CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY
KANPUR

Four Year Undergraduate Programme (FYUP)

ELECTRONICS

Syllabus of

4 YEAR B.Sc. (HONOURS)

4 YEAR B.Sc. (HONOURS WITH RESEARCH)

AND

4+1 YEAR (B.Sc. HONOURS/ B.Sc. HONOURS WITH RESEARCH + M.A.) IN ELECTRONICS

SESSION 2025-2026 ONWARDS

Minutes of the Meeting of the Board of Studies (BoS)

Subject: Electronics

The meeting of the Board of Studies of the subject Electronics was held on 5th August, 2025 through hybrid mode in the Department of Electronics and Communication Engineering, C.S.J.M. University, Kanpur at 16:30 hrs. The Google Meet link for the meeting was: https://meet.google.com/cko-wcca-uqq

Members Board of Studies

Convener (BoS):

- **Dr. Manoj Johri**, Professor, Dept. of Physics & Electronics, DAV P.G. College, Kanpur

External Subject Experts:

1. **Dr. Ganga Ram Mishra**, Professor, Dept. of Physics & Electronics, RMLAU, Ayodhya
2. **Dr. Rajiv Manohar**, Professor, Dept. of Physics, Lucknow University, Lucknow
3. **Dr. Manish Mishra**, Professor, Dept. of Electronics, DDU University, Gorakhpur
4. **Dr. Khem B. Thapa**, Professor, Dept. of Physics, BBAU, Lucknow
5. **Dr. O.P. Singh**, Associate Professor, IET, Lucknow

Internal Members:

1. **Dr. Vishal Awasthi**, Associate Professor, CSJM University, Kanpur
2. **Dr. Ajay Tiwari**, Assistant Professor, CSJM University, Kanpur
3. **Dr. Om Prakash Gupta**, Assistant Professor, DBS P.G. College, Kanpur
4. **Dr. Swadesh Kumar Gupta**, Assistant Professor, DBS P.G. College, Kanpur

Invitee Member:

- **Mr. Sachin Gupta**, Assistant Professor,DAV P.G. College, Kanpur

Agenda and Resolutions

1. **Approval of FYUP Syllabus (2025 Onwards)**
    - The Board of Studies discussed, reviewed, and approved the **Four-Year Undergraduate Programme (FYUP)** in **Electronics** aligned with the **NEP 2020** guidelines.
    - The program includes exit options with:
        - **Certificate** (after 1 year)
        - **Diploma** (after 2 years)

- **Bachelor's Degree** (after 3 years)
- **Honours/Honours with Research** (after 4 years)

2. **One-Year Postgraduate Program**
   - The BoS approved the introduction of a **One-Year M.Sc. in Electronics** for students who complete the 4-year FYUP with Research**.**

3. **Course Structure Overview**
   The newly approved structure includes:
   - **Core Theory & Practical Courses** in:
     - Basic Circuit Theory, Semiconductor Devices, Analog and Digital Electronics, Microprocessors, Communication Systems, Artificial Intelligence, and IoT.
   - **Skill-based Labs**, **Internships**, and **Research Projects**.
   - **Advanced Electives** like:
     - Embedded Systems, Machine Learning, Python Programming, VLSI, Transducers, and Optoelectronics.
4. **Integration of Research and Projects**
   - Emphasis was laid on incorporating research projects from 4th year onwards**.**
   - Eligibility for research component: Students securing **75% or above till 6th semester**.
5. **Syllabus Enclosure**
   - The **detailed syllabus** and **course structure** (as per uploaded document titled *"B.Sc. Electronics Course Structure and Syllabus under FYUP"*) were circulated and **attached to the minutes** for academic session **2025–2026 onwards**.

Conclusion

The meeting concluded with a vote of thanks by the Convener**,** appreciating the contribution of all members toward curriculum enhancement and academic reform under NEP 2020.

Dr. Manoj Johri
(Convener (BoS))

Dr. Khem B. Thapa
(Member of BoS)

Dr. Vishal Awasthi
(Member of BoS)

Dr. Ajay Tiwari Dr.
(Member of BoS)

Om Prakash Gupta
(Member of BoS)

Dr. Swadesh Kumar Gupta
(Member of BoS)

Mr. Sachin Gupta
(Member of BoS)

छत्रपति शाहू जी महाराज विश्वविद्यालय,कानपुर
CHHATRAPATI SHAHU JI MAHARAJ UNIVERSITY, KANPUR

B.Sc. Course Structure and Syllabus under Four Year Undergraduate Program (FYUP)

Subject: Electronics

Year	Semester	Course Code	Paper Title	Theory/ Practical	Credit
Certificate in Electronics					
First Year	I	B140101T	Basic Circuit Theory and Network Analysis	Theory	4
		B140102P	Circuits and Network Lab	Practical	2
	II	B140201T	Semiconductor Devices and Electronic Circuit	Theory	4
		B140202P	Semiconductor Devices and Circuit Lab	Practical	2
Diploma in Advanced 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
		B140403R*	Research Project/Internship	Project	3
Degree in Bachelors of Science					
Third Year	V	B140501T	Electromagnetic and Antenna Fundamentals	Theory	4
		B140502T	Microprocessor Programming and Interfacing	Theory	4
		B140503P	Antenna and Microprocessor Lab	Practical	2
	VI	B140601T	Communication Electronics	Theory	4
		B140602T	Linear Integrated Circuits	Theory	4
		B140603P	IC and Communication Lab	Practical	2
Degree in Bachelor of Science(Honors) Without Research					
Fourth Year	VII	B140701TN	Physics of Electronic Materials	Theory	4
		B140702TN	Advanced Semiconductor Devices	Theory	4
		B140703TN	C^{++} Programming and Data Structure	Theory	4
		B140704PN	C^{++} Programming and Data Structure Lab	Practical	4
		B140705TN	Signal Analysis and Mathematical Methods in Electronics	Theory	4
	VIII	B140801TN	Instrumentation and Measurement	Theory	4
		B140802TN	Artificial Intelligence	Theory	4

		B140803TN	Advanced Microprocessor and Microcontroller	Theory	4
		B140804PN	Microprocessor and Microcontroller Lab	Practical	4
		B140805TN	Advance Antenna and Microwave Theory	Theory	4

Degree in Bachelor of Science(Honors) With Research **Research Project (VIIth & VIIIth Sem) will be given only to those students who obtain minimum of 75% marks till their sixth semester**					
Fourth Year	VII	B140701TN	Physics of Electronic Materials	Theory	4
		B140702TN	Advanced Semiconductor Devices	Theory	4
		B140703TN	C^{++} Programming and Data Structure	Theory	4
		B140704PN	C^{++} Programming and Data Structure Lab	Practical	4
		B140706RN	Research Project/Dissertation	Project	4
	VIII	B140801TN	Instrumentation and Measurement	Theory	4
		B140802TN	Artificial Intelligence	Theory	4
		B140803TN	Advanced Microprocessor and Microcontroller	Theory	4
		B140804PN	Microprocessor and Microcontroller Lab	Practical	4
		B140806RN	Research Project/Dissertation	Project	4
Degree in Master of Science in Electronics (1 Year)					
Fifth Year	IX	B140901TN	IC Technology and VLSI Design	Theory	4
		B140902TN	Advance Communication	Theory	4
		B140903TN	**Elective** (Any one) Transducers and Sensor	Theory	4
		B140904TN	**Elective** (Any one) Micro Sensor Design	Theory	4
		B140905TN	**Elective** (Any one) Embedded System	Theory	4
		B140906PN	Communication Lab	Practical	4
		B140907RN	Research Project/Dissertation	Project	4
	X	B141001TN	IoT and its application	Theory	4
		B141002TN	Digital Signal Processing	Theory	4
		B141003TN	**Elective** (Any one) Opto Electronic Devices	Theory	4
		B141004TN	**Elective** (Any one) Python Programming	Theory	4
		B141005TN	**Elective** (Any one) Machine Learning	Theory	4
		B141006PN	Digital Signal Processing Lab	Practical	4
		B141005RN	Research Project/Dissertation	Project	4

*** As Per FYUP Guideline, at the undergraduate level, in the fourth semester or after the second year during the summer vacation, it will be mandatory for the student to undertake a** Research Project / Internship / Field Work / Survey Work **worth three credits in one of the two major subjects chosen by the student.**

Four Year Undergraduate Programme (FYUP)

ELECTRONICS

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Electronics				
Course Code	B140101T	Course Title	Basic Circuit Theory and Network Analysis		

Course Outcomes (COs)

1. Identifies the basic elements and systems used in
2. Analog and digital circuits. Explore fundamental.
3. Laws and elements of electrical circuits.
4. Understand DC circuit, theorems, and networks.

Credits: 4

Unit	Topics
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. Inductor : Fixed and Variable Inductors, Self and Mutual inductance, Faraday's law & Lenz's law 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.
II	**Circuit Analysis:** Kirchhoff's Current Law(KCL), Kirchhoff's voltage Law(KVL),Node 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.
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.

