National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities/ Colleges
SUBJECT: ELECTRONICS

Name	Designation	Affiliation
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Department of Higher Education

U.P. Government, Lucknow

National Education Policy-2020
Common Minimum Syllabus for all U.P. State Universities

Proposed Titles for Theory and Practical Papers Under Graduate Programme

SUBJECT: ELECTRONICS

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National Education Policy-2020Common Minimum Syllabus for all U.P. State Universities

Semester-wise Titles of the Papers in B.Sc. (Electronics)

SEMESTER-WISETITLESOFTHEPAPERSINUGELECTRONICSCOURSE

YEAR	SEME-STER	COURSE CODE	PAPER TITLE	THEORY / PRACTICAL	CREDIT
			CERTIFICATE INBASICELECTRONICS		
FIRST YEAR	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
			DIPLOMA INADVANCED ELECTRONICS		
SECOND YEAR	III	B140301T	Analog Electronics	Theory	4
		B140302P	Analog Electronics Lab	Practical	2
	IV	B140401T	Digital Electronics	Theory	4
		B140402P	Digital Electronics Lab	Practical	2
			DEGREE INBACHELOROFSCIENCE		
THIRD YEAR	V	B140501T	Electromagnetics and Antenna Fundamentals	Theory	4
		B140502T	Microprocessor Programming and Interfacing	Theory	4
		B140503P	Antenna and Microprocessor Lab	Practical	2
	VI	B140601T	Communications Electronics	Theory	4
		B140602T	Linear Integrated Circuits	Theory	4
		B140603P	IC and Communication Lab	Practical	2

PROGRAMME SPECIFIC OUTCOMES (PSOs)

CERTIFICATE

INBASICELECTRONICS

FIRST YEAR

Identifies the basic elements and systems used in real analog world and modern digital world.
Explore fundamental laws and elements of electrical circuits.
Understand DC circuit, theorems, and networks.
Understands 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 MOS FET

DIPLOMA

INADVANCED ELECTRONICS

SECOND YEAR

Convert different type of codes and number systems in computers and communication.
Describe switch model used to illustrate building blocks of digital circuits.
Use Boolean algebra and Karnaugh maps for reduction of logic expressions and circuits.
Perform arithmetic operation on binary numbers and design simple arithmetic logic circuits.
The learner will be able to develop Ability to apply basic concepts of P-N Junction and Transistor in developing simple application circuits.
Understand the power supply at block level. Attain knowledge of various amplifiers and their comparison. Identify the applications of JFET & MOSFET. Familiarization with basics of thyristor family.

DEGREE

INBACHELOROFSCIENCE

THIRD YEAR

This programme contains very important aspects of electronics course curriculum, namely, Communication,Electromagnetics,antenna,Microprocessor&and Integrated Circuits fundamentals.
The learner will be able to develop Ability to apply basic concepts of electronics circuit design in application based circuit development.
Understand the fundamentals of communication systems.
Use microprocessors to design systems for real life application.

SEMESTER-WISE PAPER TITLES WITH DETAILS

YEAR	SEME-STER	PAPER	PAPER TITLE	PREREQUISITE For Paper	ELECTIVE For Major Subjects
			CERTIFICATE INBASICELECTRONICS		
FIRST YEAR	SEMESTER I	Theory Paper-1	Basic Circuit Theory and Network Analysis	Physics in 12th / Mathematics in12th	YES Open to all
		Practical Paper	Circuits and Networks Lab	Opted Sem I, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat
	SEMESTER II	Theory Paper-1	Semiconductor Devices and Electronic Circuits	Physics in 12th / Mathematics in 12th	YES Open to all
		Practical Paper	Semiconductor Devices and Circuits Lab	Opted Sem II, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat.
			DIPLOMA INADVANCED ELECTRONICS		
SECOND YEAR	SEMESTER III	Theory Paper-1	Analog Electronics	Passed Sem I, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat.
		Practical Paper	Analog Electronics Lab	Opted Sem III, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat.
	SEMESTER IV	Theory Paper-1	Digital Electronics	Physics in 12th / Mathematics in 12th	YES Open to all
		Practical Paper	Digital Electronics Lab	Opted Sem IV, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat.
			DEGREE INBACHELOROFSCIENCE		

