Siddharth University, Kapilvastu, Siddharthnagar

Syllabus
of
Electronics
As Major Type for
B.Sc. Programme
in
Choice Based Credit System (CBCS)
based on
National Education Policy-2020
[Revised vide Academic Council on 25.07.2023]

(Common Minimum Syllabus for all U.P. State Universities and Colleges)

2021

Year wise Structure of B.Sc. (Electronics)

This course shall be offered in B.Sc. programme as a major subject along with two other major subjects and combinations available for the students of B.Sc. programme. Electronics shall be one major subject along with other two major subjects which may be opted by the students as per the combinations offered by the University/College under CBCS.

Year	Sem.	Course Code	Paper Title	Theory/Practical	Credits
I	I	B140101T	Basic Circuit Theory and Network Analysis	Theory	4
		B140102P	Circuits and Networks Lab	Practical	2
	II	B140201T	Semiconductor Devices and Electronic Circuits	Theory	4
		B140202P	Semiconductor Devices and Circuits Lab	Practical	2
II	III	B140301T	Analog Electronics	Theory	4
		B140302P	Analog Electronics Lab	Practical	2
	IV	B140401T	Digital Electronics	Theory	4
		B140402P	Digital Electronics Lab	Practical	2
III	V	B140501T	Electromagnetics and Antenna Fundamentals	Theory	4
		B140503P	Antenna Fundamentals Lab	Practical	2
		B140502T	Microprocessor Programming and Interfacing	Theory	4
		B140504P	Microprocessor Lab	Practical	2
	VI	B140601T	Communications Electronics	Theory	4
		B140603P	Communication Electronics Lab	Practical	2
		B140602T	Linear Integrated Circuits	Theory	4
		B140604P	Integrated Circuit Lab	Practical	2

Total Credits= 48

Programme/Class: Certificate	Year: First	Semester: First
Paper-1 Theory	**Subject: Electronics**	
Course Code:B140101T	**Course Title: Basic Circuit Theory and Network Analysis**	

Course outcomes:

1. Identifies the basic elements and systems used in analog and digital circuits.
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.

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Basic Circuit Concepts**: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel. Inductors: Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, Testing of resistance and inductance using multi meter. Capacitors: Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors, testing of capacitors using multi meter.	**14**
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, 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.	**14**
III	**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. Passive Filters: Low Pass, High Pass, Band Pass and Band Stop.	**12**
IV	**Network Theorems**: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem.	**10**

V	AC circuit analysis using Network theorems. Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. **Network Graph Theory:** Equivalent Graph,Incidence matrix,Tie-Set and Cut Set.	**10**

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)
6. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
7. Bell,ElectronicCircuits,Oxford University Press
8. Carlson,Circuits,cengage
9. Kuo,Network Analysis and Synthesis,Wiley
10. Dorf and Svoboda,Introduction to Electric Circuits,Wiley
11. Decarlo and Lin,Linear circuit Analysis,Oxford

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Programme/Class: Certificate	Year: First	Semester: First
Subject: Electronics		
Course Code: B140102P	**Course Title: Circuits and Networks Lab**	

Course Outcomes (COs)

Understand experimental electronics to know the circuit elements and their interconnections. Measurement precision and perfection is achieved through Lab Experiments. Some online Virtual Lab Experiments will also give an insight in simulation techniques and provide a basis for modeling.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List

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 VishwaVidyapeethamhttps://vlab.amrita.edu/

Programme/Class: Certificate	Year: First	Semester: Second
Paper-1	Theory	Subject: Electronics
Course Code:B140201T	Course Title: Semiconductor Devices and Electronic Circuits	

Course Outcomes:

1.Understand the basic material and properties of semiconductors
2. Explore the constructional features of basic semiconductor devices.
3. Describe the biasing principles of semiconductor devices like diode and transistors
4. Explain the I-V characteristics of semiconductor devices like diode, BJT, UJT, JFET and MOS FET.
5.The learner will be able to apply basic concepts of P-N Junction in developing simple application circuits.
6. Understand the power supply at block level.
7. Attain knowledge of various amplifiers and their comparison.
8. Identify the applications of JFET & MOSFET.
9. Familiarization with basics of thyristor family.

