducers - Reluctance type - construction, working Linear variable differential transformer (LVDT) -construction, working, advantages. Pressure transducer, Capacitive transducer, Resistance transducer, Strain Gauge: Principle, construction, working, Photo electric transducers, Photovoltaic cell, photo diode and photo transistor- working principle, applications. Piezo electric transducer, working principle, applications.
Applications: pressure sensor, flow meters, vibration, speed sensors.

Unit 2: DATA ACQUISITION AND CONVERSION **10 Hours**

Introduction, general data acquisition system (DAS), objective of DAS, Single channel and multi channel DAS block diagrams qualitative description. Digital to Analog converter - R-2R ladder and binary weighted ladder circuits, brief analysis. D to A using op-amp summing amplifier. Analog to Digital converter- Successive approximation method, Flash ADC, block diagram explanation.

UNit 3: MEASURING INSTRUMENTS **18 Hours**

Digital voltmeter- features, advantages and performance characteristics, digital voltmeter types, ramp type digital voltmeter, dual slope type digital voltmeter, - block diagram, working principle, advantages and disadvantages, Digital multimeter, Electronic Counter, Frequency meter, capacitance meter- Block diagram, working and applications, resolution and sensitivity of digital multimeter, Oscilloscopes- analog dual trace type, block description and principle of operation, signal generator.

Unit 4: DISPLY DEVICES **08 Hours**

Principle, Working Mechanism and Applications: Seven Segment Display and its types, Liquid Crystal Display, LED Display, Touch Screen (Resistive and Capacitive), Plasma Display, OLED Display, DLP.

Self-Study **08 Hours**
Introduction to Signal Conditioning in Instrumentation Systems, Instrumentation Amplifier, Measurements using CRO, General Block Diagram of Medical Instrumentation System.

Books Recommended:

1. Electronic Instrumentation - H.S.Kalsi, 2nd Edition, TMH, 2005
2. Sensors and Transducers – D Patranabi
3. Bio Medical Instrumentation System – Khandpur

Reference Books:
1. Electronic Instrumentation and measuring Techniques, W.D. Cooper, A.D. Helfrick 3rd Edition, PHI, 2000
2. A Course in Electrical, Electronics Measurement and Instrumentation, A.K. Sawhney, Dhanpat Rai & sons, 1996.
3. Instrumentation devices and systems, C.S.Rangan, G.R.Sarma, VSV Mani, TMH, 1998
4. Sensors and Transducers – Ian R. Sinclair

Practical-IV

EL4P1: Practicals **(11 sessions 4 hours/week)**

List of Experiments:

1. Op-amp Integrator –Frequency response & waveforms.
2. Op-amp Differentiator –Frequency response & waveforms.
3. Finding unknown capacitance using IC555.
4. Flash ADC – IC Quad op-amp.
5. Study of Instrumentation amplifier.
6. Study of DAC using binary weighted resistors.
7. Current to voltage convertor.
8. Voltage to current convertor.
9. Finding unknown resistance using Wheatstone bridge.
10. Study of R-2R ladder network.
11. Study of loading effect of voltmeter and correction using Op-Amp buffer.
12. Characteristics of Photodiode and phototransistor.

ELE-OE 4.1 RENEWABLE ENERGY AND MANAGEMENT

Unit 1: Energy Resources **12 Hours**

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity. Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models, equivalent circuits, and sun tracking systems

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Unit 2: Different forms of energy **12 Hours**

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics, and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

Geothermal Energy: Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power. Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications, Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

Unit 3: E- waste management **06 Hrs**

E- waste management: concepts waste management, advantages and disadvantages, Different methods, Waste materials, handling disposal, recycling procedures

SEMESTER V

ELE DSC 5: Power Electronics and Nanoscience

Unit 1: Special purpose diodes and Optoelectronic devices **14 Hours**

Introduction, Zener diode, reverse characteristic of Zener diode, Zener diode specifications Zener diode equivalent circuit, Zener diode applications, Tunnel diode; V-I characteristics, parameters, equivalent circuit, applications. Varactor diode; specifications, applications. Schottky diode; applications. Step recovery diode, harmonic generator (or Frequency Multiplier). PIN diode: applications. Light emitting diode, LED voltage drop and Current, LED applications, Multicolour LEDs, seven segment displays, dot matrix displays, use of LEDs in Facsimile machines, liquid Crystal Displays, advantages of liquid crystal displays, applications of liquid crystal displays, photodiodes; applications, commercially available photodiodes, Photoconductive cell, Photovoltaic or solar cell, Laser diode; applications, optical disks, read only optical disks equipment, printers using laser diodes, hologram sensors, laser range finder, Light activated SCR(LASCR), optical isolators, optical modulators

