Course Structure for (3+1) year
UG Science Major

ELECTRONICS

Department of Electronics
Faculty of Science
Deen Dayal Upadhyaya Gorakhpur University

Gorakhpur-273009

(2024-25)

Course Structure for 3+1 year UG Science Major
ELECTRONICS

Year	Semester	Course Code	Course Title	Credits [T+P]
Ist	I	ELE 102F	Basic Circuit Theory	4+0
		ELE 103F	Circuit and Networks Lab	0+2
	II	ELE 104F	Semiconductor Devices and Electronic Circuits	4+0
		ELE 105F	Electronic Devices Lab	0+2
2nd	III	ELE 201F	Analog Electronics	4+0
		ELE 202F	Analog Electronics Lab	0+2
	IV	ELE 203F	Digital Electronics	4+0
		ELE 204F	Digital Electronics Lab	0+2
3rd	V	ELE 301F	Operational Amplifier and Applications	4+0
		ELE 302F	Introduction to Microprocessor and Microcontroller	4+0
		ELE 303F	OPAMP and Microprocessor Lab	0+2
	VI	ELE 304F	Communication Electronics	4+0
		ELE 305F	Programming language	4+0
		ELE 306F	Programming and Communication Lab	0+2
4th	VII	ELE 401F	Network Analysis and Synthesis	4+0
		ELE 402F	Devices and Linear Integrated Circuits	4+0
		ELE 403F	Switching Theory and Digital Design	4+0
		ELE 404F	Advanced Microprocessor and Interfacing	4+0
		ELE 405F	Network, Devices, Digital and Microprocessor Lab	0+4
	VIII	ELE 406F	Control System	4+0
		ELE 407F	Digital Communication	4+0
		ELE 408F	Opto-Electronics	4+0

		ELE 409F	**Electromagnetic Theory and Antenna**	**4+0**
		ELE 410F	**Control, Power Electronics, Digital Communication, Opto-Electronics, EM theory and Antenna lab**	**0+4**

OR

For Students who secured 75% Marks in First Six Semesters of UG Programme

Year	Semester	Course Code	Paper Title	Credit [T+P]
4th	**VII**	**ELE 401F**	**Network Analysis and Synthesis**	**4+0**
		ELE 402F	**Devices and Linear Integrated Circuits**	**4+0**
		ELE 403F	**Switching Theory and Digital Design**	**4+0**
		ELE 404F	**Advanced Microprocessor and Interfacing**	**4+0**
		ELE 405F	**Network, Devices, Digital and Microprocessor Lab**	**0+4**
	VIII	**ELE 406F**	**Control System**	**4+0**
		ELE 407F	**Digital Communication**	**4+0**
		ELE 411F	**Research Project**	**0+12**

PROGRAMME SPECIFIC OUTCOMES (PSOs)

First-Year

The learner will be able to:

- Identify the basic elements and systems used in modern analog and digital world.
- Explore fundamental laws and elements of electrical and electronic circuits.
- Understand DC circuits, theorems, and networks.
- Understand AC circuits and related terminologies with examples.
- Understand the basic material and properties of semiconductors.
- Explore the constructional features of basic semiconductor devices.
- Describe the biasing principles of semiconductor devices like diode and transistors.
- Explain the I-V characteristics of semiconductor devices like diode, BJT, UJT, JFET and MOSFET.

Second-Year

The learner will be able to:

- Convert different type of codes and numbersused in digital computers andcommunication.
- Describe switch model used to illustrate building blocks of digital circuits.
- Use Boolean algebra and K- map for reduction of logic expressions and circuits.
- Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.
- Develop ability to apply basic concepts of P-N Junction and Transistor in developing simple applicationcircuits.
- Understand the power supply at block level.
- Attain knowledge of various amplifiers and their comparison.
- Identify the applications of JFET & MOSFET and become familiar with Thyristor family.

Third- Year

The learner will be able to:

- Develop skill to apply basic concepts of electronics circuit design in application based circuit development.
- Understand the fundamentals of communication systems.
- Use microprocessors and microcontrollors to design systems for real life application.
- Elucidate and design the linear and nonlinear applications of an op-amp and special application ICs.
- Create and demonstrate live project using analog and digital ICs.
- Interface various I/O devices and design and evaluate systems that will provide solutions to real-world problem.

Fourth- Year

The learner will be able to:

- Develop skill to apply knowledge of various linear ICs including OTA in application based circuit development.
- Understand the advanced concept of digital communication systems.
- Use advanced microprocessors and microcontrollors in design of automation based applications.
- Elucidate and design the control systems applications.
- Create and demonstrate live research project in various field of analog and digital Electronics domain.

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Year: First	**Semester:** First
Subject: Electronics	
Course Code: ELE 102F	**Course Title: Basic Circuit Theory**

Course Outcomes:

The completion of this course will enable students to:

1. Identify the basic circuit elements and electrical networks.
2. Explore fundamental laws and elements of electrical circuits.
3. Understand DC circuit, theorems, and networks.
4. Understands AC circuits and related terminologies with examples.
5. Grab opportunity in equipment and circuit design field.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Circuit Analysis**: Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Source transformation, Star-Delta Conversion DC Transient Analysis: RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits.
II	**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. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth.
III	**Network Theorem**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, and Maximum Power Transfer Theorem, Circuit analysis using Network theorems.
IV	**Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. Network Graph Theory: Equivalent Graph, Incidence matrix, Tie-Set and Cut Set.

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. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), Damodar Group (Publishers),Burdwan, ISBN: 978-93-85775-15-4 (2019)
4. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
5. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005)

Year: First	**Semester:** First
Subject: Electronics	
Course Code: ELE 103F	**Course Title: Circuit and Networks Lab**

Course Outcomes:

The completion of this course will enable students to:

1. Understand experimental electronics to know the circuit elements and their interconnections.
2. Verify various laws and theorems of electronic circuits.
3. Measure precision and achieve perfection through Lab Experiments.
4. Perform some online Virtual Lab Experiments that will also give an insight in simulation techniques and provide a basis for modeling.
5. Get hands on skill in electronic circuit design which will provide employment opportunity in electronic circuit design and testing field.

Credits: 02	**Core: Compulsory**

List of Experiments

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 Kirchhoff'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.