IV	**Network Graph Theory:** Equivalent Graph, Incidence matrix, Tie-Set and Cut Set. AC circuit analysis using Network theorems. Two Port Networks: Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters.
V	Network Theorem: Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Millman's Theorem, Maximum Power transfer Theorem

Suggested book

1. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), Damodar Group (Publishers),Burdwan, ISBN: 978-93-85775-15-4 (2019)
2. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
3. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005)
4. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
5. Bell, Electronic Circuits,Oxford University Press
6. Carlson, Circuits,cengage
7. Kuo, Network Analysis and Synthesis, Wiley
8. Dorf and Svoboda, Introduction to Electric Circuits, Wiley
9. Decarlo and Lin, Linear circuit Analysis, Oxford

Programme / Class	Certificate	Year	B.Sc. I	Semester	I
Subject	Electronics				
Course Code	B140102P	Course Title	Circuits and Network Lab		

Course Outcomes (COs)

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

Credits: 2

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'sTheorems
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.

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Electronics				
Course Code	B140201T	Course Title	Semiconductor Devices and Electronic Circuit		

Course Outcomes (COs)

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

Unit	Topics
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.
II	**Bipolar Junction Transistor (BJT)** Symbol, pins, basic types- PNP and NPN, unbiased transistor, Biased Transistor, transistor currents, concept of current gain ,BJT Configuration CE,CB,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.

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.
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
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

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)

Programme / Class	Certificate	Year	B.Sc. I	Semester	II
Subject	Electronics- I				
Course Code	B140202P	Course Title	Semiconductor Devices and Circuit Lab		

Course Outcomes (COs)

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

Credits: 2

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 Common Collector Configuration of BJT and obtain voltage gain, ri, ro.
3. Study of the I-V Characteristics of the UJT and SCR.
4. Study of the I-V Characteristics of JFET and MOSFET
5. Study of Characteristics of Solar Cell
6. Study of Hall Effect.
7. Study of the half wave rectifier and Full wave rectifier.
8. Designing and testing of 5V/9 V DC regulated power supply and find its load-regulation
9. Study of clipping and clamping circuits.
10. Designing of a Single Stage CE amplifier.
11. Study of Class A, B and C Power Amplifier
12 Shift Oscillator
13 Study of the frequency response of Common Source FET amplifier

Programme / Class	Diploma	Year	B.Sc. II	Semester-III
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

Unit	Topics
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.
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.

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.
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.
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.

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

Programme / Class	Diploma	Year	B.Sc. II	Semester-III
Subject	Electronics			
Course Code	B140302P	Course Title- Analog Electronics lab		

Course Outcomes (COs)

1. 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.
2. Measurement precision and perfection is achieved. Through Lab Experiments.
3. Online Virtual Lab Experiments give an insight in simulation techniques and provide a basis for modeling.

Credits: 2

Topics

Lab Experiment List

1 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

Programme / Class	Diploma	Year	B.Sc. II	Semester-IV
Subject	Electronics			
Course Code	B140401T	Course Title- Digital 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

Unit	Topics
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 .
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
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
IV	**Arithmetic Circuits** Binary Addition, Binary Subtraction, Unsigned Binary Numbers, Sign-magnitude Numbers,2's Complement representation, 2's Complement Arithmetic, Arithmetic Building Blocks, The Adder-subtracter, Fast-Adder, Arithmetic Logic Unit, Binary Multiplication and Division
V	**LATCHES** Latches, Flip-flops - SR, JK, D, T, and Master-Slave -Edge triggering Level Triggering Asynchronous Ripple or serial counter Asynchronous Up/Down counter - Synchronous counters Synchronous Up/Down counters ,Programmable counters Modulo n counter, Registers , shift registers - Universal shift registers Shift register 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)

Programme / Class	Diploma	Year	B.Sc. II	Semester-IV
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

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 Theorem
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

Programme / Class	Degree	Year	B.Sc. III	Semester-V
Subject	Electronics			
Course Code	B140501T	Course Title- Electromagnetic and Antenna Fundamentals		

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

Unit	Topics
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 Stoke's Theorem, Green's Theorem , Laplacian of a scalar
II	**Electrostatic-**Coulomb's law ,Electric Field and Electric Potential due to Discrete and Continuous Charge Distribution 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 Equation and their derivations and Examples of solution, Uniqueness Theorem Capacitance and Capacitors, Method of Images, Electrostatic Energy and Forces, Energy Density.
III	**Magneto static-** BioSavart's law and Application, Magnet Dipole, Ampere's law-Maxwell Equation and Applications, Magnetic Flux and Magnetic Flux Density, 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
IV	**Time-Varying Fields and Maxwell's equation-**Equation, Stationary Circuit in Time-Varying Magnetic Field, Transformer and Motional EMF, Displacement

	Current,Maxwell's equation in Differential and integral form and Constiuitve Relation,Potential Lorentz Gauge and Wave Equation for Potentials, Concept of Retarded Potentials, Electromagnetic Boundary Conditions.
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.

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. Ida, Engineering Electromagnetics, Springer.
8. Sadiku, Elements of Electromagnetics, Oxford.
9. Rao and Narayanappa, Engineering Electromagnetics, Cengage.
10. Hayt, Buck and Akhtar, Engineering Electromagnetics, Tata McGraw Hill.
11. Cheng, Field and Wave Electromagnetics, Pearson.
12 Rao, Elements of Engineering Electromagnetics, Pearson..

Programme / Class	Degree	Year	B.Sc. III	Semester-V
Subject	Electronics			
Course Code	B140502T	Course Title- Microprocessor Programming and Interfacing		

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

Unit	Topics
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.
II	**8085 Instruction and Programming:** Operation Code, Operand and Mnemonics, Instruction Classification, Addressing Modes, Instruction Format, Instructions Set, Data Transfer, Arithmetic, Increment, Decrement, Logical, Branch and Machine Control Instructions, Assembly Language Programming Examples, Stack Operations, Subroutines and Delay Loops Call and Return Operations, Use of Counters, Timing and Control Circuitry, Timing Diagram, Instruction Cycle, Machine Cycle, T (Timing)-States, Time Delay.
III	**Interrupts:** Structure, Hardware and Software Interrupts, Vectored and Non-Vectored Interrupts, Latency Time and Response Time.
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).
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.

Suggested Reading:

1. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram.
2. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai.
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.

Programme / Class	Degree	Year	B.Sc. III	Semester-V
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. 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

Topics

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

Programme / Class	Degree	Year	B.Sc. III	Semester-VI
Subject	Electronics			
Course Code	B140601T	Course Title- Communication Electronics		

Course Outcomes (COs)

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

1. Explain the basic concepts and principles of analog and digital communication systems.
2. Describe and analyze various analog modulation schemes such as AM, FM, and PM, and their demodulation methods.
3. Design basic circuits used in communication systems including oscillators, mixers, modulators, and demodulators.
4. Understand the impact of noise in communication systems and analyze system performance under noisy conditions

Credits: 4

Unit	Topics
I	**AM GENERATION & TRANSMISSION** Need for modulation Amplitude modulation Frequency Spectrum of the AM Wave - Modulation Index Power relations in the AM Wave AM generation AM Transmitter. - Forms of Amplitude Modulation Evolution of SSB Balanced Modulator Methods of SSB Generation Vestigial side band Transmission. **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.
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.
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.
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.
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.

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.

Programme / Class	Degree	Year	B.Sc. III	Semester-VI
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 nonlinear 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

Unit	Topics
I	**Basic Operational Amplifier:** Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741)
II	**Op-Amp parameters:** input offset voltage, input offset current, input bias current, differential input resistance, Input capacitance, offset voltage adjustment range, input voltage range, common mode rejection ratio, slew rate, supply voltage rejection ratio.
III	**Op-Amp Circuits:** Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Inverting, Non-inverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. **Comparators**: Basic comparator, Level detector, Voltage limiters, Schmitt Trigger. **Signal generators:** Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator, and Voltage controlled oscillator.
IV	**Signal Conditioning circuits:** Sample and hold systems, Active filters: First order low pass and high pass Butterworth filter, Second order filters, Band pass filter, Band reject filter, All pass filter, Log and antilog amplifiers
V	**Multivibrators (IC 555):** Block diagram, Astable and monostable multivibrator circuit, Applications of Monostable and Astable multivibrators. Phase locked loops (PLL): Block diagram, phase detectors, IC565**.**

Suggested Books:

1.Op-Amps and Linear IC's, R. A. Gayakwad, Pearson Education

2.Operational amplifiers and Linear Integrated circuits, R. F. Coughlin and F. F. Driscoll, Pearson Education

3.Integrated Electronics, J. Millman and C.C. Halkias, Tata McGraw- Hill,

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

5.OP-AMP and Linear Integrated Circuits, K.L.Kishore, Pearson

Programme / Class	Degree	Year	B.Sc. III	Semester-VI
Subject	Electronics			
Course Code	B140603P	Course Title- IC and Communication 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 nonlinear 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

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
11. Study of op-amp characteristics.
12. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an op amp.