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks : As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Semiconductor Basics** Introduction to Semiconductor Materials, Intrinsic Semiconductors and Extrinsic semiconductors, n type semiconductors, p type semiconductors with reference to energy levels, Donors, Acceptors, concept of Fermi Level. **PN Junction Diode** Symbol, pins, unbiased diode, depletion layer, barrier potential, working in forward bias and reverse bias, concept of break down, I-V characteristics, knee voltage, break down voltage, bulk resistance, zener diode, light emitting diode, photo diode, solar cell.	14
II	**Bipolar Junction Transistor (BJT)** Symbol, pins, basic types- PNP and NPN, unbiased transistor, Biased Transistor, transistor currents, concept of current gain, α, β of BJT, configurations CE,CB and CC, with respect to CE configuration I-V characteristics-base curve and collector curves, load line, operating point, Biasing techniques - voltage divider bias, emitter bias, collector feedback bias and base bias.	12
III	**UJT, JFET and MOSFET** Symbol, types, construction, working principle, I-V characteristics, Specifications parameters of: Uni-Junction Transistor (UJT), Junction Field Effect Transitor (JFET), Metal Oxide Semiconductor FET (MOSFET), comparison of JFET, MOSFET and BJT.	10
IV	**Diode Circuits** Half wave rectifier, transformer, full wave rectifier, bridge rectifier, choke input filter, capacitor input filter, peak inverse voltage and surge current, block diagram of power supply, zener regulator, clippers and limiters, clampers and voltage multipliers	12

V	**Transistor Circuits** Transistor as a switch, transistor as an amplifier, class A operation, class B operation, Emitter follower, class B push-pull emitter follower, class C operation, Single stage RC coupled CE amplifier, voltage gain, concept of frequency response and bandwidth, JFET biasing in ohmic/active region, MOSFET in digital switching	**12**

Recommended Book:

1. Electronic Principles - Albert Malvino, David J. Bates , 7th Edition (2016)
2. Basic Electronics - B, Grob, Mitchel E. Schultz , 11th Editio, (2007)
3. Solid state Electronic Devices, B. G. Streetman and S. Banerjee, Pearson Education (2006)
4. Electronic Principles, Albert Malvino, David J. Bates, 7th Edition (2016)
5. Basic Electronics - B, Grob, Mitchel E. Schultz , 11th Edition, (2007)
6. Basic Electronics and Linear circuits, N. N. Bhargava, D. C. Kulshreshtha, S. C. Gupta, Tata McGraw Hill (2008)
7. Semiconductor devices, Kanaan Kano, Pearson Education (2004)

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha – DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Semiconductor Devices:

1.Virtual Labs an initiative of MHRD Govt. of India http://vlabs.iitkgp.ernet.in/be/index.html#
2. Virtual Labs at Amrita VishwaVidyapeetham, https://vlab.amrita.edu/
3. Virtual Labs an initiative of MHRD Govt. of India, http://vlabs.iitkgp.ernet.in/be/index.html#

Programme/Class: Certificate	Year: First	Semester: Second
Subject: Electronics		
Course Code: B140202P	**Course Title: Semiconductor Devices and Circuits Lab**	

Course Outcomes (COs)

To know the Characteristics of semiconductor devices and circuits and their uses in electronic equipment. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments can give an insight in simulation techniques and provide a basis for modeling.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List

1. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
2. Study of the I-V Characteristics of the CE configuration of BJT and obtain ri, ro, β.
3. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain ri, ro, α.
4. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain, ri, ro.
5. Study of the I-V Characteristics of the UJT and SCR.
6. Study of the I-V Characteristics of JFET and MOSFET
7. Study of Characteristics of Solar Cell
8. Study of Hall Effect.
9. Study of the half wave rectifier and Full wave rectifier.
10. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation
11. Study of clipping and clamping circuits.
12. Designing of a Single Stage CE amplifier.
13. Study of Class A, B and C Power Amplifier.
14. Study of the Colpitt's Oscillator.
15. Study of the Hartley's Oscillator.
16. Study of the Phase Shift Oscillator
17. Study of the frequency response of Common Source FET amplifier

Online Virtual Lab Experiment List / Link

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

Programme/Class: Diploma	Year: Second	Semester: Third
Paper-1	Theory	Subject: Electronics
Course Code: B140301T	Course Title: Analog Electronics	

Course outcomes:

The learner should be able 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.

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Regulated Power Supply :** **Rectifier Circuit :** Half, full and bridge rectifier circuits with resistor load, their output waveforms, output DC voltage and power, rectifier efficiency and ripple factor; Design consideration and rating; Voltage multiplying rectifiers; Doubler, trippler and quadrupler. **Filter Circuits** : Series inductor, shunt capacitor, L-section, Π-section and R-C filter circuits; Evaluation of output D.C. voltage and ripple factor when they are fed with AC full wave rectifier; Design consideration. **Regulator Circuits :** Load and line regulation, stabilization ratio, internal impedance and temperature coefficient of voltage regulation; Linear voltage regulator circuits; Non-feedback type; Series and shunt regulator; Design consideration of each circuit. **Controlled Rectification and Switch Mode Power Supply** : SCR controlled half and full wave rectifier circuits and their analysis; Elements of SMPS, SCR control and stability in SMPS.	**14**
II	**Amplifier : Basic Requirements and Principles.** **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 Z, Y and hybrid parameters form and their analysis; Noise and distortion in SST amplifier.	**12**
III	**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. **Negative Feedback Amplifier:** C-E amplifier with series and shunt feedback; Emitter follower; Source follower, Cascade amplifier for transistor and FET, Darlington pair.	**10**

IV	**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.	**12**
V	**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 Colpitt oscillator circuit and their analysis; Negative resistance oscillator; Frequency stability; Crystal controlled oscillator; Pierce and Miller circuits.	**12**

Suggested Books:

1. Electronic Devices and Circuits by J. Millman& C. Halkias (McGraw Hill, New York)
2. Electrical Circuits and Introductory Electronics by Vinod Prakash (Lok Bharti Prakashan, 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

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: Electronics		
Course Code: B140302P	**Course Title: Analog Electronics Lab**	

Course Outcomes (COs)

Experimental Electronics has the most striking impact on the academia and industry wherever the instruments are used to know the Characteristics of devices and circuits behavior are very important in view of its application in electronic equipment. Measurement precision and perfection is achieved through Lab Experiments. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List

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. Basic knowledge of the circuits of the test instruments.
16. Identification of electronic components.
17. Study of ac power control using SCR

Online Virtual Lab

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

Programme/Class: Diploma	Year: Second	Semester: Fourth
Paper-1	Theory	Subject: Electronics
Course Code: B140401T	Course Title: Digital Electronics	

Course outcomes:

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

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks:As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Number Systems and Codes** Binary Number System, Binary-to-decimal Conversion, Decimal-to-binary Conversion, Octal Numbers, Hexadecimal Numbers, The ASCII Code, The Excess-3 Code, The Gray Code, Error Detection and Correction .	14
II	**Digital principles and logic** Definitions for 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, AND-OR-Invert Gates, Positive and Negative Logic	12
III	**Combinational Logic Circuits** Boolean Laws and Theorems, Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs, Quads, and Octets , Karnaugh Simplifications , Don't-care Conditions , Product-of-sums Method, Product-of-sums Simplification, Simplification by QUINE-Mc-CLUSKY Method	10
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	12
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 – Shift counters – Ring counter – Shift counters - Sequence generators. Logic Families register	12