Online Virtual Lab Experiment List / Link

Virtual Labs at Amrita VishwaVidyapeetham **https://vlab.amrita.edu/**

Year: First	**Semester:** Second
Subject: Electronics	
Course Code: ELE 104F	**Course Title: Semiconductor Devices and Electronic Circuits**

Course Outcomes:

The completion of this course will enable students to:

1. Explore the constructional features of semiconductor devices.
2. Describe the biasing principles of semiconductor devices like diode and transistors.
3. Explain the I-V characteristics of semiconductor devices like diode, BJT, UJT, JFET and MOSFET.
4. Apply basic concepts of P-N Junction in developing simple application circuits.
5. Understand the power supply at block level and attains knowledge of various amplifiers and their comparison.
6. Get employment opportunity in semiconductor devices and application field.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Semiconductor Diodes:** p-n junction Diode: depletion layer, barrier potential, working in forward bias and reverse bias, concept of break down, I-V characteristics, knee voltage, break down voltage, Zener and Avalanche breakdown; Working principle, Symbol, I-V Characteristics and application of Zener diode, Light emitting diode, Photo diode, Solar cell, Varactor diode, Tunnel diode, Schottky diode.
II	**Bipolar Junction Transistors:** PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations.
III	**Field Effect Transistors:** JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel).
IV	**Power Semiconductor devices:** Symbol, types, construction, working principle, I-V characteristics, and specification parameters of Thyristors (Silicon controlled rectifier), DIAC and TRIAC.
V	**Diode Circuits:** Rectifier: Half, full and bridge rectifier circuits with resistor load, their output waveforms, output DC voltage and power, rectifier efficiency and ripple factor; Voltage multiplying rectifiers; Doubler, Trippler and Quadrupler; Filter: Series inductor, shunt capacitor, L-section, $\boldsymbol{\pi}$-section and R-C filter circuits; Regulator: Load and line regulation, stabilization ratio, internal impedance and temperature coefficient of voltage regulation; Linear voltage regulator circuits; Series and shunt regulator, SCR controlled half and full wave rectifier circuits and their analysis; Switched mode power supply (SMPS)

Suggested Books:

1. Electronic Principles - Albert Malvino, David J. Bates , 7thEdition (2016)

2. Solid state Electronic Devices, B. G. Streetman and S. Banerjee, Pearson Education (2006).

3. Electronic Principles, Albert Malvino, David J. Bates, 7thEdition (2016)

4. Basic Electronics – B.Grob, Mitchel E. Schultz , 11th Edition, (2007)

5. Basic Electronics and Linear circuits, N. N. Bhargava, D. C. Kulshreshtha, S. C. Gupta, Tata McGraw Hill (2008)

6. Electronic Devices and Circuits by J. Millman& C. Halkias (McGraw Hill, New York)

Year: First	**Semester:** Second
Subject: Electronics	
Course Code: ELE 105F	**Course Title: Electronic Devices Lab**

Course Outcomes:

The completion of this course will enable students to:

1. Understand the theory and working principle of semiconductor devices through experiment.
2. Design rectifier and filter circuits and study their parameters.
3. Explain and verify the I-V characteristics of various of BJT and transistor family.
4. Make skilled and get employment opportunity in semiconductor devices and application field.

Credits: 02	**Core: Compulsory**

List of Experiments

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Static characteristics of Varactor diode.
3. Characteristics of Light Emitting Diode (LED).
4. Study of Characteristics of Solar Cell
5. Study of the I-V Characteristics of the CE configuration of BJT and obtain r_i, r_o, β.
6. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain r_i, r_o, α.
7. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, r_i, r_o.
8. Study of the I-V Characteristics of the UJT and SCR.
9. Study of the I-V Characteristics of JFET and MOSFET
10. Study of Hall Effect.
11 . Study of the half wave rectifier and Full wave rectifier.
12. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation
13. Study of clipping and clamping circuits.
14. Designing of a Single Stage CE amplifier.
15. Study of the frequency and phase response of Common Source FET amplifier

Online Virtual Lab Experiment List / Link

Virtual Labs at Amrita VishwaVidyapeetham https://vlab.amrita.edu/

Year: Second	**Semester:** Third
Subject: Electronics	
Course Code: ELE 201F	**Course Title: Analog Electronics**

Course Outcomes:

The completion of this course will enable students to:

1. Understand biasing of transistor with stability.
2. Understand feedback in amplifier and various features of multistage amplifiers.
3. Describe various power amplifiers and their application.
4. Understand design concepts of different oscillators.
5. Get employment opportunity in analog system design field.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Transistor Biasing and Stability** : General principle of transistor amplifier; Load line and Q point, thermal stability, stability factors; Transistor biasing; Fixed bias, Collector to base bias, emitter bias and voltage divider bias circuits. **Small Signal Transistor Amplifiers**: Small signal transistor amplifier circuits in different configurations and hybrid *h*-parameters form and their analysis; Noise and distortion in SST amplifier.
II	**Amplifier Circuits: Feedback Amplifier** Concept of feedback, negative and positive feedback, voltage (series and shunt), current (series and shunt) feedback amplifiers, gain, input and output impedances. **Multistage Amplifier**: Cascading of amplifier and voltage gain; R-C, L-C and T-C coupled two stage amplifier circuits and their phase and frequency response and bandwidth.
III	**Power Amplifiers**: Difference between voltage and power amplifier, classification of power amplifiers, Class A, Class B, Class C and their comparisons. Operation of a Class A single ended power amplifier. Operation of Transformer coupled Class A power amplifier, overall efficiency. Circuit operation of complementary symmetry Class B push pull power amplifier, crossover distortion, heat sinks. **Tuned amplifiers**: Circuit diagram, Working and Frequency Response for each, Limitations of single tuned amplifier, Applications of tuned amplifiers in communication circuits. Double tuned amplifier.
IV	**Audio Oscillators**: Positive feedback and Bark-Hausen criteria of sustained oscillation; Phase shift and Wien bridge oscillator. **RF Oscillator**: Tuned base, Tuned collector, Hartley and Colpitts oscillator circuit and their analysis; Negative resistance oscillator; Frequency stability; Crystal controlled oscillator; Pierce and Miller circuits.