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VII
Subject	Electronics			
Course Code	B140701TN	Course Title- Physics of Electronic Materials		

Course outcomes:

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

1. Explain the crystal structure, bonding, and defects in materials and how these affect their electronic properties..
2. Describe and analyze the electrical, thermal, and optical behavior of different materials (metals, semiconductors, insulators).
3. Use quantum mechanics and statistical physics to explain the behavior of electrons in solids, including energy bands and carrier statistics.
4. Relate material properties to the functioning of electronic and optoelectronic devices such as diodes, transistors, LEDs, and solar cells.

Credits: 4

Unit	Topics
I	**Fundamentals of Materials Science***:* Relative stability of Phase, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Elementary idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposit ion of thin film using sputtering methods (RT and glow discharge).Smart Materials
II	**Crystal Structures:** Crystal structures, classification of crystals, lattices, reciprocal lattice, Miller indices, Amorphous materials, Electronic structure and related properties, Bloch theorem, phonons, Nearly Free electron theory, Introduction to tight binding and various band structures, Band structure calculation methods, thermal conductivity due to electrons and phonons, perturbation theory.
III	**Semiconductors:** Metal-semiconductor and, Direct and Indirect semiconductors, Variation of energy bands with alloy composition, charge carriers in semiconductors, effective mass, Intrinsic and Extrinsic materials, Diffusion and drift, diffusion length, diffusion and recombination. The Fermi level & Fermi dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration Qualitative and Quantitative analysis, Temperature dependency of carrier concentration, conductivity and mobility, effects of temperature and doping on mobility, high field effects, the hall effects, Invariance of the Fermi level at equilibrium.
IV	**Dielectric and Magnetic Materials:** Dielectric properties, Electronic polarisability, Clausius Mossotti relation, dielectric constant static and frequency dependence, Kramer-Kronig relation, damped oscillation, Piezoelectric properties, polymers and their properties. Magnetic and Electro-optical properties, Magnetism & various contributions to para and dia magnetism, Fero and Ferri magnetism and ferrites, Magnons and dispersion relation, antiferro magnetism, domains and domain walls, coercive force, hysterisis, methods for parameters measurements

V	**Superconductivity and Liquid Crystals:** Different Properties of Superconductor, Meissner effect, London equation, BCS theory, Josephson effect, High temperature Superconductors, Types of liquid crystals and their mesomorphous phases, Elementary theory of order, Transition Metal Alloys

RECOMMENDED BOOKS

1. "A First Course In Material Science" by Raghvan, McGraw Hill Pub.
2. "Solid State Physics" by S.O.Pillai,New Age Publication.
3. "Electrical Engineering Materials",by A.J. Dekker, PHI Pub.
4. "Electronic Components and Materials" Grover and Jamwal, DhanpatRai and Co.
5. 'The Science and Engineering of materials' by Donald R.Askeland,Chapman & Hall Pub.
6. "Introduction to Liquid Crystal" by Peter J. Collings and Michael Hird,CRC Press.

Programme / Class	Honors//Research	Year	B.Sc. IV	Semester-VII
Subject	Electronics			
Course Code	B140702T N	Course Title-Advance Semiconductor Devices		

Course outcomes:
At the end of this course, students will be able to
1. Explain the physical principles and quantum mechanics underlying the operation of advanced semiconductor devices.
2. Analyze the characteristics and performance of modern semiconductor devices such as MOSFETs, MESFETs, HEMTs, and BJTs.
3. Evaluate the behavior of short-channel and Nano scale devices considering effects such as velocity saturation, DIBL, and quantum confinement.
4. Interpret and model carrier transport mechanisms including drift, diffusion, tunneling, and ballistic transport in semiconductor materials.

Credits: 4

Unit	Topics
I	**Fundamentals of Materials Science***:* Relative stability of Phase, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. Elementary idea of point, line and planar defects. Concept of thin films, preparation of thin films, Deposit ion of thin film using sputtering methods (RT and glow discharge).Smart Materials
II	**Crystal Structures:** Crystal structures, classification of crystals, lattices, reciprocal lattice, Miller indices, Amorphous materials, Electronic structure and related properties, Bloch theorem, phonons, Nearly Free electron theory, Introduction to tight binding and various band structures, Band structure calculation methods, thermal conductivity due to electrons and phonons, perturbation theory.
III	**Semiconductors:** Metal-semiconductor and, Direct and Indirect semiconductors, Variation of energy bands with alloy composition, charge carriers in semiconductors, effective mass, Intrinsic and Extrinsic materials, Diffusion and drift, diffusion length, diffusion and recombination. The Fermi level & Fermi dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration Qualitative and Quantitative analysis, Temperature dependency of carrier concentration, conductivity and mobility, effects of temperature and doping on mobility, high field effects, the hall effects, Invariance of the Fermi level at equilibrium.
IV	**Dielectric and Magnetic Materials:** Dielectric properties, Electronic polarisability, Clausius Mossotti relation, dielectric constant static and frequency dependence, Kramer-Kronig relation, damped oscillation, Piezoelectric properties, polymers and their properties. Magnetic and Electro-optical properties, Magnetism & various contributions to para and dia magnetism, Fero and Ferri magnetism and ferrites, Magnons and dispersion relation, antiferromagnetism, domains and domain walls, coercive force, hysterisis, methods for parameters measurements

V	**Superconductivity and Liquid Crystals:** Different Properties of Superconductor, Meissner effect, London equation, BCS theory, Josephson effect, High temperature Superconductors, Types of liquid crystals and their mesomorphous phases, Elementary theory of order, Transition Metal Alloys

RECOMMENDED BOOKS

1. "A First Course In Material Science" by Raghvan, McGraw Hill Pub.
2. "Solid State Physics" by S.O.Pillai,New Age Publication.
3. "Electrical Engineering Materials",by A.J. Dekker, PHI Pub.
4. "Electronic Components and Materials" Grover and Jamwal, DhanpatRai and Co.
5. 'The Science and Engineering of materials' by Donald R.Askeland,Chapman & Hall Pub.
6. "Introduction to Liquid Crystal" by Peter J. Collings and Michael Hird,CRC Press.

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VII
Subject	**Electronics**			
Course Code	**B140703TN**	**Course Title- C^{++} Programming and Data Structure**		

Course outcomes:

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

1. Apply the fundamentals of C++ programming including variables, data types, control structures, functions, and arrays to solve basic computational problems.
2. implement object-oriented programming concepts such as classes, objects, constructors, destructors, inheritance, and polymorphism using C++
3. Develop and use data structures like stacks, queues, linked lists, trees, and graphs to efficiently store, organize, and manipulate data
4. Analyze and implement various searching and sorting algorithms and evaluate their time and space complexity.

Credits: 4

Unit	Topics
I	*Introduction:* Object oriented programming, characteristics of an object-oriented language. **C++ programming language:** Tokens, keywords, identifier and constants, basic data types, user defined data types, derived data types, arithmetic operators, relational operators, logical operators, assignment operators, increment and decrement operators, conditional operators, bit wise operators, special operators, expressions and evaluation of expressions, scope resolution operator, member dereferencing operators, manipulators, type cast operator, implicit conversions, precedence of operators, new and delete operators. Arrays, pointers and structures.
II	*Decision making, Branching and Looping:* If, if-else, else-if, switch statement, break, continue and go to statement, for loop, while loop and do loop. **Functions:** Function definition, function arguments and passing, returning values from functions, referencing arguments, function overloading, virtual functions, library functions, local, static and global variables
III	*Classes and Objects:* Classes and objects, member functions, class constructors and destructors, array of objects, operator overloading. **Class inheritance:** Derived class and base class, multiple inheritance, polymorphism.
IV	**Streams in C++ - Stream Classes** – Formatted and Unformatted data – Manipulators – User Defined Manipulators – File Streams – Opening and Closing a File – File Pointers Manipulation – Template Classes and Functions– Exception Handling: Try, Catch, And Throw. Exception Handling – Multithreading – Applets – Graphics Programming
V	*Data Structures:* Multidimensional arrays definition implementation multidimensional arrays in control loops, pointers to multidimensional arrays. Stacks and queues array

	implementation: Definition of stacks and queues, Terminology, implementation using arrays, Link Lists, stacks and queues, Implementation of stacks and queues.

RECOMMENDED BOOKS

1. "A First Course In Material Science" by Raghvan, McGraw Hill Pub.
2. "Solid State Physics" by S.O.Pillai,New Age Publication.
3. "Electrical Engineering Materials",by A.J. Dekker, PHI Pub.
4. "Electronic Components and Materials" Grover and Jamwal, DhanpatRai and Co.
5. 'The Science and Engineering of materials' by Donald R.Askeland,Chapman & Hall Pub.
6. "Introduction to Liquid Crystal" by Peter J. Collings and Michael Hird,CRC Press.

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VII
Subject	Electronics			
Course Code	B140704PN	Course Title- C^{++} Programming and Data Structure lab		

Course outcomes:

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

1. Explain the crystal structure, bonding, and defects in materials and how these affect their electronic properties..
2. Describe and analyze the electrical, thermal, and optical behavior of different materials (metals, semiconductors, insulators).
3. Use quantum mechanics and statistical physics to explain the behavior of electrons in solids, including energy bands and carrier statistics.
4. Relate material properties to the functioning of electronic and optoelectronic devices such as diodes, transistors, LEDs, and solar cells.

