ST JOSEPH'S UNIVERSITY

BENGALURU-27

DEPARTMENT OF ELECTRONICS

Curriculum for B.Sc.

as per

SJU- 2024-25

SYLLABUS FOR
UNDERGRADUATE PROGRAMME

2024-2025 Onwards (SEP)

Semester	Title
	Major: Discipline Core
I Semester	**DSC1: Electronics Devices and Circuits**
II Semester	**DSC2: Amplifiers, Oscillators and OP-Amp**
III Semester	**DSC 3: Digital Electronics**
IV Semester	**DSC 4: Power Electronics**

Curriculum Structure

Semester III

Semester- I

EL 124: Electronics Devices and Circuits

Unit 1 **12 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).

Unit 2 **12 Hours**

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).

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.

Unit 3 **8 Hours**

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 4 **8 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).

Self-study **05 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.

Practical I

EL 1P1: Practical **(11 sessions 3 hours/week)**

List of experiments

Study of resistance color code, 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. *Half wave rectifier*, and Center tap full wave rectifier with & without capacitor filter
7. Voltage quadrupler 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

Semester- II

EL 224: Amplifiers, Oscillators and Op-Amp.

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, complementary 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. Common Source Amplifier, MOSFET: E&D, **MOSFET** – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, CMOS logic, CMOS inverter - circuit, working and 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. Barkhausen 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 (no derivation), 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 **04 Hours**
IC555 block diagram & pin diagram. IC555 Applications – Astable (derivation) and Monostable multivibrators, Voltage controlled oscillator. Schmitt trigger. IC Regulators: LM317, IC78XX, 79XX series (block diagram)

UNIT 4: Operational Amplifier (Op-Amp) - Theory and Applications **11 Hours**
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, gain, R_{if}, R_{of}. Virtual ground, unity gain bandwidth product.

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 : 04 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] Astable multivibrator using IC555.
[12] Tuned amplifier.
[13] FET CS amplifier

Semester- III

EL 324 : Digital Electronics

Unit1: Number system **03 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.

Unit2: Boolean Algebra **07 Hours**

The Inverter, 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. 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.

Unit 3: Logic families & Pulse characteristics **10 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 4: Combinational logic circuits **09 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 & ICs 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 5: Sequential logic circuits **12 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 Asynchronous up – down counters. IC7490, mod 4, 8-decade counters, Synchronous counters (3-bit counter), Johnson & Ring counters.

Self-Study **04 Hours**

Interfacing of TTL with sub families, Realization of Multiplexers 32:1 using 16:1, Demultiplexers 1:32, mod 8,16-decade counter, error checking and correction codes (Only parity check).

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 3 hours/week)**

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

SEMESTER IV

EL424 : Power Electronics

Unit- 1: Power diodes **08 Hours**

Need for semiconductor power devices, Power diodes: Tunnel diode; V-I characteristics, parameters, equivalent circuit, applications. Varactor diode: specifications, applications. Schottky diode; construction, enhancement of reverse blocking capacity; Step Recovery Diode (SRD), harmonic generator. Optical disks, read only optical disks equipment, printers using laser diodes, hologram sensors, laser range finder, optical isolators, optical modulators

Unit-2: Power Devices **15 Hours**

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

Insulated Gate Bipolar Transistors (IGBT): Basic structure, I-V Characteristics, switching characteristics, device limitations, safe operating area (SOA) etc. **Power MOSFETs** - Operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

Unit -3: Applications of Thyristors **06 Hours**

SCR as a static switch, phase-controlled rectification, single phase half wave, and full wave. R and RC triggering of SCR, UJT Triggered SCR. AC voltage controller using SCR and TRIAC as a switch.

Unit- 4: Power Inverters and Choppers **12 Hours**

Power Inverters: Need for commutating circuits and their various types, DC link inverter, Parallel capacitor commutated inverters with and without reactive feedback and its analysis, Series Inverter - limitations and improved versions.

Choppers: basic chopper circuit, types of choppers (Type A-D), step-down chopper, step-up chopper, operation of DC chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper (using class D commutation).

Self-Study **04 Hours**

Electromechanical machines: basic structure of rotor, shaft, thyristor control of AC motor, Light activated SCR (LASCR), Snubber Circuit

Suggested Books:

1. Power Electronics, P.C. Sen, TMH

2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid, Pearson Education
5. Power Electronics, Applications and Design, Ned Mohan, Tore.
6. Power Electronics, K. HariBabu, Scitech Publication.
7. Power Electronics, M.S. Jamil Asghar, PHI.

Practical-IV

EL4P1: Practical **(10 sessions - 3 hours / week)**

List of Experiments:

1. V-I Characteristics of MOSFET
2. V-I Characteristic of IGBT
3. Study of I-V characteristics of DIAC
4. Study of I-V characteristics of a TRIAC
5. V-I Characteristics of **SCR** and determination of firing angle
6. UJT Characteristics and relaxation oscillator
7. SCR Half wave rectifier
8. SCR Half wave rectifier using RC triggering / UJT Triggering
9. R and RC triggering of SCR.
10. Design of Snubber circuit
11. Study of Chopper circuits

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**