Suggested Books:

1. Electronic Devices and Circuits by J. Millman& C. Halkias (McGraw Hill, New York)
2. Electrical Circuits and Introductory Electronics by VinodPrakash (LokBhartiPrakashan, Allahabad)
3. Electronic Fundamentals and Applications by J.D. Ryder (PHI Pvt. Ltd., New Delhi)
4. Electronic devices, David A Bell, Reston Publishing Company
5. Electronic Circuits: Discrete and Integrated, D. L. Schilling and C. Belove, Tata McGraw Hill
6. Electronic Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill

Year: Second	**Semester:** Third
Subject: Electronics	
Course Code: ELE 202F	**Course Title: Analog Electronics Lab**

Course Outcomes:

The Experimental Electronics has the most striking impact on the academia and industry wherever the instruments are used to know the characteristics of devices.

The completion of this course will enable students to:

1. Understand the circuit theory through experiments on various analog circuits as well as its application.
2. Generate and measure precision output through various analog circuits.
6. Make skilled and get employment opportunity in analog system design field.

Credits: 02	**Core: Compulsory**

List of Experiments

1. Study of full wave and bridge rectifier.
2. Study of unregulated power supply.
3. Study of Zener and emitter follower regulator circuits.
4. Study of transistor series and shunt regulator circuits.
5. Study of controlled rectification using SCR.
6. To study biasing stability in BJT.
7. Phase and frequency response of RC network.
8. Phase and frequency response of low pass and high pass filter.
9. Phase and frequency response of interstage transformer.
10. Phase and frequency response of R-C coupled amplifier.
11. Generation and Fourier analysis of saw tooth wave.
12. Testing of electronic component by CRO and their measurement by LCR bridge.
13. Design of regulated low voltage power supply.
14. Design of low signal R-C coupled amplifier.
15. Study of ac power control using SCR
16. Study of Class A, B and C Power Amplifier.
17. Study of the Colpitt's Oscillator.
18. Study of the Hartley's Oscillator.
19. Study of the Phase Shift Oscillator

Online Virtual Lab Experiment List / Link

Virtual Labs at Amrita VishwaVidyapeetham **https://vlab.amrita.edu/**

Year: Second	**Semester:** Four
Subject: Electronics	
Course Code: ELE 203F	**Course Title: Digital Electronics**

Course Outcomes:

The completion of this course will enable students to:

1. Convert different type of codes and number systems in computers and communication.
2. Describe switch model used to illustrate building blocks of digital circuits.
3. Use Boolean algebra and Karnaugh maps for reduction of logic expressions and circuits.
4. Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.
5. Understand the operation of latches and their application in sequential circuits.
6. Get employment opportunity in digital system design field.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Number Systems and Codes**: Binary Number System, Binary-to-decimal Conversion, Decimal-to-binary Conversion, Octal Numbers, Hexadecimal Numbers and their inter conversion The ASCII Code, The Excess-3 Code, The Gray Code, Error Detection and Correction.
II	**Logic gates and Families:** Definitions of Digital Signals, Digital Waveforms, Digital Logic, Digital Computers, Digital Integrated Circuits, Digital IC Signal Levels, Digital Logic, The Basic Gates-NOT, OR, AND, Universal Logic Gates-NOR, NAND, ANDOR-Invert Gates, Positive and Negative Logic; **Digital Logic families**: Fan-in, Fan out, Noise Margin, Power Dissipation, Figure of merit, Speed power product in RTL, DTL, TTL, ECL and CMOS logic gates, their circuit description and basic characteristics and their comparison.
III	**Combinational Logic Circuits** Boolean Laws and Theorems, SOP and POS Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets, Karnaugh Map Simplifications, Don't-care Conditions, Simplification by QUINE-Mc-CLUSKY Method; Design of Encoders, Decoders, Multiplexer, Demultiplexer and various code converters.
IV	**Arithmetic Circuits:** Binary Addition, Binary Subtraction, Unsigned Binary Numbers, Sign-magnitude Numbers,2's Complement representation, 2's Complement Arithmetic, Arithmetic Building Blocks, The Adder-subtracter, Fast-Adder, Arithmetic Logic Unit, Binary Multiplication and Division.
V	**LATCHES**: Latches, Flip-flops - SR, JK, D, T, and Master-Slave -Edge triggering – Level Triggering Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Modulo–n counter, Registers – shift registers - Universal shift registers.

Suggested Books:

1. Digital System Design, Morris Mano, Pearson Education (2014)
2. Digital Principals, Schaum's outline series, Tata McGraw Hill (2006)
3. Digital Fundamentals, T. L. Floyld, Pearson Education (2013)
4. Electronic Principals, A. P. Malvino, Tata McGraw-Hill, (2003)

Year: Second	**Semester:** Four	
Subject: Electronics		
Course Code: ELE 204F	**Course Title: Digital Electronics Lab**	

Course Outcomes:

The completion of this course will enable students to:

1. Design simple combinational logic circuits.
2. Design Latches and Flip-Flops.
3. Use Boolean algebra and K-map for design of various digital circuits.
4. Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.
5. Design counter and shift register circuits.
6. Make skilled and get employment opportunity in digital system design field.

Credits: 02	**Core: Compulsory**

List of Experiment

1. Study of AND, OR, NOT, NAND, NOR and XOR gates using IC
2. Designing of logic gates using NAND gate IC
3. Designing of logic gates using NOR gate IC.
4. Verification of Demorgan's theorems.
5. Construction of gates using discrete components
6. Design and Verify Following:-
   - i. Code conversion
   - ii. Half adder and Full adder
   - iii. Half subtractor and Full subtractor
   - iv. Multiplexer and De-Multiplexer
   - v. Encoder and Decoder
   - vi. Study of Flip flops
   - vii. Shift register
   - viii. Ripple counter

ıal Lab Experiment List / Link

s at Amrita VishwaVidyapeethamhttps://vlab.amrita.edu/

Year: Third	**Semester:** Five
Subject: Electronics	
Course Code: ELE 301F	**Course Title: Operational Amplifier and Applications**

Course Outcomes:

The completion of this course will enable students to:

1. Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
2. Elucidate and design the linear and non-linear applications of an op-amp and special application ICs.
3. Explain and compare the working of multi vibrators using special application IC 555 and general-purpose op-amp.
4. Get employment opportunity in analog IC design and applications.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**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)
II	**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. Ideal and practical characteristics.
III	**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.
IV	**Signal Conditioning circuits**: Sample and hold systems, Active filters: First order low pass and high pass butter worth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers
V	**Multivibrators (IC 555):**Block diagram, Astable and mono stable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565.