Credits: 4

Topics

Lab Experiment List

1. Write a program to calculate the roots of quadratic equation Ax2 +Bx+C=0.
2. Write a program to calculate the average of a set of n numbers including zero and negative numbers
3. Write a program to sort an array element in ascending order and descending order using bubble sort technique.
4. Write a program to plot a sin (X).
5. Write a program to find a row sum and column sum of a given matrix and built a new matrix with the help of row sum and column sum and previous matrix.
6. Write a program to read and print two-dimensional matrix of order nxm. Find the sum of diagonals.
7. Write a program that calculate and prints out the maximum and minimum of array.
8. Write a program for sorting names in alphabetical order.
9. Write a program to plot and exponential series.
10. Write a program to print the terms in the exponential series, till the term is equal to 0.00001 also compute the exponential series of x, ex =1+x+x2 /2!+x3 /3!+……..+0.00001.
11. Write a program for matrix addition and matrix multiplication.
12. Write a program for the operation of (a) addition (b) subtraction (c) multiplication (d) division. Using switch command.
13. Write a program to find the factorial of a given number and Fibonacci series using switch command.
14. Write a program to find the sum of natural numbers using function
15. Write a C++ program to create a class to handle telephone directory, include name, phone number (landline, mobile), STD/ISD code, City and Country as data members and write member function to create new directory, display directory, sort according to name, edit, add, delete and search as per name/telephone number.
16. Program to demonstrate exception handling mechanism while divide by zero.
17. Program to demonstrate generic programming for sorting using a. class templates b. function

Programme / Class	Honors	Year	B.Sc. IV	Semester-VII
Subject	Electronics			
Course Code	B140705TN	Course Title- Signal Analysis and Mathematical Methods in Electronics		

Course outcomes:

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

1. Analyze continuous-time and discrete-time signals and systems using time-domain and frequency-domain techniques.
2. Apply Fourier series, Fourier transforms, and Laplace transforms to represent and analyze signals in various domains.
3. Use Z-transforms for the analysis of discrete-time signals and systems, including system stability and frequency response
4. Solve linear differential and difference equations relevant to electronic systems and signal processing.

Credits: 4

Unit	Topics
I	**Signal Analysis:** Classification of signals and systems, some ideal signals, energy signal, power signals, energy and power spectral densities. Periodic & non periodic, analog & digital, deterministic & random, unit impulse, unit step. LTI networks, the concept of frequency in continuous & discrete time domain, linear time invariant system definition. Impulse response of LTI system
II	**Fourier Series & Transforms:** Fourier Series, Dirchilit conditions, determination of Fourier Co-efficients, Statement of Fourier Integral Theorems, Fourier series–sine and cosine series, Fourier Transforms & properties, Fourier Transform of various functions, Fourier Sine & Cosine transforms. Inverse transforms. Convolution Theorem, Parsevals Identity, applications. **Laplace Transforms:** Laplace transforms, Region of Convergence (ROC), Basic properties of Laplace Transforms. Laplace transform of derivatives and integrals, shifting theorem, differentiation and integration of transforms, inverse transforms, convolution property. Laplace transform of unit step function, impulse function and periodic function, Solutions of linear differential equations with constant coefficients using Laplace transform applications
III	**Z – Transforms:** Definition of Z- transforms, Region of Convergence (ROC), properties, initial and final value theorem. Z transform of unit step sequence, unit ramp sequence, polynomial functions, trigonometric functions. Shifting property, convolution property, Inverse transform. Pole-Zero plots from z-transform. Solutions of 1st & 2nd order difference equations with constant coefficients using Z transforms.

IV	**Probability & Statistics:** Introduction: Probability- Mathematical approach and Statistical Approach. Types of Sampling-Simple Random Sampling Stratified Random Sampling. Random Variables, Probability Density function, Probability Mass Function. Mathematical Expectation- Mean, Expectations and Variance of a Distribution. Binomial, Poisson, Exponential, Normal Distributions,co-relation
V	**Computational Methods Numerical Differentiation and Integration:** Finite Differences, Derivatives using Forward, Backward and Central Difference Formulae, Newton-Cote's quadrature formula, Trapezoidal rule, Simpson's rules, Weddle's rule. Numerical methods for Solution of Ordinary Differential Equation- Picards Method ,Taylor Series Method , Eulers and Modified Eulers methods, Runge and Runge Kutta Methods , Predictor and Corrector Method.

RECOMMENDED BOOKS

1. "Advance Engineering Mathematics" by H.K.Dass,PHI Pub.
2. "Advanced Engg. Mathematics" by Erwin Kreyszig,Wiley India Pvt. Ltd..
3. 'Signals and System' by Samarjit Ghosh,Pearson Education.
4. "Digital Signal Processing" by S. Salivahanan, A. Vallavara and C. Gnanpriya,TMH Pub..
5. "Laplace and Fourier Transforms" by Goyal and Gupta,Pragati Prakashan.
6. "Higher Engineering Mathematics" by Dr. B. S. Grewal, Khanna Pub.
7. "Signal and System" by Nagrath, Sharan and Ranjan, McGraw Hill Pub.

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VIII
Subject	Electronics			
Course Code	B140801TN	Course Title- Instrumentation and Measurement		

Course outcomes:

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

1. Understand the basic concepts, standards, and units of measurement used in instrumentation systems...
2. Explain the static and dynamic characteristics of measurement systems and analyze their performance.
3. Identify and classify various types of sensors and transducers used for measuring physical parameters such as temperature, pressure, displacement, and flow..
4. Design and analyze signal conditioning circuits including amplifiers, filters, and analog-to-digital conversion systems.

Credits: 4

Unit	Topics
I	**Introduction of Measurement** Precision & accuracy, Characteristics of Instruments, Measurement of frequency, phase, time – interval, impedance, power measurement, energy measurement and measurement of distortion, Errors in Measurement
II	**Measuring Instruments-** Basic galvanometer ,conversion to voltmeter ,ammeter and ohmmeter ,Multimeter Measurement of R,L,C Using Bridge, Voltage, Current, Energy, Frequency/Time power , power factor, working principle and procedure of operation of Digital Voltmeter, Digital Multimeters, Digital Frequency Meter, Q-Meter, Digital Storage Oscilloscope. Spectrum Analyzer, Logic Analyzer, recorders-Galvanometer recorders, Strip recorder, X-Y recorder
III	**Measurement of Non – Electrical Quantities** Measurement of Displacement, Velocity, Acceleration, Force, Torque, Strain, Speed & Sound, Temperature, Pressure, Flow, Humidity, Thickness
IV	**Electrical Transducers:** Fundamental Concept & Transducers Classification Resistance, Capacitance, Inductance, Piezoelectric, Thermoelectric, Techogenerator, Optical & Digital Transducers
V	**Virtual Instrumentation** Historical Perspective, advatages, block – diagram and architecture of a virtual instrument data – flow techniques, graphical programming in data flow comparison with conventional programming, Develpment of virtual instrument using GUI**.**

RECOMMENDED BOOKS

1. "Measurement, Instrumentation and Sensors Handbook" by J. G. Webster, CRC Press.
2. "Digital Measurement Techniques" by T. S. Rathore, Narosa Publishing House, New Delhi.
3. "Modern Electronic Instrumentation and Measurement Techniques" by Cooper and Helfrick, PHI.
4. "Electronic Instrumentations and Measurements" by Larry Jones and A. Foster Chin, John Wiley.

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VIII
Subject	Electronics			
Course Code	B140802TN	Course Title -Artificial Intelligence		

Course outcomes:

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

1. Understand and explain the fundamental concepts, history, and applications of Artificial Intelligence (AI)...
2. Describe and analyze the electrical, thermal, and optical behavior of different materials (metals, semiconductors, insulators).
3. Use quantum mechanics and statistical physics to explain the behavior of electrons in solids, including energy bands and carrier statistics.
4. Relate material properties to the functioning of electronic and optoelectronic devices such as diodes, transistors, LEDs, and solar cells.

Credits: 4

Unit	Topics
I	Introduction to Artificial Intelligence. Natural and artificial intelligence. Role of representation of knowledge, Description matching and goal reduction, exploiting natural constraints in problem solving, Exploiting alternative paths, Best paths.
II	Reasoning, Logic and Theorem proving: Deductive and inductive reasoning. Heuristic methods, proof by resolutions and constraint propagation, problem solving paradiagrams.
III	Knowledge replacement: First order predicate calculus, Skolemlsation, Resolution principle, Unification nementic networks, frame, system value inheritance, introduction to prolog, Introduction to expert systems, application of expert system and various shells.
IV	Application of artificial intelligence methods in various disciplines: database management, computer aided
V	Design principles of pattern recognition system, statistical pattern recognition, Parameter estimation methods-Principle Component Analysis(PCA) and Linear discriminant analysis (LDA),Classification Techniques, Nearest Neighbor(NN) Rule, Bayes Classifier, Support Vector Machine (SVM

RECOMMENDED BOOKS

1 “Artificial Intelligence” by Elaine Rich and Kelvin Knight,TMH Pub.