THIRD YEAR	SEMESTER V	Theory Paper-1	Electromagnetics and Antenna Fundamentals	Passed Sem I, Th Paper-1	YES Phy./Chem./Comp. Sc./Math./Stat.
		Theory Paper-2	Microprocessor Programming and Interfacing	Passed Sem IV, Th Paper-1	YES Phy./Chem./Comp. Sc./ Math./Stat.
		Practical Paper	Antenna and Microprocessor Lab	Opted Sem V, Th Paper-2	YES Phy./Chem./Comp. Sc./Math./Stat.
		Theory Paper-1	Communications Electronics	Passed Sem III, Th Paper-1 Sem IV, Th Paper-1	YES Phy./Chem./Comp. Sc./Math./Stat.
	SEMESTER VI	Theory Paper-2	Linear Integrated Circuit	Passed Sem II, Th Paper-1 Sem III, Th Paper-1	YES Phy./Chem./Comp. Sc./Math./Stat.
		Practical Paper	IC and Communication Lab	Opted Sem VI, Th Paper-1	YES Phy./Chem./Comp. Sc./Math./Stat.

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:

Identifies the basic elements and systems used in analog and digital circuits.
Explore fundamental laws and elements of electrical circuits.
Understand DC circuit, theorems, and networks.
Understands AC circuits and related terminologies with examples.

Credits: 4	Compulsory
Max. Marks: 25-75	Min. Marks:.....
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/

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Passed Sem I, Th Paper-I

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
2. edX,https://www.edx.org/course/subject/electronics
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/#electrical-engineering-and-computer-science
4. Swayam - Government of India,https://swayam.gov.in/explorer?category
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

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 / Elective

Max. Marks: **25+75** Min. Marks:

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

Unit	**Topics**	**No. ofLectures**
	Lab Experiment List	60
	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+75	Min. Marks:.....
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

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

Semiconductor Devices:

Virtual Labs an initiative of MHRD Govt. of India

1. 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#

This course can be opted as an Elective by the students of following subjects

Open to all

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Physics in 12th / Mathematics in 12th

Suggested Equivalent Online Courses

6. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
7. edX,https://www.edx.org/course/subject/physics
8. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/
9. Swayam - Government of India,https://swayam.gov.in/
10. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

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 / Elective

Max. Marks: **25+75** Min. Marks:

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

Unit	**Topics**	**No. of Lectures**
	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	60
	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+75	Min. Marks:.....

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 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

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://heccontent.upsdc.gov.in/SearchContent.aspx
4. SwayamPrabha - DTH Channel,https://www.swayamprabha.gov.in/index.php/program/

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Passed Sem III, Th Paper-1
Sem IV, Th Paper-1

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
2. edX,https://www.edx.org/course/subject/
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/
4. Swayam - Government of India,https://swayam.gov.in/
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

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 / Elective

Max. Marks: **25+75** Min. Marks:

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

Unit	Topics	No. ofLectures
	Lab Experiment List	60
	Study of full wave and bridge rectifier. 1. Study of unregulated power supply. 2. Study of Zener and emitter follower regulator circuits. 3. Study of transistor series and shunt regulator circuits. 4. Study of controlled rectification using SCR. 5. To study biasing stability in BJT. 6. Phase and frequency response of RC network. 7. Phase and frequency response of low pass and high pass filter. 8. Phase and frequency response of interstage transformer. 9. Phase and frequency response of R-C coupled amplifier. 10. Generation and Fourier analysis of saw tooth wave. 11. Testing of electronic component by CRO and their measurement by LCR bridge. 12. Design of regulated low voltage power supply. 13. Design of low signal R-C coupled amplifier. 14. Basic knowledge of the circuits of the test instruments. 15. Identification of electronic components. 16. 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: 25–75	Min. Marks:.....

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 epresentation, 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 register	12

counters Ring counter Shift counters - Sequence generators. Logic Families

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)**

Suggestive Digital Platforms / Web Links

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

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Physics in 12^{th} / Mathematics in 12^{th}

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
2. edX,https://www.edx.org/course/subject/
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/
4. Swayam - Government of India,https://swayam.gov.in/
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

Programme/Class: Certificate **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 / Elective

Max. Marks: **25+75** Min. Marks:

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

Unit	**Topics**	**No. of Lectures**
	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	60
	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+75	Min. Marks:.....