Suggested Books:

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

Year: Third	**Semester:** Five
Subject: Electronics	
Course Code: ELE 302F	**Course Title: Introduction To Microprocessor and Microcontroller**

Course Outcomes:

The completion of this course will enable students to:

1. Understand the basic blocks of microcomputers i.e. CPU, Memory, I/O and architecture of microprocessor and microcontroller
2. Apply knowledge and demonstrate proficiency of designing hardware interface for memory and I/O as well as write assembly language programs for target microprocessor and microcontroller.
3. Derive specifications of a system based on the requirements of the application and select the appropriate microprocessor.
4. Get employment opportunity in automated system design field.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Introduction to Microprocessors:** Introduction, Applications, Basic Block Diagram, Speed, Word Size, Memory Capacity, Classification of Microprocessors (Mention Different Microprocessors being used). 8085 Microprocessor: Main Features, Architecture, Block Diagram, CPU, ALU, Registers, Flags, Stack Pointer, Program Counter, Data and Address Buses, Control Signals, Pin-Out Diagram and Pin Description.
II	**8085 Instruction and Programming:** Operation Code, Operand and Mnemonics, Instruction Classification, Addressing Modes, Instruction Format, Instructions Set, Data Transfer, Arithmetic, Increment, Decrement, Logical, Branch and Machine Control Instructions, Assembly Language Programming Examples, Stack Operations, Subroutines and Delay Loops Call and Return Operations, Use of Counters, Timing and Control Circuitry, Timing Diagram, Instruction Cycle, Machine Cycle, T (Timing)-States, Time Delay.
III	**Interrupts and Interfacing:** Interrupt Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts, Latency Time and Response Time, Basic Interfacing Concepts, Memory Mapped I/O and I/O Mapped I/O and Isolated I/O Structure, Partial/Full Memory Decoding, Interfacing of Programmable Peripheral Interface (PPI) Chip (8255), Address Allocation Technique and Decoding, Interfacing of I/O Devices (LEDs and Toggle-Switches as Examples).
IV	**Introduction to Microcontroller:** Difference between microprocessor and microcontroller, Block and Pin-Out Diagram of 8051 Microcontroller, I/O Port Pins Description and their Functions, I/O Port Programming in 8051 (using Assembly Language), I/O Programming: Bit Manipulation.

Suggested Books:

1. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram.
2. B. Ram, Fundamentals of Microprocessors and Microcomputers, DhanpatRai.
3. Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, PHI.
4. Mathur and Panda, Microprocessors and Microcontrollers, PHI.

5. Shah, 8051 Microcontrollers: MCS 51 Family and its Variants, Oxford.
6. Ayala and Gadre, The 8051 Microcontroller and Embedded System using Assembly and C, Cengage.
7. Mazidi, Mazidi and McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Pearson

Year: Third	**Semester:** Five
Subject: Electronics	
Course Code: ELE 303F	**Course Title: OPAMP and Microprocessor Lab**

Course Outcomes:

The completion of this course will enable students to:

1. Understand architecture and assembly language programming of microprocessor.
2. Understand the concept of interrupts and interfacing with various peripherals and to realize the features of a microcontroller and its timer applications
3. Be proficient in the use of IDE's for designing, testing and debugging microprocessor based systems.
4. Interface various I/O devices, design and evaluation of system that will provide solutions to real world problem.
5. Understand and Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
6. Elucidate and design the linear and non-linear applications of an op-amp and special application ICs.

Credits: 02	**Core: Compulsory**

List of Experiment

A. Microprocessor Lab

1. Program for 8 Bit &16 Bit Addition and Subtraction
2. Program for 8 Bit&216 Bit Multiplication and division
3. Program for Square and Square root of a number
4. Program for Sorting and Searching
5. Program for Smallest and Largest number in an array.
6. Program for Reversing a String
7. Program for Fibonacci series.
8. Program for Factorial of a number
9. Program for B.C.D to Binary, Binary to B.C.D, ASCII to Binary,
10. Binary to ASCII Conversion
11. Six letter word display.
12. Rolling display
13. Interfacing seven segment display to display any character.
14. Program to display Time(Hours and Minutes)
15. Program for 1's complement and 2's complement of 8 bit and 16 bit data
16. Interfacing Traffic light controller
17. Interfacing Stepper motor control
18. Interfacing Matrix Keyboard
19. Interfacing A.D.C &D.A.C
20. Study of 8255 chip and generation of

    1. Square wave, 2. Triangular wave and 3. Saw Tooth wave

B. OPAMP Lab

1. Study of op-amp characteristics.
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.

Online Virtual Lab Experiment List / Link

Virtual Labs at Amrita VishwaVidyapeethamhttps://vlab.amrita.edu/

Year: Third	**Semester:** Six
Subject: Electronics	
Course Code: ELE 304F	**Course Title: Communication Electronics**

Course Outcomes:

The completion of this course will enable students to:

1. To understand the principles of analog and digital communication
2. To study the amplitude modulation and demodulation techniques.
3. To learn frequency modulation and demodulation techniques
4. To apply engineering concepts in design and development of various analog communication systems.
5. Get employment opportunity in communication system applications.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**AM GENERATION & TRANSMISSION** Need for modulation – Amplitude modulation – Frequency Spectrum of the AM Wave - Modulation Index – Power relations in the AM Wave – AM generation – AM Transmitter. - Forms of Amplitude Modulation – Evolution of SSB – Balanced Modulator – Methods of SSB Generation – Vestigial side band Transmission.
II	**FM GENERATION & TRANSMISSION** Frequency Modulation - Frequency Spectrum of the FM Wave – Modulation Index – Effect of Noise – Adjacent & Co-Channel Interference – Wide Band & Narrow Band FM-FMGeneration; **Analog Pulse Modulation**: Channel Capacity, Sampling Theorem, Basic Principles of PAM, PWM and PPM, Modulation and Detection Technique for PAM only, Multiplexing, TDM and FDM.
III	**Transmitter and Receiver** – TRF Receiver – Super Heterodyne Receiver – Image Frequency Rejection – Frequency Changing & Tracking – Choice of IF – AM Detection – AGC – SSB Detection. FM Receiver – Amplitude Limiter – De-Emphasis – FM Detection – Balanced Slope Detector – Phase Discriminator – Ratio Detector. Direct and Indirect methods - FM Transmitter – Pre-Emphasis.
IV	**Digital Communication:** Conversion of analog signal to digital. Sampling Theorem – Quantization & Quantization Error – PCM Modulation & Detection -ASK – FSK – BPSK – QPSK – DPSK .
V	**CELLULAR COMMUNICATION** Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G, 4G and 5G concepts.