Unit 2: Thyristors **09 Hours**

Introduction to Thyristors. Types of Thyristors, silicon-controlled rectifier (SCR); operation, biasing, equivalent circuit, turning ON SCR, turning OFF SCR, V-I characteristics, forward characteristics, reverse characteristics, ratings, applications. Triac; operation, V-I characteristics, ratings, applications, difference between SCR and Triac, Unijunction transistor; basic construction, equivalent circuit, intrinsic stand-off ratio, UJT operation, characteristics, applications, Programmable Unijunction Transistor, Diac; V-I characteristics, Silicon Controlled switch; operation, applications.

Unit 3 : Nanoelectronics **10 Hours**

Introduction to nanomaterials: 3D, 2D, 1D, 0D (Qauntum dots), Nano size particles, advantages, applications. Nanostructures: Introduction, different strategies for synthesis of 3D, 2D, 1D (nanorods and nanowires) and 0D (Semiconductor nano dots: quantum dots, Metals nano particle/dots: plasmonics), CNT, SET. Preparation methods: Bottom-up: CVD, ALD and PVD (Mention only), Top-down synthesis: Ball milling, photo lithography.

Unit 4 : Instrumentation and characterization techniques **06 Hours**

Structural and Surface analysis: XRD, AFM, STM, SEM and TEM instrument description, principles of working.

Self-Study **06 Hours**

Sputtering, e-beam, thermal evaporation, Sol-Gel Processing – Spin coating.

Text Books:

1. Power Electronics: Bimbhra P S, Khanna publishers, 2003.
2. Power Electronics Circuit devices and applications: Rashid M H, PHI, Pearson/Prentice Hall, 2004
3. Semiconductor device and characterization, Dieter K. Schroder, 3rd edition, IEEE press and Wiley Interscience publications, 2006
4. Material Science of Thin Films: Deposition & Structure, Milton Ohring, 2nd edition, Academic Press, 2002
5. Fundamental of Nanoelectronics, George W. Hanson, Indian edition published by Dorling Kindersley, India Pvt. Ltd, 2009.

6. Nanoscale Transistors: Device Physics, Modeling and Simulation, Springer International edition, 2008

Reference Books:

1. Thyristor Engineering: Berde M S, Khanna publishers, 2001
2. Power electronics - P C Sen, Tata McGraw-Hill Education, 1987.
3. Power Electronics: Vedam Subrahmanyam, New Age International, 2002
4. Modern Power Electronics and AC Drives: Bimal K.Bose, Pearson education, 2002
5. Silicon VLSI Technology: Fundamentals, Practice, and Modeling James D. Plummer, Michael D. Deal , Peter B. Griffin, Prentice Hall, 2000.
6. Nanoelectronics and information technology, Rainer Waser, Wiley – VCH, 3rd Edition, 2012
7. Scanning Probe Microscopy: Analytical Methods (NanoScience and Technology)- Roland Wiesendanger, Springer, 1998
8. Advanced X-ray Techniques in Research and Industries - A. K. Singh, IOS Press,2005

Practical V-Paper 1

EL5P1: Practicals **(11 sessions 4 hours/week)**

Power Electronics and Nanoscience Lab

1. V-I Characteristics of **SCR** and determination of firing angle
2. R and RC triggering of SCR.
3. UJT characteristics/Oscillator.
4. UJT triggering of SCR.
5. SCR Half wave rectifier using R, RC and UJT triggering.
6. Diac characteristics
7. Triac characteristics
8. Full Wave Rectifier using SCR.
9. Series Regulator (line, load)
10. Photo-diode characteristics
11. Photovoltaic cell
12. Photo transistor
13. CV characteristics of thin film capacitors.
14. I-V characterisation of PN junction.

ELE DSC 6: Microprocessors

UNIT 1: Introduction to Computer Architecture **05 Hours**

Introduction to Microprocessor: history and development, Buses, speed, memory. Parallel Architectures: SIMD, MMID, Multicore Processor, Hyper Threading Technology, ARM Architecture.