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.
4. Electronic Principals, A. P. Malvino, Tata McGraw-Hill, (2003)

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx

Programme/Class: Diploma	Year: Second	Semester: Fourth
Subject: Electronics		
Course Code: B140402P	**Course Title: Digital Electronics Lab**	

Course Outcomes (COs)

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

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List

1.Study of AND, OR, NOT, NAND, NOR and XOR gates using IC
2. Designing of all the logic gates using NAND gate IC
3. Designing of all the logic gates using NOR gate IC
4. Verification of Demorgan's theorems
5. Construction of gates using discrete components

Design and Verify Following:-

6. Code conversion
7. Half adder and Full adder
8. Half subtractor and Full subtractor
9. Multiplexer and De-Multiplexer
10. Encoder and Decoder
11. Study of Flip flops
12. Shift register
13. Ripple counter

Online Virtual Lab Experiment List / Link

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

Programme/Class: Degree	Year: Third	Semester: Fifth
Paper-1	Theory	Subject: Electronics
Course Code: B140501T	Course Title: Electromagnetics and Antenna Fundamentals	

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

1. Getting familiar with vector algebra, coordinate system and coordinate conversion
2. Plotting of fields (Electrostatic and Magnetostatics) and solution of Laplace's equation.
3. Physical interpretation of Maxwell's equation and problem solving in different media.
4. Understanding of propagation of an electromagnetic wave.
5. Basics of antenna ,its radiation behavior and different types of antenna

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Vector Analysis, Poisson's Equation and Laplace Equation:** Scalars and Vectors, Unit Vector and Vector Components, Vector Field, Vector Algebra, Rectangular (Cartesian) Coordinate, Curvilinear Coordinates: Unit Vectors and Scalar Factors, Cylindrical Coordinate and Spherical Coordinate, Differential Length, Area and Volume, Line, Surface and Volume Integrals, Del Operator, Gradient of a Scalar, Divergence of a Vector and Divergence Theorem, Curl of a Vector and Stokes's Theorem, Green's Theorem, Laplacian of a Scalar.	14
II	**Electrostatics:** Coulomb's Law, Electric Field and Electric Potential due to Discrete and Continuous Charge Distributions, Electric Flux Density, Gauss's Law – Maxwell's Equation and Applications, Electric Dipole, Electric Fields in Different Materials, Current and Current Density, Polarization, Dielectric Constant, Linear and Nonlinear, Homogeneous and Inhomogeneous, Isotropic and Anisotropic Dielectrics, Boundary Conditions, Poisson's and Laplace's Equations and their Derivations and Examples of Solutions, Uniqueness Theorem, Capacitance and Capacitors, Method of Images, Electrostatic Energy and Forces, Energy Density.	12
III	**Magnetostatics:** Biot Savart's Law and Applications, Magnetic Dipole, Ampere's Circuital Law – Maxwell's Equation and Applications, Magnetic Flux and Magnetic Flux Density – Maxwell's Equation, Scalar and Vector Magnetic Potentials. Magnetization in Materials and Permeability, Anisotropic Materials, Magnetic Boundary Conditions, Inductors and Inductances, Mutual and Self Inductance, Magnetic Circuits, Magnetic Energy, Forces, Torque and Moment.	10
IV	**Time-Varying Fields and Maxwell's Equations:** Faraday's Law of Electromagnetic Induction – Maxwell's Equation, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement Current, Maxwell's Equations in Differential and Integral Form and Constitutive Relations, Potential Functions, Lorentz Gauge and Wave Equation for Potentials, Concept of Retarded Potentials, Electromagnetic Boundary Conditions.	12