Suggested Books:

1. Electronic Communication, George Kennedy, 3rd edition, TMH.
2. Electronic Communication, Roddy and Coolen, 4th edition, PHI.
3. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), Damodar Group (Publishers),Burdwan, ISBN: 978-93-85775-15-4 (2019)
4. Electronic Communication systems, Kennedy & Davis, IV edition-TATA McGraw Hill.

Year: Third		**Semester:** Six	
Subject: Electronics			
Course Code: **ELE 305F**		**Course Title: Programming Language**	
Course Outcomes: The completion of this course will enable students to: 1. Learn language C programming model 2. Write code in C language for arithmetic and logical problems 3. Write simple Python programs. 4. Develop Python programs with iteration and recursions.			
Credits: 04		**Core: Compulsory**	
Unit	**Topics**		
I	**C Programming Language**: Introduction, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables: declaration & assigning values. Structure of C program, Arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, expressions and evaluation of expressions, type cast operator, precedence of operators.		
II	**Decision making, branching & looping**: Decision making, branching and looping: if, if-else, else-if, switch statement, break, for loop, while loop and do loop. Functions: Defining functions, function arguments and passing, returning values from functions.		
III	**Overview of Programming:** Structure of a Python Program, Elements of Python **Introduction to Python**: Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms, Identifiers and keywords, Literals, Strings, Operators (Arithmetic operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator)		
IV	**Creating Python Programs**: Input and Output Statements, Control statements (Branching, Looping, Conditional Statement, Exit function, Difference between break, continue and pass.), Defining Functions, default arguments, Errors and Exceptions.		
V	**Iteration and Recursion**: Conditional execution, Alternative execution, Nested conditionals, The return statement, Recursion, Stack diagrams for recursive functions, Multiple assignment, The while statement, Tables, Two-dimensional tables .		

Suggested Books:

1. Ellis Horowitz and Sartaz Sahani "Fundamentals of Computer Algorithms", Computer Science Press.
2. Introduction to Problem Solving with Python E. Balagurusamy TMH 1st 2015
3. Think Python Allen Downey O'Reilly 1st 2012
4. Yashavant Kanetkar, Let Us C , BPB Publications
5. Programming in ANSI C, Balagurusamy, 2nd edition, TMH.
6. Byron S Gottfried, Programming with C , Schaum Series

Year: Third	**Semester:** Six
Subject: Electronics	
Course Code: ELE 306F	**Course Title: COMMUNICATION AND PROGRAMMING LAB**

Course Outcomes:

The completion of this course will enable students to:

1. Understand basics of communication systems.
2. Build understanding of various analog and digital modulation and demodulation
3. Understand the basics of a digital communication system
4. Write Programs in Python and C programming for arithmetic and logical operations.
5. Prepare the technical report on the programming carried.

Credits: 02	**Core: Compulsory**

List of Experiment

Communication:

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 Pulse Amplitude Modulation
5. Study of Pulse Width Modulation
6. Study of Pulse Position Modulation
7. Study of Pulse Code Modulation
8. Study of Amplitude Shift Keying
9. Study of Frequency Shift Keying
10. Study of Phase Shift Keying

Programming

1. C Program to Swap Two Numbers
2. Program to Calculate Fahrenheit to Celsius and vice-versa
3. C Program for Area and Perimeter of Rectangle
4. C Program for Area and Perimeter of circle
5. C Program to Find Factorial of a Number
6. Generate the Fibonacci series up to the given limit N and also print the number of elements in the 33 series.
7. C Program to find the GCD of two integer numbers.
8. Python Program to Find the Square Root
9. Python Program to Calculate the Area of a Triangle
10. Python Program to Solve Quadratic Equation
11. Python Program to Swap Two Variables
12. Python Program to Generate a Random Number
13. Python Program to Convert Kilometers to Mile

Online Virtual Lab Experiment List / Link: **Virtual Labs at Amrita VishwaVidyapeetham**https://vlab.amrita.edu/

Year: Fourth	**Semester:** Seven
Subject: Electronics	
Course Code: ELE 401F	**Course Title: Network Analysis and Synthesis**

Course Outcomes:

The completion of this course will enable students to:

7. Apply the knowledge of basic circuital law and simplify the network using reduction techniques
8. analyze the circuit using Kirchhoff's law and Network simplification theorems.
9. infer and evaluate transient response, Steady state response, network functions.
10. evaluate two-port network parameters.
11. synthesize one port network using Foster and Cauer Forms.
12. This course prepares learner for various national level competitive examination.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Network Analysis:** Circuit elements, Passive and Active circuit elements, concept of ideal voltage and current sources, graph theory, KCL, KVL, node/ cut set, mesh/ tie-set analysis, Transient response of DC and AC networks: Differential equation approach (first and higher order differential equations), initial conditions in networks. Laplace Transformation: Introduction to the Laplace transform approach, partial fraction expansion, Heaviside‟s expansion theorem, Relation between impulse response and system function.
II	**Network Theorems:** Principle of Superposition, Tellegen‟s, Thevenin, Norton, Millman and Maximum Power transfer theorem, T, π and L circuits. Two Port Networks: Two port parameters, Relationship of two port variables, Shortcircuit admittance parameter, the open circuit impedance parameter, transmission parameter, the h–parameters, Relationship between parameter sets, interconnections of two–port networks
III	**Frequency Domain Analysis:** Frequency domain analysis of RLC circuits, Phase diagram, magnitude of phase response curve in s–plane; poles and zeros, relation between location of poles, time response and stability, frequency response and bode plots, interrelation between frequency response and time response, convolution integral.
IV	**Network Synthesis:** Positive real function, Hurwitz polynomials, reliability condition of network, Synthesis of one port network, Synthesis of LC, RC and RL network , Foster and Cauer forms; Two port synthesis by ladder network.