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:** BiotSavart'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 Bandwidthand Beam Width, Beam Efficiency, Antenna Temperature, Antenna polarization , EIRP,Friis Transmission Formula.Principles of Horn, Parabolic dish and rectangular Patchantennas.	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. SoundaraRajan, 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/

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Passed Sem I, Th Paper-1

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
2. edX,https://www.edx.org/course/subject/
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/
4. Swayam - Government of India,https://swayam.gov.in/
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

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+75	Min. Marks:.....

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/

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Passed Sem IV, Th Paper-1

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX,https://www.edx.org/course/subject/
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/ /
4. Swayam - Government of India,https://swayam.gov.in/
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

Programme/Class: **Degree**	Year: **Third**	Semester: **Fifth**
	Subject: **Electronics**	
Course Code: B140503P	Course Title: **Antenna and 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.
5. Understand working of simple Antenna

Credits: **2** Core Compulsory / Elective

Max. Marks: **25+75** Min. Marks:

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

Unit	Topics	No. of Lectures
	Lab Experiment List	
	A. Microprocessor Lab 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	60

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

C.Antenna

1.Experiment to determine Directivity, Bandwidth, Beamwidth of different types of antenna

Online Virtual Lab Experiment List / Link
Virtual Labs at Amrita VishwaVidyapeethamhttps://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+75	Min. Marks:.....

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**Conceptof 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/

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 Marks
Class performance/Participation: 5 Marks

Course Prerequisites

Passed Sem III, Th Paper-1
Sem IV, Th Paper-1

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/physics-and-astronomy
2. edX,https://www.edx.org/course/subject/physics
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/physics/
4. Swayam - Government of India,https://swayam.gov.in/explorer?category=Physics
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

i. Further Suggestions

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+75	Min. Marks:.....

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 monostablemultivibrator circuit, Applications of Monostable and Astablemultivibrators. 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. 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/

This course can be opted as an Elective by the students of following subjects

Phy./Chem./Comp. Sc./ Math./Stat

Suggested Continuous Internal Evaluation (CIE) Methods

Total Marks: 25
House Examination/Test: 10 Marks
Written Assignment/Presentation/Project / Research Orientation/ Term Papers/Seminar: 10 MarksClass performance/Participation: 5 Marks

Course Prerequisites

Opted / Passed
Sem II, Th Paper-1
Sem III, Th Paper-1

Suggested Equivalent Online Courses

1. Coursera,https://www.coursera.org/browse/physical-science-and-engineering/
2. edX,https://www.edx.org/course/subject/
3. MIT Open Course Ware - Massachusetts Institute of Technology,https://ocw.mit.edu/courses/
4. Swayam - Government of India,https://swayam.gov.in/
5. National Programme on Technology Enhanced Learning (NPTEL),https://nptel.ac.in/course.html

Further Suggestions

Programme/Class: **Degree**	Year: **Third**	Semester: **Sixth**
Subject: **Electronics**		
Course Code: B140603P	Course Title: **IC andCommunication 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
4. Understand and Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
5. Elucidate and design the linear and non linear applications of an op-amp and special application ICs.
6. Explain and compare the working of multi vibrators using special application IC 555 and general purpose op-amp.

Credits: **2**	Core Compulsory / Elective
Max. Marks: **25+75**	Min. Marks:

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

Unit	Topics	No. of Lectures
	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 11. Study of op-amp characteristics. 12. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.	

	13. Designing of analog adder and subtractor circuit. 14. Designing of an integrator using op-amp for a given specification and study its frequency response. 15. Designing of a differentiator using op-amp for a given specification and study its frequency response. 16. Designing of a First Order Low-pass filter using op-amp. 17. Designing of a First Order High-pass filter using op-amp. 18. Designing of a RC Phase Shift Oscillator using op-amp. 19. Study of IC 555 as an astablemultivibrator. 20. Study of IC 555 as monostablemultivibrator.	60
	Online Virtual Lab Experiment List / Link	
	Virtual Labs at Amrita VishwaVidyapeethamhttps://vlab.amrita.edu/index.php?sub=59	