V	**Antenna Fundamentals** Antenna Basics: Introduction-Definition, functions and properties of Antenna-Radiation mechanism of Antennas Antenna Parameters(qualitative study only) : Isotropic Radiator, Antenna Impedance, Radiation resistance, Radiation Pattern, Radiation Power density & Intensity, Gain, Directive Gain & Power Gain, Directive Gain and Directivity, Antenna Efficiency, Effective Area/Aperture, Antenna Bandwidth and Beam Width, Beam Efficiency, Antenna Temperature, Antenna polarization , EIRP, Friis Transmission Formula. Principles of Horn, Parabolic dish and rectangular Patch antennas.	**12**

Suggested Reading:

1. G.S.N Raju, Antennas and Wave Propagation, PEARSON.
2. John D. Krauss, Antennas for all Applications, 3/e, TMH.
3. Constantine A Balanis, Antenna Theory and Design, 2/e, Wiley Publications.
4. R.E Collin, Antennas & Radio Wave Propagation, McGraw Hill, 1985.
5. Thomas A. Milligan, Modern Antenna Design, IEEE PRESS, 2/e, Wiley Interscience.
6. V. Soundara Rajan, Antenna Theory and Wave Propagation, Scietech Publishers, Chennai.
7. Spiegel, Lipschutz and Spellman, Vector Analysis, Schaum's Outline Series, Tata McGraw Hill.
8. Ida, Engineering Electromagnetics, Springer.
9. Sadiku, Elements of Electromagnetics, Oxford.
10. Rao and Narayanappa, Engineering Electromagnetics, Cengage.
11. Hayt, Buck and Akhtar, Engineering Electromagnetics, Tata McGraw Hill.
12. Cheng, Field and Wave Electromagnetics, Pearson.
13. Edminster, Electromagnetics, Schaum's Outline Series, Tata McGraw Hill.
14. Rao, Elements of Engineering Electromagnetics, Pearson.
15. Griffiths, Introduction to Electrodynamics, Pearson.
16. Jordan and Balmain, Electromagnetic Waves and Radiating Systems, Pearson.

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Programme/Class: Degree	Year: Third	Semester: Fifth
Paper-2	**Theory**	Subject: **Electronics**
Course Code: B140502T	**Course Title: Microprocessor and Microcontroller**	

Course Outcomes: At the end of this course, students will be able 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.

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
I	**Introduction to Microprocessor:** 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.	**10**
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.	**16**
III	**Interrupts:** Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts, Latency Time and Response Time.	**12**
IV	**Interfacing:** 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).	**12**
V	**8051 I/O Port Programming:** Introduction of I/O Port Programming, 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.	**10**

Suggested Reading:

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.

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Programme/Class: **Degree**	Year: **Third**	Semester: **Fifth**
Subject: **Electronics**		
Course Code: B140503P	Course Title: **Antenna Fundamentals Lab**	

Course Outcomes (COs)

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

1. to understand working of simple Antenna
2. to understand the concept Antenna its radiation behavior
3. to understand working of different types of antenna

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**	

Topics

In this course the students shall be exposed to various practical problems based on the Directivity, Bandwidth, Beamwidth of different types of antenna, etc. and the Teacher-in-Charge shall design 10-15 problems. The students shall be required to systematically work out the solution of those problems and implement in the laboratory.

Online Virtual Lab Experiment List / Link

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

Programme/Class: **Degree**	Year: **Third**	Semester: **Fifth**
Subject: **Electronics**		
Course Code: B140504P	Course Title: **Microprocessor Lab**	

Course Outcomes (COs) At the end of this course, students will be able to

1. to understand architecture and assembly language programming of microprocessor.
2. to 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.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List:

1. Program for 8 Bit Addition and Subtraction
2. Program for16 Bit Addition and subtraction
3. Program for 8 Bit Multiplication and division
4. Program for 16Bit Multiplication and Division
5. Program for Square and Square root of a number
6. Program for Sorting and Searching
7. Program for Smallest and Largest number in an array.
8. Program for Reversing a String
9. Program for Fibonacci series.
10. Program for Factorial of a number
11. Program for B.C.D to Binary, Binary to B.C.D, A S C I I to Binary,
12. Binary to ASCI I Conversion
13. Six letter word display.
14. Rolling display
15. Interfacing seven segment display to display any character.
16. Program to display Time(Hours and Minutes)
17. Program for 1's complement and 2's complement of 8 bit and 16 bit data
18. Interfacing Traffic light controller
19. Interfacing Stepper motor control
20. Interfacing Matrix Keyboard
21. Interfacing A.D.C
22. Interfacing D.A.C
23. Study of 8255 chip and generation of
    1. Square wave
    2. Triangular wave
    3. Saw Tooth wave

Online Virtual Lab Experiment List / Link

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

Programme/Class: Degree	Year: Third	Semester: Sixth
Paper-1	**Theory**	Subject: **Electronics**
Course Code: B140601T	**Course Title: Communication Electronics**	

Course outcomes:

At the end of this course students will be able to

1. To understand the principles of communication
2. To study the amplitude modulation and demodulation techniques.
3. To learn frequency modulation and demodulation techniques
4. On completion of course student will apply engineering mathematical concepts in various communication techniques
5. To understand the cellular communication

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
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. **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.	**16**
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-FM generation.	**08**
III	**AM & FM RECEPTION** AM 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.	**12**
IV	**PULSE MODULATION** PAM Modulation & Detection – PWM Modulation & Detection - PPM Modulation & Detection - Sampling Theorem – Quantization & Quantization Error – PCM Modulation & Detection - Companding – ASK – FSK – BPSK – QPSK – DPSK .	**08**

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 and 4G concepts.	**16**

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.
5. Advanced Electronic Communication systems, Wayne Tomasi- 6th edition, Low priced edition- Pearson education
6. Blake, Electronic Communication Systems, Cengage.
7. Kundu, Analog and Digital Communications, Pearson.
8. Taub, Herbert, and Donald L. Schilling. Principles of communication systems. McGraw-Hill Higher Education
9. Kennedy, Electronic Communication System, TMH.

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. National Programme on Technology Enhanced Learning (NPTEL),https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

Programme/Class: Degree	Year: Third	Semester: Sixth
Paper-2	**Theory**	Subject: **Electronics**
Course Code B140602T	**Course Title: Linear Integrated Circuits**	

Course outcomes:

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

Credits: 4	Compulsory
Max. Marks: 25+50	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures = 60

Unit	Topics	No. of Lectures
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)	**12**
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.	**12**
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.	**12**
IV	**Signal Conditioning circuits:** Sample and hold systems, Active filters: First order low pass and high pass butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers	**12**

V	**Multivibrators (IC 555):** Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565.	**12**

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

Suggestive Digital Platforms / Web Links

1. MIT Open Learning - Massachusetts Institute of Technology,https://openlearning.mit.edu/
2. NPTEL ,https://www.youtube.com/user/nptelhrd
3. Uttar Pradesh Higher Education Digital Library,http://heecontent.upsdc.gov.in/SearchContent.aspx

Programme/Class: **Degree**	Year: **Third**	Semester: **Sixth**
Subject: **Electronics**		
Course Code: B140603P	Course Title: **Communication Electronics Lab**	

Course Outcomes (COs)

At the end of this course, students will be able 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 problem.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List:

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

Online Virtual Lab Experiment List / Link

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

Programme/Class: **Degree**	Year: **Third**	Semester: **Sixth**
Subject: **Electronics**		
Course Code: B140604P	Course Title: **Integrated Circuit Lab**	

Course Outcomes (COs)

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

1. Understand and 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.

Credits: **2**	Core Compulsory
Max. Marks: **25**	Min. Marks: As per UGC/University CBCS norm

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: **0-0-4**

Topics

Lab Experiment List:

1. Study of op-amp characteristics.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.
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 a stable multivibrator.
10. Study of IC 555 as mono stable multivibrator

Online Virtual Lab Experiment List / Link

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