Suggested Books:

1. Network Analysis and Synthesis by Franklin F. Kuo
2. Network Analysis by M.E. Valkenberg
3. Network Synthesis by M.E. Valkenberg
4. Network and System by D. Roy Choudhury
5. Network Analysis by Atre

Year: Fourth	**Semester:** Seven
Subject: Electronics	
Course Code: ELE 402F	**Course Title: Devices and Linear Integrated Circuits**

Course Outcomes:

The completion of this course will enable students to:

1. Apply the knowledge of basic semiconductor material physics.
2. Analyze the characteristics of various electronic devices like diode, transistor etc., and able to classify and analyze the various circuit configurations of Transistor and MOSFETs. Illustrate the qualitative knowledge of Power electronic Devices
3. Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques. Elucidate and design the linear and non-linear applications of an OPAmp and special application ICs
4. Illustrate the application of Voltage regulator ICs.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Semiconductor Physics:** Basic features of metals, Semiconductor, Insulator, energy band/E-k diagram, degenerated and non-degenerated semiconductor, Drift and diffusion currents, Continuity equation.
II	**Semiconductor Devices:** P-N junction: barrier potential, depletion width, I-V characteristics and junction capacitance, **Transistor:** structure, characteristics and parameters, Ebber–Moll model, JFET, MOSFET, CMOS, C–V characteristics.
III	**Operational Amplifier:** Op-Amp fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage, ac and dc characteristics). Basic building blocks using Op-Amps; Inverting/ Non-inverting VCVS, Integrator, Differentiators, CCVS and VCCS, Instrumentation Amplifiers, Active Filter (LP, HP, BP and Notch); Oscillators; Voltage regulators: Op-Amp regulators, IC regulators, Fixed voltage regulators (78/79XX), 723 IC regulators (Current limiting, Current foldback); SMPS; IC Timer (555) applications; Phase Locked Loop (PLL): Principle, Definition and Applications
IV	**Logarithmic Amplifiers:** Log/ Antilog Modules, Precision rectifier, Peak detector, Sampleand Hold (S/H) circuits, Op-Amp as comparator, Schmitt Trigger, Square and Triangular wave generator, Multivibrator, IC Analog multiplier application, Analog Multiplexer and Demultiplexer.

Suggested Books:

1. Physics of Semiconductor Devices by S.M. Sze
2. Transistor by D.L. Croissete.
3. Integrated Electronics by Millman and Halkias.
4. Electronics Devices and Circuit Theory by R.L. Boylestad& L. Nasheisky.
5. Op-Amp and Linear Integrated Circuits by Ramakant A. Gayakwad.

Year: Fourth	**Semester:** Seven
Subject: Electronics	
Course Code: ELE 403F	**Course Title: Switching Theory and Digital Design**

Course Outcomes:

The completion of this course will enable students to:

1. Manipulate numeric information in different forms, e.g. different bases, signed integers, various codes such as ASCII, Gray, and BCD.
2. Solve Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions.
3. Design and Analyze combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.
4. Design and Analyze sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.

Credits: 04	**Core: Compulsory**

Unit	**Topics**
I	**Review of Introductory Concepts:** Switching Networks, Number system and inter-conversion, Review of Logic Families, Boolean Algebra and its application, Positive and Negative Logic, Minterm and Maxterm, 5 and 6 variable K-Map Reduction.
II	**Analysis and Design of Combinational & Sequential Circuit:** Realization of Boolean functions using two level NAND-NAND, NOR-NOR logic, multiplexers, decoders, ROM, PLA; Interfacing of logic families: open- collector, totem-pole and tri-state outputs, TTL-CMOS interfacing, CMOS-TTL interfacing, loading rules, fan-out.
III	**Analysis and Design of Sequential Circuit**: State diagrams, characteristic equations of different flip-flops, conversion from one type to another type of flip flops, State Machine: Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector. Introduction to Algorithmic state machines-construction of ASM chart and realization for sequential circuits.
IV	**Fault Diagnosis and Hazards:** Fault detection and fault location of single fault by fault table method, Path sensitizing method, method of Boolean difference and SPOFF method, Two level circuit fault detection and multilevel circuit fault. Detection

Suggested Books:

1. Fundamentals of Logic Design by Charles H. Roth
2. Digital System Design and Microprocessor by John P Hayes
3. Digital Fundamental by Floyd
4. An Engineering Approach to Digital Design by William I. Fletcher
5. Digital Design by M. Morris Mano
6. Digital Logic and Computer Design by M. Morris Mano

Year: Fourth	**Semester:** Seven
Subject: Electronics	
Course Code: ELE 404F	**Course Title: Advanced Microprocessor and Interfacing**

Course Outcomes:

The completion of this course will enable students to:

1. Identify a detailed s/w & h/w structure of the 8086 and 8088 Microprocessor.
2. Illustrate how the different peripherals are interfaced with Microprocessor.
3. Distinguish and analyze the properties of Advanced Microprocessors and Microcontrollers.
4. Aanalyze the data transfer information through serial & parallel ports.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Introduction to Microprocessors:** Evolution of microprocessors, Register structure, ALU, Bus organization, Timing and control, Architecture: Architecture of 8086/ 8088, Intel organization, Bus cycle.
II	**Assembly Language Programming:** Addressing modes, Data transfer instructions, Arithmetic and logic instructions, Program control instructions (Jumps, Conditional jumps, and Subroutine call), Loop and String instructions, Assembler Directives, Parameter passing and Recursive procedures.
III	**CPU Module Design:** Signal descriptions of pins of 8086 and 8088, Clock generation, Address and data bus, Demultiplexing; Memory organization, Read and write cycle, Timing, Interrupt structures, Minimum mode CPU module, Maximum mode operation (Coprocessor configuration), Features of numeric processor 8087.
IV	**Interfacing:** Programmed I/O, Interrupt driven I/O, DMA, Parallel I/O (8255-PPI), Serial I/O(8251/ 8250, RS-232 Standard), 8259 – Programmable Interrupt Controller, 8237 DMA controller, 8253/ 8254 – Programmable Timer/ Counter, A/D and D/A conversion. Protected virtual addressing mode (PVAM), architecture, Special features and overview of 80286, 80386 and 80486, Pentium Pro processors, Superscalar architecture, MMX (Multimedia Extension) and SIMD (Single Instruction Multiple Data) technology.