2. “Introduction to Artificial Intellegence” by E charniak and D McDermott,Pearson Pub.

3. “Artificial Intellegence and expert systems” byDan W Patterson,PHI Pub.

4. “Artificial Intellegence –A Modern Approach” by Stuart Russell and Peter Norvig,Pearson Education

Programme / Class	Honors/Research	Year	B.Sc. IV	Semester-VIII
Subject	Electronics			
Course Code	B140803TN	Course Title-Advanced Microprocessor and Microcontroller		

Course outcomes:

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

1. Understand the architecture, instruction set, and operation of advanced microprocessors and microcontrollers...
2. Analyze and design assembly language programs for microprocessors and microcontrollers to solve real-time problems.
3. Interface microprocessors and microcontrollers with external devices such as memory, I/O ports, ADC/DAC, and sensors.
4. Develop embedded system applications using microcontrollers with an emphasis on timers, interrupts, and serial communication.

Credits: 4

Unit	Topics
I	**Introduction to Microprocessor** Evolution of Microprocessors, Register structure, ALU, Bus Organization, Timing and Control. Introduction to 8085: Architecture, pin diagram, memory interfacing, memory mapping and organization, timing diagram of different cycles
II	**Fundamentals of 8086 Microprocessor** Internal organization of 8086, Bus interface unit, Execution unit, Register organization, Sequential memory organization, Bus cycle. Signal Description of pins of 8086 and 8088, Clock generation, Address and data bus, demultiplexing, Buffering memory organization, Read and Write cycle Timings, Interrupt structures, Addressing modes and their features.
III	**Assembly Language Programming** Instruction format and addressing modes, Data transfer instructions, Arithmetical and logical instructions, Program control Instructions (jumps, conditional jumps), stacks and subroutines, interrupts. .
IV	**Basic of Interfacing**: Programmed I/O, Interrupt driven I/O, Parallel I/O (8255-PPI), 8259 Programmable Interrupt Controller, 8237-DMA Controller, 8253/8254 Programmable Timer/Counter,(8279) Keyboard and display interface.
V	**8051 Microcontroller** Architecture, configuration, I/O port Structure, registers, memory organization, Instruction set, Basic Assembly language programming concept.

RECOMMENDED BOOKS

1. “Microprocessor Architecture, Programming and Applications” by R. S. Gaonkar,Penram International Pub.

2. “Microprocessors and Interfacing” by Douglas V.Hall, TMH Pub.

3. “Microprocessor & Microcontroller” A.P. Godse and D.A. Godse,Technical Publication.

4. “Introduction to 8086, 80186, 80286, 80386, 80486, Pentium and Pentium Pro Processors” by B. Bray, Tata Mc-Graw Hill Pub.

5. “The 8051 Microcontroller architecture, programming and application” by K. J. Ayala, Cengage Learning.

6. “The 8051 Microcontroller and Embedded Systems” by M. Ali Mazidi, J. G. Mazidi & Rolin, Pearson Prentice Hall.

Programme / Class	Honors/Research	Year	B.Sc.IV	Semester - VIII
Subject	Electronics			
Course Code	B140804PN	Course Title	Microprocessor and Microcontroller Lab	

Course Outcomes (COs)

1- Write and execute assembly language programs for basic arithmetic, logical, and data manipulation operations using microprocessors (e.g., 8085/8086).

2- Develop and test programs on microcontrollers (e.g., 8051) for real-time tasks involving timers, counters, and interrupts.

3- Interface microprocessors/microcontrollers with external peripherals such as LEDs, switches, LCDs, keypads, motors, and sensors.

4- Implement and troubleshoot interfacing circuits for ADCs, DACs, stepper motors, and serial communication modules.

Credits: 4

Topics

Lab Experiment List

1. Write programme for Addition/Subtraction of 8 and 16t numbers using 8085.
2. Write programme for Multiplication/Division of 8 and 16 numbers using 8085.
3. Write programme to compute the factorial of an integer using 8085.
4. Write programme for Addition and Subtraction of two packed BCD's numbers using 8085.
5. Write programme to find the largest signed number in a given series of data using 8085.
6. Write programme to find sum of a given series of numbers using 8085.
7. Write programme to find the largest and smallest number from a given unordered array of 8- bit numbers using 8085.
8. Write programme to perform BCD addition using 8085.
9. Write programme for BCD to Binary and Binary to BCD conversion using 8085.
10. Write programme to convert BCD into its equivalent binary number using 8085.
11. Write programme convert Binary number into its equivalent unpacked BCD number using 8085.
12. Write programme to arrange the data array in ascending and descending order using 8085.
13. Write a programme to control the operation of a steeper motor using 8085 and 8251 PPI.
14. Program 8253 in mode 3 to generate square wave.
15. Program 8255 in mode 0 i.e. simple I/O mode. Program Port A in I/P mode, Port B in input mode. Read data from Port A & B, add it & display the result in Port C.
16. Interface 8251 with 8085 M.P.U. and program it in asynchronous transmitter mode, use 8251 Group A.
17. Interface 8251 with 8085 M.P.U. and program it in asynchronous

	receiver mode, use 8251 Group A. 18. Study of master 8259 in stand-alone mode. Generate and interrupt request-using 8259 and display the respective interrupt in address field. 19. Write programme to add first ten natural numbers using 8051. 20. Write programme for Multiplication of two numbers using 8051. 21. Write programme to toggle the bits of an I/O port using 8051. 22. Write programme to convert Hexadecimal to Decimal number using 8051. 23. Write an 8051 ALP to generate 10 KHz square wave on any pin of port 0. 24. Write programme to obtained 1 sec delay using 8051. 25. Write an 8051 ALP to generate 10 KHz square wave on any pin of port 0 using interrupts.

Programme / Class	Honors	Year	B.Sc. IV	Semester-VIII
Subject	Electronics			
Course Code	B140805TN	Course Title- Advance Antenna and Microwave Theory		

Course outcomes:

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

1-Understand the fundamental principles of antenna theory including radiation mechanisms, antenna parameters, and types of antennas...

2- Analyze the radiation patterns, gain, directivity, and impedance characteristics of various antenna configurations.

3- Design and evaluate advanced antenna structures such as arrays, aperture antennas, microstrip antennas, and reflector antennas.

4- Apply the theory of microwave transmission lines, waveguides, and cavity resonators to analyze microwave circuits.

Credits: 4

Unit	Topics
I	**Electromagnetic Plane Wave** Electron motion in electromagnetic field, electric and magnetic wave equations, Maxwell's equation, Poynting theorem, uniform plane wave and reflection, uniform plane wave propagation in free space and perfect dielectric,, plane wave propagation in lossy media, duality theorem, uniqueness theorem ,image theory ;equivalence principle; introduction and reciprocity theorem.
II	**Transmission Lines and Antennas** Basic equation , reflection and transmission coefficient , standing wave and standing wave ratio , line impedance and admittance, Determination of characteristics impedance, Fundamental of Smith Chart, Impedance Matching: Single and Double Stub Matching, microwave Coaxial Connectors. The Radiation mechanism, Current and Voltage distribution, Antennas gain, Antenna resistance, Bandwidth, Beam width and Polarization, effects of Antenna height, Dipole arrays, Folded dipole. Microwave Antennas - Parabolic reflector, Horn and Lens antenna. Special purpose antennas - Yagi, Log periodic and Loop antennas.
III	**Micro strip Antennas** Advantages and limitations of Microstrip antennas, radiation mechanism, antenna configurations, Rectangular Patch, Quarter wave rectangular patch, Circular Patch, Quality factor, Bandwidth, and frequency, Input Impedance, Coupling, Circular Polarization. Microstrip feeds – coplanar feed, proximity coupled feed, aperture coupled feed, waveguide feed.
IV	**Linear Wire Antennas and Arrays** Infinitesimal Dipole, Small Dipole, Region Separation, Finite Length Dipole, Half-Wavelength Dipole Linear Elements Near or on Infinite Perfect Conductors, Ground Effects ,Two element array, Element linear array : uniform linear amplitude and spacing, N-element linear array: Directivity, Circular array
V	**Theory of Microwave Propagation, Waveguides and Components** Fundamentals of microwave propagation, Rectangular Wave guide – TE and TM modes , power transmission, excitation in rectangular wave guide, circular wave guides – TE,TM and TEM mode, Cavity resonator, Q-factor. Waveguide Tee - E-plane tee, H-plane tee,

	Hybrid tee, scattering parameters (s-matrix), circulators, isolators, directional couplers.

RECOMMENDED BOOKS

1. “Electromagnetic Wave & Radiating System” by Jordan & Balmain, PHI Pub.
2. “Introduction to Electrodynamics” by David J. Griffiths , PHI Pub.
3. “Antennas” by J.D.CKraus,McGraw Hill.
4. “Elements of Electromagnetics” by Matthew N. O. Sadiku,Oxford Series.
5. “Antenna Theory and Design” by W. L.Stutzman, and G.Thiele,John Wiley & Sons.
6. “Microwave Devices and circuits” by Samuel Y.Liao,PHI Pub.
7. “Microwave and Radar Engineering” by M. Kulkarni, Umesh Publication..