UNIT 2: Introduction and Architecture of Microprocessor 8086 **10 Hours**

Microprocessor Overview, Intel 8086 Microprocessor: Register Organization, Architectural block diagram: Bus interface unit, Execution unit, pipelining, pin configuration, flags, data and address bus demultiplexing, Generation of 20-bit Address, modes of operation: - minimum mode and maximum mode. Accessing odd and even memory bank, instruction cycle, fetch-execute cycles, timing diagrams - memory read, write, I/O write.

UNIT 3: Instruction Set and Programming of 8086 **15 Hours**

Addressing modes: -Immediate, register and Memory addressing modes Instruction Sets - data transfer, arithmetic and logical, shift and rotate, branch and machine control group. Programming: Some examples; addition, subtraction, multiplication, division of two 8 bit numbers, one's compliment, two's compliment, to find the number of one's in a given byte, addition and subtraction of 16 bit numbers, Average of 10 numbers, Fibonacci series, count 00-99, program to generate ASCII equivalent values for decimal numbers 0 to 9, smallest and largest numbers, Delay program. Stack, Subroutine, Interrupts: - Types/classification of interrupts, Sources of 8086 interrupts, interrupt sequence and vector table.
Intel 8255 (PIC): Internal Block Diagram, operation.

Unit 4: Introduction to Advanced Microprocessors **05 Hours**

Introduction, Features of: Pentium Pro, Pentium II, Pentium III, Pentium IV, multi-Core, ARM, Core-i series, Mobile processors (mention only).

Unit 5: Memory Devices **04 hours**

Need for memory devices, computer memory devices, Memory Hierarchy, primary and secondary, real and virtual memory, volatile and non-volatile, Memory write ability and storage permanence, Composing Memories, Types of semiconductor memories: - ROM, PROM, EPROM, EEPROM, Flash, RAM, SRAM, DRAM, PSRAM and NVRAM, cache memory, SSD.

Self-Study **06 hours**

Memory mapped I/O scheme, I/O mapped I/O scheme, DMA Intel 8257, Brief overview of Artificial Intelligence and IOT.

Reference Books:

1. "Advanced Microprocessors and Peripherals"- A.K. Ray, K.M. Bhurchandi. Tata Mc. Graw Hill.
2. "Microprocessors and Microcontrollers"- B.P. Singh. Galgotia publications.
3. "Microprocessor theory and applications"- M. Rafiquizzaman, PHI.
4. "The 8088 and 8086 Microprocessors Programming, interfacing, software, hardware and Applications" - Waltier A. Triebel and Avtar Singh. PHI. "The Intel Microprocessors 8086/8088, 80186, 80386, 80486 Architecture, Programming
5. Upgrading and Repairing PCs by Scott Muller; Publishers: Techmedia.

6. 8051 Microcontroller: Internals, Instructions, Programming & Interfacing By Ghoshal Subrata 7. Advanced microprocessor and peripheral interfacing – Douglas V. Hall.

Practical V – Paper 2

EL5P2: Practicals (Intel 8086 ALPs using MASM) (11 sessions 4 hours/week)

1. Addition and subtraction of 8-bit numbers.
2. Addition and subtraction of 16-bit numbers.
3. Multiplication of two given numbers.
4. Program for division.
5. To find the square and cube of a number.
6. To find the average of ten given 8-bit numbers.
7. 1's and 2's complement of 8-bit and 16-bit numbers.
8. Smallest and largest number in a data array.
9. To find the number of ones and zeros in a data.
10. To interchange the data present in two different memory locations.
11. To generate Fibonacci series.
12. Arranging a series of 8-bit numbers in Ascending and descending order

VI Semester

ELE DSC 7: Electronic Communication

Unit 1: Analog and Digital Modulation Techniques **12 Hours**

EM spectrum, wave propagation - ground, space and sky waves (mention only), block diagram of general communication system.

Modulation – Need for modulation, types of modulation – AM, FM, PM. Amplitude modulation - definition, expression for instantaneous voltage, frequency spectrum, representation, modulation index, power relations, modulation by several sine waves, Generation of AM waves, Collector modulator, AM transmitter, types of AM.