Suggested Books:

1. Advanced Microprocessor and Interfacing by D.V. Hall
2. Microprocessor Systems: The 8086/ 8088 family Architecture, Programming and Design by Yu-Chehg Liu and Gibson
3. The Intel Microprocessor Architecture Programming and Interfacing by Barry B Brey

Year: Fourth	**Semester:** Seven
Subject: Electronics	
Course Code: ELE 405F	**Course Title: Network, Devices, Digital and Microprocessor Lab**
Credits: 04	**Core: Compulsory**

Course Outcomes:

The completion of this course will enable students to:

1. to develop knowledge of basic circuital law and simplify the network using reduction techniques
2. Analyze the circuit using Kirchhoff‟s law and Network theorems
3. Use electronic component and Opamp to generate desired output.
4. Analyze the characteristics of various electronic devices like diode, transistor

1. Experiments on Network Theorem.
2. Experiments on Network Synthesis.
3. Experiments on OP-AMP and its applications.
4. Experiments on Electronic Devices
5. Experiments on Combinational logic Design
6. Experiments on Sequential Logic Design.
7. Application of Microsim or other circuit simulation software.
8. Experiments on Microprocessor and Microcontroller programming.

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 406F	**Course Title: Control System**

Course Outcomes:

The completion of this course will enable students to:

1. Translate physical phenomena into corresponding mathematical descriptions, and application of appropriate tools to analyze the behavior of control systems.
2. Deploy graphical tools to analyze and design control systems in time-domain.
3. Understands that the frequency domain is a complementary point of view, and learns to design control systems in frequency-domain.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Input/ Output Relationship:** Introduction to open loop and closed loop control system, Mathematical representation of Physical Systems, Transfer Function, Block diagram and its reduction, Signal flow graph, Reduction Algebra, Mason's gain formula.
II	**Time–Domain Analysis:** Test input signal for transient analysis, Time domain performance criterion, Transient response of first order, second order and higher order systems, Error analysis: Static and dynamic error coefficients, Error criterion, Introduction to system optimization.
III	**Frequency Domain Analysis:** Polar and inverse polar plots, Bode–Plot, Frequency domain specifications, Relative stability: Gain margin and Phase margin, correlation with time domain, M and N circles, Stability Theory: Concept of stability, Asymptotic and conditional stability, Routh-Hurwitz criterion, Nyquist- Stability criterion, Root locus plots.
IV	**PID System:** Proportional, Integral and Derivative control, PI, PID control, Compensation technique: Concept of Lag, Lead, Lag and Lead Networks, Design of closed loop systems using compensation technique.

Suggested Books:

1. Automatic Control System by B.C. Kuo
2. Modern Control Engineering by K. Ogata
3. Control System Engineering by I.J. Nagrath
4. Modern Control System by Doff and Bishop
5. Modern Electronic Instrumentation and Measurement Technique by Cooper

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 407F	**Course Title: Digital Communication**

Course Outcomes:

The completion of this course will enable students to:

1. Apply the knowledge of statistical theory of communication and explain the conventional digital communication system.
2. Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.
3. Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.
4. Describe and analyze the digital communication system with spread spectrum modulation.
5. Design as well as conduct experiments, analyze and interpret the results to provide valid conclusions for digital modulators and demodulator using hardware components and communication systems.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Signal Representation:** Time domain and frequency domain representation, Fourier series and Fourier transform, Numerical computation of FT, Properties of Fourier transform; Linearity, Symmetry, Folding, Delay, Frequency shift. Cosine and Sine transform, Transforms of derivatives, Convolution theorem, Dirac Delta function, energy signal and Power signal, Energy spectral density, Power spectral, Cross – correlation, Auto – correlation function, Parseval‟s theorem.
II	**Noise:** External and internal source of noise, Voltage and current models of a noisy resistor, Calculation of thermal noise in RC circuit, Shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth, Calculation of noise figure for the cascaded network. Review of Analog Communication System: Amplitude and Angle Modulation, Noise in DSB-SC, SSB-SC and AM system, Noise in FM and PM, FM Threshold and its extension, Pre – Emphasis and De – Emphasis in FM.
III	**Digital Modulation System:** Sampling Theorem, Signal reconstruction in Time Domain, Practical and flat-top sampling, sampling of band pass signal; types of analog pulse modulation, method of generation and detection of PAM, PWM and PPM, spectra of pulse modulated system; Discretization in time and amplitude, Linear quantizer, Quantization noise power calculation, Signal to quantization noise ratio, non-uniform quantizer, A-law and μ-law companding; Encoding and Pulse Code Modulation, Band width of PCM, DPCM, DM, Idling noise and slope overload, ADM, Adaptive DPCM.
IV	**Digital Modulation Technique:** Fundamental of TDM, Electronic Commutator, Types of Digital Modulation, Waveform for ASK, FSK, and PSK, Differential Phase Shift Keying, QPSK and MSK. Information Theory: Concept of Information Measure, Entropy and Information rate, conditional entropy and redundancy, Source coding, Fixed and variable length codes, Source coding theorem, Shannon–Fano and Huffman coding for 1st, 2nd and 3rd order extension, Mutual information and channel capacity

	of discrete memory less channel, Hartley – Shannon Law.