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140901TN	Course Title- IC Technology and VLSI Design		

Course outcomes:

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

1. Explain the crystal structure, bonding, and defects in materials and how these affect their electronic properties.
2. Describe and analyze the electrical, thermal, and optical behavior of different materials (metals, semiconductors, insulators).
3. Use quantum mechanics and statistical physics to explain the behavior of electrons in solids, including energy bands and carrier statistics.
4. Relate material properties to the functioning of electronic and optoelectronic devices such as diodes, transistors, LEDs, and solar cells.

Credits: 4

Unit	Topics
I	Crystal Growth & Wafer Characterization Electronic Grade Silicon, CZ Crystal Growing, Silicon Shaping, Processing Consideration. Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators. Growth Mechanism, Oxide Properties, Oxidation Induced Defects. Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography. Feature Size Control and Anisotropic, Etch Mechanisms, Reactive Plasma Etching Techniques and Equipment .
II	**Diffusion and Metallization** Models of Diffusion in Solids, Fick's One Dimensional Diffusion Equations, Atomic Diffusion Mechanisms. Range Theory, Implantation Equipment, Annealing. Metallization Applications, Metallization Choice, Physical Vapour Deposition, Patterning, Bipolar IC Technology .
III	**Introduction to MOS** MOS, CMOS IC Technology, Metal Gate, Poly Silicon Gate, P-Channel, N-Channel Devices, Enhancement Mode and Depletion Mode Devices and their Characteristics .
IV	**VLSI design Introduction** Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design. Manufacturing CMOS Integrated Circuits, Design Rules, IC Layout, Scaling factors, advantages of scaling, limitations to scaling, scaling of wires and interconnections.
V	**The CMOS Inverter** The Static CMOS Inverter, Performance of CMOS Inverter, Power, Energy and Energy Delay, Static CMOS Design, Dynamic CMOS Design, Introduction, From custom to semi-custom and structure-array Design Approaches, Custom Circuit

	Design, Cell based Design Methodology, Array based Implementation Approaches

RECOMMENDED BOOKS

1. "VLSI Technology" by S. M. Sze,Mcgraw Hill Pub.
2. "Solid State Electronic Devices" by Ben G. Streetman, PHI Pub.
3. "VLSI Design" by K.Lal Kishore and V. Prabhakarl, I.K.International Pub.
4. "Physics and Technology of Semiconductor Devices" by A. S. Grove, John Wiley and Sons Pub.
5. "Basic VLSI design" by Douglas A Pucknell and Kamran Eshraghian, PHI Pub.
6. "CMOS VLSI design" by Neil H E Weste and David Harris, Pearson Pub.

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Programme / Class	Honors	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140902TN	Course Title- Advance Communication		

Course outcomes:

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

1. Understand and explain advanced concepts in analog and digital communication systems, including modulation and demodulation techniques...
2. Analyze the performance of various digital modulation schemes (e.g., QAM, PSK, FSK) in terms of bandwidth, power efficiency, and bit error rate (BER).
3. Evaluate the impact of noise, interference, and channel impairments on the performance of communication systems.
4. Apply the principles of information theory, including entropy, mutual information, and channel capacity, to evaluate communication system efficiency.

Credits: 4

Unit	Topics
I	**Concept of Communication** Communication system, Study of basic block diagram of communication system, Bandwidth and its requirement, Modulation and its types, Need of modulation, Noise, External and internal source of noise, Calculation of thermal noise and shot noise, Noise figure, Noise temperature, Equivalent noise bandwidth, Random process, Stationary process, Ergodic process, Gaussian process, Poisson process, Power spectral density .
II	**Amplitude Modulation** Baseband and carrier modulation, Amplitude modulation with full carrier, Mathematical analysis. Power relation in AM wave, Double sideband suppressed (DSB-SC) system, Singal sideband suppressed (SSB- SC) system, Vestigial sideband (VSB) modulation system, Quadrature amplitude modulation (QAM), AM transmitter and receiver, Time division multiplexing (TDM). .
III	**Angle Modulation** Frequency modulation, Analysis of FM waveform and frequency spectrum, Bessel function, Wide-band FM and Narrow band FM, Mathematical analysis of WBFM and NBFM, Phase modulation, Generation and detection of FM, Generation and detection of PM, frequency division multiplexing (FDM). .
IV	**Digital Communication System& Modulation Techniques** Element of digital communication system, Sampling process, Sampling theorem, Natural and flat top sampling, Analog pulse modulation : Types of analog pulse modulation, Method of generation and detection of PAM, PWM, PPM, Pulse code modulation, Quantization error, Delta modulation, Adaptive delta modulation, Compandig. Digital modulation techniques: ASK, FSK, PSK, BFSK, BPSK, QPSK, Inter symbol linterfferance, Matched filter, Probability of error, Correlation receiver.

V	**Digital Modulation Techniques** Digital modulation techniques: ASK, FSK, PSK, BFSK, BPSK, QPSK, Inter symbol interference, Matched filter, Probability of error, Correlation receiver.

RECOMMENDED BOOKS

1. "Communication System" by S. Haykin, John Willy & Sons Pub.

2. "Modern analog & Digital Communication Systems" by B.P. Lathi,Oxford Univ.Press.

3. "Electronic Communication Systems" by George Kennedy, TMH Pub.

4. "Analog Communication System" by P.Chakrabarti, Dhanpat Rai Pub.

5. "Digital and Analog Communication Systems" by Leon W. Couch,Pearsons Education.

6. "Digital communications" by J. G. Proakis,Mc-GrawHill Pub.

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140903TN	Course Title- Transducers and Sensor		

Course outcomes:

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

1. Understand the basic principles and classifications of transducers and sensors used in engineering applications...
2. Explain the working principles of various types of sensors including temperature, pressure, displacement, strain, and flow sensors.
3. Analyze the electrical and mechanical characteristics of transducers and evaluate their performance parameters such as sensitivity, accuracy, and linearity.
4. Design signal conditioning circuits to interface sensors with electronic measurement and control systems.

Credits: 4

Unit	Topics
I	Transducer for measurement of non-electrical quantities, temperature transducer, Pressure transducer, Force transducer ,Liquid level transducer, Flow transducer
II	**Passive Electrical Transducer** Timers, counters and watchdog timers, applications, UART, PWM application, LCD controller, keypad controllers, stepper motor control, ADC and DAC. Memory: Different types of ROM & RAM, cache system design
III	**Interfacing**: introduction to interfacing, communication basics, basic protocol concepts, interrupts and DMA, arbitration, multilevel bus architectures, communication - serial parallel and wireless protocols, I 2C, CAN, USB, FireWire, parallel and wireless protocols.
IV	**Software Considerations**: Basics of real time concepts, bus transfer mechanism, software concepts, system concepts, real time definitions, events and determinism, synchronous and asynchronous events, time loading, real time design issues, examples of real time systems. the software life cycle: phases of the software life cycle, interrupts: basics - shared data problem, interrupt latency.
V	**Introduction to RTOS** : Tasks, states, data – semaphores and shared data. More operating system services – message queues, mail boxes and pipes, timer function, events, memory management, interrupt Basic design using RTOS: Principles, an example, encapsulating semaphores and queues, hard real time scheduling considerations, saving memory, space and power. Embedded software development tools: Host and target machines, linkers/locators for embedded software.

RECOMMENDED BOOKS

1. “Embedded system Design” by Frank Vahid and Tony Givargis, John Wiley.
2. “An Embedded Software Primer” by David E.Simon, Pearson Education.
3. “Real Time System Design and Analysis” by Phillip A Laplante, PHI Pub.

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140904TN	Course Title- Micro-Sensor Design		

Course outcomes:

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

1. To understand the definition of micromachining and MEMS as well as an historical perspective of this emerging field.
2. To understand the fundamental properties of materials used for MEMS devices To gain a comprehensive perspective of various physical mechanisms for MEMS design
3. To understand the fundamental principle of piezo-resistive sensing, piezoelectric sensing, magneto static actuation and methods for fabricating
4. To understand the principle and design of Polymer based MEMS, Optical MEMS, RF MEMS.

Credits: 4

Unit	Topics
I	Introduction to MEMS and micro fabrication: History of MEMS development, characteristics of MEMS-miniaturization micro Electronics integration -Mass fabrication with precision. Micro fabrication microelectronics fabrication process-silicon based MEMS processes- new material and fabrication processing points of consideration for processing.
II	Electrical and Mechanical properties of MEMS materials: Conductivity of semiconductors, crystal plane and orientation, stress and stain - definition relationship between tensile stress and stain- mechanical properties of silicon and thin films, flexural beam bending analysis under single loading condition- types of beam- deflection of beam- longitudinal stain under pure bending spring-constant, torsional deflection, intrinsic stress, resonance and quality factor.
III	Sensing and actuation: Electrostatic sensing and actuation-parallel plate capacitor and its application and tactile sensor parallel Plate actuator- comb drive. Thermal sensing and actuations-thermal sensors-actuators and its applications. Piezoresistive sensors piezoresistive sensor material- stress in flexural cantilever and membrane and its application. Piezoelectric sensing and actuation- piezoelectric material properties-quartz-PZT-PVDF ZnO and its applications. Magnetic actuation- micro magnetic actuation principle- deposition of magnetic materials-design and fabrication of magnetic coil.
IV	**Polymer, RF and Optical MEMS:** Polymers in MEMS- polymide-su-8 liquid Crystal polymer (LCP)-PDMS-PMMA-parylene- fluorocarbons, application-acceleration, pressure, flow and tactile sensors. RF MEMS- Impedance tuners, Tunable filters, Phase shifters, Reconfigurable antennas Optical MEMS-passive MEMS Optical components-lenses-mirrors- actuation for active optical MEMS.