Frequency modulation – Definition and wave representation, frequency deviation, carrier swing, modulation index, derivation of instantaneous voltage, note on Bessel functions, frequency spectrum, FM generation: principle - varactor diode modulator, FM transmitter, pre-emphasis, de-emphasis, AFC, comparison between AM & FM. Numerical problems.

Pulse modulation techniques-sampling theorem, Pulse modulation types-PAM, PWM, PPM, brief description, waveforms, PCM-Quantization Digital communication systems –Introduction to digital modulations. FSK, BPSK and ASK- brief description, waveforms, Advantages and disadvantages of digital transmission. Applications. Characteristics of data transmission circuits-Shannon limit for information capacity Bandwidth requirements, data transmission speeds, Noise, Cross talk, Echo suppressors, Distortion and equalizer,

Unit 2: Antenna and RADARS **08 Hours**

Radiation mechanism - dipole from open circuited transmission line, antenna equivalent circuits, wire radiators in space – resonant, antenna – radiation pattern and current distribution for different lengths and current distribution ($l=\lambda/2, 2\lambda/2, 3\lambda/2$), Non resonant antenna, Antenna parameters: definitions and expressions for gain, directive gain, power gain directivity, beam width, bandwidth, polarization, radiation resistance, derivation for total power radiated by an antenna and radiation resistance. Grounded antenna and ungrounded antenna, micro strip antenna (mention only).

RADAR: Introduction, principle, frequencies, block diagram of pulse radar system, function of each block, CW Doppler radar – working principle, applications, RADAR range equation derivation, factors influencing max range, Applications of RADAR (Brief explanation).

Unit 3: Satellite Communication **07 Hours**

Introduction, Kepler's laws, satellite orbits, satellite system-block diagram of satellite sub systems (space segment), station keeping, altitude control, ground station (simplified block diagram of earth station), uplink, downlink, cross-link, Transponder (C-band multi-channel), satellite band width, frequency reuse, Multiple access methods - TDMA, FDMA, and CDMA.GPS –services like SPS & PPS.

Unit 4: Optical Fiber Communications **06 Hours**

Introduction-need for optical fiber communication, Block diagram of OFC system, Core and clad concept, light propagation through optical fibre, Expressions for acceptance angle and numerical aperture. Modes of Propagation, Light sources - Requirements and examples. Construction and working of unguided LASER diode. Photo detector –PN photo diode PIN photo diode requirements and examples. Advantages and disadvantages of fibre optic communication, Losses in optical fiber-Rayleigh scattering, absorption, coupling, bending.

Unit 5: Advanced Communication and Networking **06 Hours**

Internet, internet service telephone cable and satellite connections, high speed connections: ISDN, ADSL, cable modems, emails, mobile communication - block diagram, cell, cell splitting, frequency reuse, roaming and hand off. Simplified block diagram of cellular phone, Study of GSM & CDMA system: other wireless systems: LAN, Wi-fi, Bluetooth, NFC (mention only).

Introduction, history, network architecture, protocols and standards for data communication, layered network architecture, open systems, interconnection, different layers and functions data communication circuits, serial and parallel data transmission, data communication networks.

Self-Study **06 Hours**

Modems - Classifications, modes of modem operation, AM Demodulation and FM Demodulation - Phase Discriminator, Block diagram of Super-heterodyne Receiver (AM and FM).

Books Recommended:

1. Electronic Communication, Dennis Roddy &John Coolen –IV edition-PHI, 2005
2. Electronic Communication systems, Kennedy &Davis IV the edition, 2005 TATA Mc GRAW Hill
3. Electronic Communication systems, Wayne Tomas –Vth edition –Pearson education, 2005
4. Digital Communication Systems: Ronad J. Tocci
5. Computer Networks: Tanen Baum

Reference Books:

1. Handbook of experiments in electronics and communication-Poorna Chandra Rao & Sasikala, VIKAS Publishing house, 2004
2. Basic Electronics -A text lab manual, -Paul B. Zbar, Albert P. Malvino & Michael A. Miller-Tata Mc GRAW Hill, 1997.
3. Satellite communication-Agarwal-Khanna publishers, New Delhi, 2000
4. Communication Electronics, Frenzel, TMH, 3rd Edition, 1999.
5. Advanced Electronic Communication System, Wayne Tomas I – , PHI,VI edition, 2005.