Suggested Books:

1. Modern Analog and Digital Communication by B.P. Lathi
2. Principle of Communication System by Taub and Schilling
3. Communication System by Haykin
4. Electronic Communication System by W. Tomasi
5. Digital Communication by J. G. Prokis
6. Electronic Communication System by J. F. Kennedy
7. Digital Communication by Simon Haykin

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 408F	**Course Title: Opto-Electronics**

Course Outcomes:

The completion of this course will enable students to:

1. Recognize and classify the structures of Optical fiber and types.
2. Understand the channel impairments like losses and dispersion.
3. Analyze various coupling losses.
4. Classify the Optical sources and detectors and to discuss their principle.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Optical Sources:** Principle of laser action, types of lasers, fabrication and characteristics ofsemiconductor lasers and LEDs. **Optical Detectors:** Types of photo detectors, Characteristics of photo detector, Principle ofAPD and PIN diodes, Noise in Photo detectors, Photo transistors and Photo conductors
II	**Optical Fiber:** Structure of optical wave guide, Light propagation in optical fiber, Ray andWave Theory, Modes of optical fiber, Step and Graded index fibers. Transmission characteristics of optical fibers: Signal degradation in optical fibers; Attenuation, Dispersion and Pulse broadening in different optical fibers.
III	**Fiber Joints and Couplers:** Fiber Alignments and Joint loss, Fiber Splices, FiberConnectors. Optical Fiber Communication: Components of an optical fiber communication system, Modulation formats, Digital and Analog optical communication systems, Analysis and performance of optical receivers, System design for optical communication.
IV	**Optical Fiber Communication:** The fiber as a communication link, Transmitters and Receivers, Interaction of light with semiconductor materials: absorption and electroluminescence. Semiconductor and fiber optical amplifiers. Optical Link Design: System Considerations, Photoreceiver noise, Bit error rates for attenuation and dispersion limited systems, Link Power Budget, Rise-Time Budget, Line Coding. Optical Networking and Switching: General Network Concepts, SONET/SDH, Optical Ethernet, Network Management, WDM light wave systems and WDM components.

Suggested Books:

1. Optical Electronics by Ghatak and Thyagrajan
2. Optical Fiber Communication by Gerd Keiser
3. Optical Fiber Communication by J.M. Senior
4. Optical Communication by Gower
5. An Introduction to Electro Optic Devices by Kaminov
6. Optical Information Processing by FTS Yu.

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 409F	**Course Title: Electromagnetic Theory and Antenna**

Course Outcomes:

The completion of this course will enable students to:

1. Derive and understand the Maxwell‟s equations.
2. be expected to be familiar with Electromagnetic wave propagation and wave polarization
3. Classify the Guided Wave solutions -TE, TM, and TEM, analyze and design rectangular waveguides and understand the propagation of electromagnetic waves.
4. Analyze the transmission lines and their parameters using the Smith Chart.
5. Apply the knowledge to understand various planar transmission lines.
6. Select the appropriate portion of electromagnetic theory and its application to antennas. Antenna arrays and mathematically analyze the types of antenna arrays.

Credits: 04	**Core: Compulsory**

Unit	Topics
I	**Electromagnetics:** Continuity equation, Displacement current, Maxwell‟s equation, Boundary conditions, Plane wave equation and its solution in conducting and non-conducting media, Phasor notation, Phase velocity, Group velocity, depth of penetration, Conductors and Dielectrics, Impedance of conducting medium, Polarization, Reflection and refraction of plane wave at plane boundaries, Poynting vector and Poynting Theorem.
II	**Transmission Line:** Propagation of EM wave through Line, Differential equation of the lineand their steady state solution; Distortion –less lines, Input impedance of a lossless line, Open and short circuited lines, Reflection coefficient and Standing Wave Ratio; Smith chart and their uses; Impedance matching.
III	**Wave Guide:** Propagation of EM wave through waveguide, Wave equation and its solution for boundary medium, Propagation characteristics of TE and TM mode in rectangular wave guide, Idea of circular wave guide, Waveguide components.
IV	**EM Wave Propagation:** Ground wave propagation, Surface and space wave propagation, Sky wave propagation, Ionosphere, Virtual heights, Critical frequency of layers, Skip distance and maximum usable frequency, Abnormal Ionospheric behavior. **Antenna:** Radiation from an oscillating current element, Short monopole and dipole, Halfwave dipole, Radiation pattern, Power radiated, Radiation resistance, Isotropic radiator, Directive gain, Power gain, Efficiency, Effective area, Effective length, Band width, Beam width and Polarization, Directional patterns, Directives, Effective length, Antenna impedance; Uniform arrays-Broadside, End-Fire, Pattern multiplication. VHF and UHF antennas: Folded dipoles, Yagi, Corner reflector. Microwave antennas: Parabolic reflector, feed system, Lens antennas.

Suggested Books:

1. Electromagnetic waves and Radiating System by E.C. Jorden, D.G. Balmein
2. Engineering Electromagnetics by W.H. Hayt
3. Antenna Theory by Krauss
4. Electromagnetics by J.F.D. Krauss.

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 410F	**Course Title: Control, Power Electronics, Digital Communication, Opto-Electronics, EM Theory and Antenna Lab**

Course Outcomes:

The completion of this course will enable students to:

1. Analysis of different types of control system and identify a set of algebraic equation to represent and model complicated control system in simplified form.
2. Knowledge of statistical theory of communication and explain the conventional digital communication system.
3. Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise
4.

Credits: 04	**Core: Compulsory**

1. Experiments on Control System.
2. Experiments on Digital Communication.
3. Experiments on Power Electronics.
4. Experiments on application of Lab view to Control System.
5. Experiments on application of MATLAB to Communication System.
6. Experiments on Data Acquisition System.
7. Experiments on EM Theory and Antenna.
8. Experiments on Turbo Assembler (8086, 8087 Microprocessor).
9. Experiments on Signal and System.
10. Experiments on Sensors and Transducer

Year: Fourth	**Semester:** Eight
Subject: Electronics	
Course Code: ELE 411F	**Course Title: Research Project**

Course Outcomes:

The completion of this course will enable students to:

1 Undertake a original research project and demonstrate a sound technical knowledge of their project work.

2: Integrate and apply disciplinary knowledge and skills to an independently generated research question and investigation.

3: Analyze and synthesize salient features and important theoretical, methodological and empirical trends in published literature and data.

Credits: 0+12	**Core: Compulsory**

The candidate shall formulate and complete Research Project in the emerging areas of electronics and allied discipline. The candidate has to complete Research Project related to his/her subject major. This course can be completed in the form of Research project work. It can be of interdisciplinary/ multi-disciplinary nature. This Research Project will be completed under the supervision of a faculty member of the concerned department. A co-supervisor can be taken from research organization if needed.