RECOMMENDED BOOKS

1. Chang Liu, Foundations of MEMS, Pearson International Edition, 2006.
2. Gaberiel M.Rebiz, RF MEMS Theory Design and Technology, John Wiley & Sons, 2003
3. Charles P.Poole, Frank J.Owens, Introduction to nanotechnology John Wiley & sons.
4. Julian W.Gardner, Vijay K, Microsensors, MEMS and Smart devices, John. Wiley & sons, 2001.
5. Stepan Lucyszyn, "Advanced RF MEMS", Cambridge University Press, 2010.

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140905TN	Course Title- Embedded System		

Course outcomes:

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

1. Understand the architecture and basic concepts of embedded systems and distinguish them from general-purpose computing systems...
2. Analyze and design embedded system hardware components including microcontrollers, memory, and peripheral interfaces.
3. Develop embedded software using programming languages like C and assembly for microcontrollers and real-time operating systems (RTOS).
4. Interface various sensors, actuators, and communication modules with embedded systems for real-world applications.

Credits: 4

Unit	Topics
I	**Hardware Considerations**: Introduction: Overview, design metrics, processor technology, design technology. Custom single purpose processors- introduction, RT-level combinational & sequential components, custom single purpose processor design, Optimizing program, FSMD, data path & FSM. General purpose processors and ASIP's: Basic architecture and operation of general purpose processors, programmer's view, development environment - ASIP's – microcontrollers, DSP and less general ASIP environments.
II	**Standard Processor Peripherals**: Timers, counters and watchdog timers, applications, UART, PWM application, LCD controller, keypad controllers, stepper motor control, ADC and DAC. Memory: Different types of ROM & RAM, cache system design
III	**Interfacing**: introduction to interfacing, communication basics, basic protocol concepts, interrupts and DMA, arbitration, multilevel bus architectures, communication - serial parallel and wireless protocols, I 2C, CAN, USB, FireWire, parallel and wireless protocols.
IV	**Software Considerations**: Basics of real time concepts, bus transfer mechanism, software concepts, system concepts, real time definitions, events and determinism, synchronous and asynchronous events, time loading, real time design issues, examples of real time systems. the software life cycle: phases of the software life cycle, interrupts: basics - shared data problem, interrupt latency.
V	**Introduction to RTOS** : Tasks, states, data – semaphores and shared data. More operating system services – message queues, mail boxes and pipes, timer function, events, memory management, interrupt Basic design using RTOS: Principles, an example, encapsulating semaphores and queues, hard real time scheduling considerations, saving memory, space and power. Embedded software development tools: Host and target machines, linkers/locators for embedded software.

RECOMMENDED BOOKS

1. “Embedded system Design” by Frank Vahid and Tony Givargis, John Wiley.
2. “An Embedded Software Primer” by David E.Simon, Pearson Education.
3. “Real Time System Design and Analysis” by Phillip A Laplante, PHI Pub.

Programme / Class	Honors	Year	M.Sc. I	Semester-IX
Subject	Electronics			
Course Code	B140906PN	Course Title	Communication Lab	

Course Outcomes (COs)

1- Demonstrate practical skills in generating and analyzing analog and digital modulation techniques such as AM, FM, PM, ASK, FSK, and PSK..

2- Use electronic instruments like signal generators, oscilloscopes, spectrum analyzers, and power meters to perform communication experiments.

3- Design, implement, and test communication circuits and systems including modulators, demodulators, and filters.

4. Analyze the effects of noise and distortion in communication systems through experimental measurements

Credits: 4

Topics

Lab Experiment List

1. To study the amplitude modulation and demodulation.
2. Envelop detector for AM signals.
3. Generation and Demodulation of DSB-SC signal.
4. SSB generation.
5. To study andrealize VCO as a FM generator.
6. To study and realize Phase locked loop FM generator.
7. To study and realize frequency discrimination method for FM demodulation.
8. To study and realize PLL as FM detector.
9. Study of Frequency Division Multiplexing and Demultiplexing
10. Study of Frequency Modulation (FM) and Frequency Shift Keying (FSK)
11. Study of signal sampling and reconstruction techniques and to verify Nyquist criteria and tracing.
12. Study of PAM, PWM and PPM modulation and demodulation techniques.
13. Study of TDM pulse amplitude modulation and demodulation.
14. Study of Pulse code modulation and demodulation techniques.
15. Study of Delta / Adaptive Delta Modulation and Demodulation.
16. Study of Phase Shift Keying Modulation and Demodulation Technique.
17. Study of Binary Phase Shift Keying (BPSK)
18. Study of ASK and FSK modulation and demodulation
19. Study of PSK, DPSK and QPSK Modulation and Demodulation
20. Study of Time Division Multiplexing and De-multiplexing

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-X
Subject	Electronics			
Course Code	B141001TN	Course Title- IoT and its Application		

Course outcomes:

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

1 Incorporate the best practices learnt to identify the attacks and mitigate the same.
2 Adopt the right security techniques and protocols during the design of loT products.
3 Assimilate and apply the skills learnt on ciphers and block chains when appropriate.
4 Describe the essential components of loT.
5 Find appropriate security/privacy solutions for IoT.

Credits: 4

Unit	Topics
I	Fundamentals of loT and Security and its need, Prevent Unauthorized Access to Sensor Data, Block ciphers, Introduction to Blockchain, Introduction of loT devices, lot Security Requirements, M2M Security, Message integrity, Modeling faults and adversaries, Difference among loT devices, computers, and embedded devices.
II	IoT and cyber-physical systems RFID Security, Authenticated encryption Byzantine Generals problem sensors and actuators in loT. JoT security (vulnerabilities, attacks, and countermeasures), Cyber Physical Object Security, Hash functions, Consensus algorithms and their scalability problems, Accelerometer, photo resistor, buttons.
III	Security engineering for loT development Hardware Security, Merkle trees and Elliptic curves digital signatures, verifiable random functions, Zero-knowledge systems motor, LED, vibrator. IoT security lifecycle, Front-end System Privacy Protection, Management, Secure loT Databases, Public-key crypto (PKI), block chain, the challenges, and solutions, analog signal vs. digital signal.
IV	Data Privacy Networking Function Security Trees signature algorithms proof of work, Proof of stake, Networking in loT, Device/User Authentication in loT, IoT Networking Protocols, Crypto-currencies, alternatives to Bit coin consensus, Bit coin scripting language and their use Real-time communication.
V	Introduction to Authentication Techniques Secure IoT Lower Layers, Bit coin P2P network, Ethereum and Smart Contracts, Bandwidth efficiency, Data Trustworthiness in IoT Secure loT Higher Layers, Distributed consensus, Smart Contract Languages and verification challenges data analytics in loT- simple data analyzing methods.

RECOMMENDED BOOKS

6. B. Russell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing.
7. FeilU, "Security and Privacy in Internet of Things (loTs): Models, Algorithms, and R18", CRC Press
8. Narayanan et al. "Hitcoin and Cryptocurrency Technologies: A Comprehensive Introduction." Princeton University Press, 2016.
9. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies," O'Reilly, 2014.
10. T. Alpean and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambr University Press, 2011.
11. Security and the loT ecosystem, KPMG International, 2015.
12. Internet of Things: IoT Governance, Privacy and Security Issues" by European Research

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-X
Subject	Electronics			
Course Code	B141002TN	Course Title- Digital Signal Processing		

Course outcomes:

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

1. Understand the fundamental concepts of discrete-time signals and systems and their mathematical representation.
2. Analyze and design discrete-time systems using techniques such as convolution, difference equations, and Z-transforms.
3. Apply Fourier analysis methods including Discrete-Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), and Fast Fourier Transform (FFT) for signal processing applications..
4. Design and implement digital filters, including FIR and IIR filters, and evaluate their performance

Credits: 4

Unit	Topics
I	*Introduction* Limitations of analog signal processing, Advantage digital signal processing, discrete time characterization of signals & systems some elementary discrete time sequences and systems, concepts of stability, causality, linearity time invariance and memory, linear time invariant systems, and their properties, linear constant coefficient difference equations. **Frequency domain representation of discrete time signal and systems** complex exponentials as Eigan function of LTI systems, Fourier transform of sequences.
II	*Processing of Continuous Time Signals* Discrete time processing of continuous time signals and vice – versa; decimation & interpolation, changing the sampling rate by integer and non-integer factors using discrete time processing. **Discrete Fourier transform:** DFT and its properties ; linear, periodic and circular convolution , linear filtering methods based on DFT, filtering of long data sequences; fast Fourier transform algorithm using using decimation in time and decimation in frequency techniques ; linear filtering approaches to computation of DFT.
III	*Transform Analysis of LTI Systems* Frequency response of LTI systems, system function for system characterized by linear constant coefficient difference equations. Relationship between magnitude and phase, all pass systems, minimum phase systems. **Structure for discrete time systems** Signal flow graph representation, transposed forms, lattice structures
IV	*Design of Digital Filters* Linear phase FIR filters; FIR differentiator and Hilbert transforms, FIR filter design by impulse invariance, bilinear transformation; Matched Z – transformation; frequency transformation in the analog and digital domain.