Practicals VI-Paper1

EL6P1: Practicals **(11 sessions 4 hours/week)**

List of Experiments:

1. Saw- tooth wave generator using IC 555
2. Voltage Controlled oscillator using IC 555
3. Schmitt Trigger using IC 555
4. Amplitude modulator and demodulator
5. Tuned amplifier
6. Pre emphasis and de-emphasis circuits.
7. FM generator
8. IF amplifier
9. PWM and PPM using IC 555
10. PAM
11. FSK modulation
12. ASK Modulation
13. Optical fiber experiment -Characterization of 660 nm LED
14. Setting up of Analog and Digital Link.
15. Frequency Multiplier using transistors
16. Frequency Mixer using IC 565
17. Losses in fiber.
18. Numerical Aperture of a given fiber.
19. Band elimination filter.

ELE DSC 8: Intel 8051 Microcontroller and Embedded Systems

Unit1: Introduction to Microcontrollers **03 Hours**

Definition, need, types, Classification, General block diagram, types of architecture: - Harvard Vs Princeton, RISC Vs CISC, Differences between Microprocessor and Microcontroller, Examples of popular microcontrollers, applications (mention only).

Unit 2: Introduction to 8051 Microcontroller **08 Hours**

Microcontroller Overview, Features of 8051 microcontroller, Block diagram of 8051, pin description, Memory organization, data and program memory, System Clock, Special function register, bit addressable and byte addressable SFR, brief description of each SFR. Basic Oscillator circuit, reset circuit for 8051. Interrupt structure in 8051, I/O Ports, External Memory Connections, Counters and Timers.

Unit 3: 8051 Instruction Set and Programming **13 Hours**

Addressing modes: Immediate, register, direct, register indirect, indexed and implied addressing modes, definitions and examples. Instruction set- Data transfer instructions, arithmetic instructions, logical instructions, branching operations, Subroutines and calls.

Assembly language program examples, Data transfer operation with internal and external memory, 8 bit and 16-bit arithmetic operations, addition, subtraction, multiplications, and division, Logical operations, truth table verifications, sorting of numbers in an array, Implementing BCD, Hex decimal Counters.

Unit 4: Interfacing **06 Hours**

Intel 8255: Internal Block Diagram, Modes of Operation.

Introduction to PIC16 microcontroller.

Interfacing: LED, Relay, Stepper Motor, DAC, ADC, PWM, Traffic Light Control and LCD controller.

Unit 5: Introduction to Embedded Systems **09 Hours**

Embedded Systems Overview, General block diagram, characteristics, Design Constraints – Optimizing Design Metrics, Embedded System processor technology: General Purpose processor, Single purpose processor and Application specific processor.
Standard Single Purpose Processors: Need, Overview: Timer, Keypad Controller, LCD controller, PWM, Stepper motor control, A/D converter, Real time clocks.
Custom Single purpose processor design, optimizing custom single purpose processor design.

Self study **06 Hours**
ARM microcontroller, Arduino development board (Applications).

Reference Books:
1 “8051 Micro controller” - by Kenneth J.Ayala
2 “An Embedded Software Primer”-David E. Simon
3 “Embedded System hardware and software design ”- Frank Wahid
4 “Microcontroller and Programming and Applications”- Mazidi M.A and Mazidi J.G.

Practical VI-Paper2

EL6P2: Practicals: **(11 sessions 4 hours/week)**

1. Program to add, subtract, multiply and divide two 8-bit numbers.
2. Program to add and subtract two 16 bit numbers.
3. Program to find 2's complement of an 16-bit numbers
4. Program to find the sum of N 8-bit numbers.
5. Program to solve linear equation Y=mx+c.
6. Program to find largest and smallest of N numbers.
7. Program to interchange two blocks of data.
8. Program to verify the truth table of logic gates.
9. Program to find ones and zeros in a given byte and word.
10. Program to arrange the numbers in ascending order.
11. Program to convert a hexadecimal number into a decimal number and vice versa.
12. Program to find the square of a number from look-up table.
13. Program to find whether the given data is palindrome.
14. Interfacing peripheral devices.

Question Paper Pattern

Exam duration: 2hrs **Total marks: 60**

Part A	**MCQ (Answer all)**	**1x10 = 10**
Part B	**Descriptive (Answer any 5 out of 7)**	**6x5 = 30**
Part C	**Numerical (Answer any 5 out of 7)**	**4x5 = 20**
Total		**60**