V	*Finite Precision Effects* Fixed point and floating point representations, effect of coefficient quantization, effect of round off noise in digital filters, limit cycles. **Digital signal processors** Architecture and various features of TMS/ADSP, series of digital signal processors; Instruction set and few applications of TMS 320CXX. , linkers/locators for embedded software.

RECOMMENDED BOOKS

1. "Digital Signal Processing" by Terrell T. J. and Lik-Kwan Shark,Palgrave Macmillan Pub.
2. "Discrete time signal processing" by Alan V, Oppenheim and Ronald W Shafer, PHI Pub.
3. "Introduction to Digital Signal Processing" by Kur R., McGraw Hill Pub.
4. "Theory and Applications of Signal Processing" by L. R. Rabiner and B. Gold, Prentice Hall Pub.
5. "Digital Signal Processing" by Avtar Singh and Srinivasan S, Thomson Pub.
6. "Introduction to digital Signal Processing" by J. G. Proakis and DG Manolakis, Prentice Hall Pub.

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-X
Subject	Electronics			
Course Code	B141003TN	Course Title- Opto Electronic Devices		

Course outcomes:

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

1. Understand the basic principles of optoelectronics and the interaction of light with semiconductor materials...
2. Analyze the working and characteristics of key optoelectronic devices such as LEDs, laser diodes, photodiodes, and phototransistors.
3. Evaluate the performance parameters of optoelectronic devices including quantum efficiency, response time, and spectral sensitivity.
4. Explain the design and operation of optical detectors, optical modulators, and optical sensors.

Credits: 4

Unit	Topics
I	**Introduction**: Historical developments, Optical fiber communication system, Principle of optical communication, Advantages of optical fiber communication, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Cylindrical fiber. Structure and types of optical cable: Structure of optical fibers, Single and multimode fibers, Step index and graded index optical fiber.
II	**Transmission Characteristics of Optical Fibers**: Mid-infrared and Far-infrared transmission, Inter-modal and Intra-modal dispersion, Overall fiber dispersion, Polarization. **Losses in optical fibers**: Attenuation, Material absorption losses, Linear scattering losses, Non-linear scattering losses and Fiber bends loss and Joint loss. **Preparation methods of optical fibers**: Liquid phase (melting) and Vapour phase deposition techniques.
III	**Optical Fiber Connection**: Joints, Fiber alignment, Splices, Connectors, Couplers. **Optical sources**: Absorption and emission of radiation, Einstein's relation, Population inversion, Optical emission from semiconductors, Semiconductor LASER, LED power and efficiency characteristics. Optical transmitter and receive
IV	**Optical Detectors:** Optical detection principles, Absorption and emission, Quantum efficiency, Responsively, Long wavelength cutoff, p-n photodiode, p-i-n photo diode, photo transistors. **Optical fiber measurements:** Fiber attenuation measurements, Dispersion measurements, Refractive index profile measurements, Cut-off wavelength measurements, Numerical aperture measurements. ..
V	**Digital Transmission Systems** Point to point links, system considerations, link power budget, rise time budget, modulation formats for analog communication system, introduction to WDM concepts, Introduction to advanced multiplexing strategies.

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RECOMMENDED BOOKS

1"Optical Electronics" by A. Yariv, HRW Pub.
2"Optoelectronics: An introduction" by J.Wilson and J.F.B.Hawkes, PHI Pub.
3"Optical Fiber Communication" by Gerd Keiser, TMH Pub.
4"Optical Fiber Communication" by A. Selvarajan S. Kar and T Srinivas, TMH.
5"Optical fiber communications, Principles and Practice" by John M. Senior, PHI Pub.
6"Optical fiber systems, Technology design and applications" by Charles K Kao, Mc-Graw Hill Pub.

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Programme / Class	M.Sc.	Year	M.Sc. I	Semester-X
Subject	Electronics			
Course Code	B141004TN	Course Title- Python Programming		

Course outcomes:

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

6 Learn the syntax and semantics of Python Programming Language.
7 Write Python functions to facilitate code reuse and manipulate strings.
8 Illustrate the process of structuring the data using lists, tuples and dictionaries.
9 Demonstrate the use of built-in functions to navigate the file system.

Credits: 4

Unit	Topics
I	**Basics of Python Programming** Features of Python, variables and identifiers, operators and expressions. Decision control Statements: Selection/Conditional branching statements, basic loop structures/iterative Statements, nested loops, break, continue, and pass Statements. Functions and Modules: function definition, function call, more on defining functions, recursive functions, modules.
II	**Data Structure Strings** Introduction, built-in string methods and functions, slice operation, String Module. Regular Expressions. Lists: Introduction, nested list, cloning lists, basic list operations, list methods. Functional programming.
III	**Tuples** Introduction, basic tuple operations, tuple assignment, tuples for returning multiple values, nested tuple, mutable items, uses. Sets: Introduction, Set operations. Dictionaries: Basic operations, sorting items, looping over dictionary, nested dictionaries, dictionary methods.
IV	**Files and Exceptions** Reading and writing files, pickling, handling exceptions. Built-in and user-defined exceptions. OOPS Concepts: Introduction to classes and objects, class method and static method, and private data members, Inheritance, Operator Overloading.

RECOMMENDED BOOKS

[1]. Reema Thareja,Pythan Programming using problem solving approach, Oxford University press.
[2]. Allen Downey, 'Think Python: How to Think Like a Computer Scientist', O'Reilly publications, 2nd Edition, 2015.
[3]. Albert Lukaszweski, Mysql for Python PACKT publishers
[4]. Mark Lutz, 'Learning Python', O'Reilly Publications.
[5]. Stevrt venit and Elizabeth Drake,Prelude to Programming: Concepts and Design', 6th Edition (2015).
[6]. Mark J Guzdial, 'Introduction to Computing and programming in Python, 3rd Edition, Pearson.

Programme / Class	M.Sc.	Year	M.Sc. I	Semester-X
Subject	Electronics			
Course Code	B141005TN	Course Title- Machine Learning		

Course outcomes:

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

1. Develop a good understanding of fundamental principles of machine learning
2. Formulation of a Machine Learning problem.
3. Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering
4. Evaluate performance of various machine learning algorithms on various data sets of a domain.

Credits: 4

Unit	Topics
I	Introduction to Machine Learning Why Machine learning. Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.
II	Classification and Regression Classification: Binary Classification- Assessing Classification performance, Class probability Estimation- Assessing class probability Estimates, Multiclass Classification. Regression: Assessing performance of Regression- Theory of Generalization: Effective number of hypothesis, VC Dimensions, Regularization theory.
III	Linear Models Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification, Perceptron, Support Vector Machines, Soft Margin SVM, Kernel methods for non-Linearity.
IV	Logic Based and Algebraic Models Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering. Rule Based Models: Rule learning for subgroup discovery. Tree Based Models: Decision Trees, Ranking and Probability estimation Trees.
V	Probabilistic Models Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood, Probabilistic Models with Hidden variables: Estimation-Maximization, Trends in Machine Learning: Model and Symbols- Bagging and Boosting. Data Streams and Active Learning. Deep Learning, Reinforcement Learning.

RECOMMENDED BOOKS

1 Tom Mitchell, "Machine Learning". McGraw Hill, 1997

2 E. Alpaydin, "Introduction to Machine Learning". PHI, 2005,

3 Andrew Ng. Machine learning yearning, https://www.deeplearning.ai/machine-learningyearning/

4 AurolienGeron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff O'Reilly

5 Andreas Muller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, Shroff O'Reilly

Programme / Class	Honors	Year	M.Sc. I	Semester	X
Subject	Electronics				
Course Code	B141006PN	Course Title- Digital Signal Processing lab			

Course Outcomes (COs)

1- Demonstrate practical skills in generating and analyzing analog and digital modulation techniques such as AM, FM, PM, ASK, FSK, and PSK.

2- Use electronic instruments like signal generators, oscilloscopes, spectrum analyzers, and power meters to perform communication experiments.

3- Design, implement, and test communication circuits and systems including modulators, demodulators, and filters.

4. Analyze the effects of noise and distortion in communication systems through experimental measurements

Credits: 4

Topics

Lab Experiment List

1-Generation Of signal

2-Linear Convolution and Circular convolution of two given sequences

3- To determine z-transform from the given transfer function and its ROC using MATLAB.

4- Introduction of Filter design and analysis (FDA) tool.

5- Design and implementation of digital filter for given set of specification.

6-Design and implementation of FIR filter using window techniques.

7- Finite word length Effect in Digital filter.