Dr. A.P.J. Abdul Kalam Technical University
VistarYojna, Jankipuram, Lucknow, Uttar Pradesh, 226031, Phone: 0522-2336805

ELECTRONIC & COMMUNICATION ENGINEERING DEPARTMENT

Vision of the Department

"To produce manpower in the field of Electronics and Communication Engineering, capable to compete with that elsewhere and to make the department a center of excellence in the field of Signal Processing and Microelectronics"

Mission of the Department

MD1: To develop the ability among students and understand concepts of core graduate electronics and communication engineering.

MD2: To create center of Excellence to meet global research and development challenges.

PEO1: Graduates of the programme will have an educational experience that inspires them to exhibit leadership and team building skills and have successful careers in their chosen technical or professional domain.

PEO2: Graduates of the programme will continue to learn and adapt in a constantly evolving society and contribute to the society in a professional and ethical manner.

PEO3: Graduates of the programme will inculcate good technical and professional knowledge according to requirements of industries and higher studies.

PEO4: To inculcate the spirit of innovation / creativity, independent thinking, risk taking ability, entrepreneurship and attitude to approach challenges with confidence.

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Program	B. Tech. (Electronics and Communication Engineering)
POs	**At the end of the program, the students will be able to:** **PO1** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. **PO2** Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **PO3** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. **PO4** Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. **PO5** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. **PO6** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. **PO7** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. **PO8** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. **PO9** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. **PO10** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. **PO11** Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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	PO12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
PSOs	**PSO1:** An ability to understand the concepts of basic Electronics & Communication Engineering and to apply them to various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices, etc. **PSO2:** An ability to solve complex Electronics and Communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions. **PSO3:** Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.

LOCAL *IIDD, Uttar Pradesh, UPERC etc.*	**REGIONAL** *UPSIDA, Infrastructure & Industrial Development Department(UP), etc.*	**NATIONAL** *(CII, Indian Electrical Equipment Industry, HEE, ASSOCHAM*	**GLOBAL** *Electrical and Electronic Engineering Industries (EEEI),European Union*
Local power distribution improvements	Regional power grid enhancements	National grid reliability programs	Global power system resilience initiatives
Community wireless networks	Regional communicati on infrastructure	National broadband policies	Global communication standards
Local automation for small industries	Regional electrical manufacturing hubs	National industry automation initiatives	Global industrial automation trends
Local electronics manufacturing	Regional electronics industry support	National electronics industry policies	Global semiconductor market trends
Local sustainability projects	Regional sustainable development	National green energy policies	Global sustainable development goals
Local power conversion for industries	Regional manufacturing capabilities	National research and development funding	Global technological advancements
Local electronics manufacturing	Regional electronics Industry support	National electronics Industry policies	Global semiconductor Market trends
Localized solar installations	Regional grid integration	National renewable energy policies	International climate agreements and initiatives

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Link to Document: https://invest.up.gov.in/iidd/https://shorturl.at/w4hq [PDF]	**Link to Document:** https://invest.up.gov.in/iidd/	**Link to Document:** https://www.assocham.org/HEE [PDF]	**Link to Document:** EEEI https://www.eeuropa.org/electrical-and-electronic-engineering-industries.html

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Courses: Course Outcomes (COs) are available in individual syllabus files which can be accessed by clicking on the respective Course Name

Course Code	Course Name	Curricula relevant to local, regional, national and global developmental needs			
		Local	Regional	National	Global
IEC101/IEC201	Fundamentals of Electronics Engineering	✓		✓	✓
IEC151/IEC251	Basic Electronics Engineering Lab	✓	✓		
IEC301	Electronics Devices & Circuits	✓	✓	✓	
IEC302	Digital Logic Design	✓	✓	✓	
IEC303	Electromagnetic Field Theory & Wave Propagation		✓	✓	✓
IEC351	Electronics Devices & Circuit Lab	✓	✓	✓	
IEC352	Digital Logic Design Lab	✓	✓	✓	
IEC353	Circuit Simulation Lab	✓	✓	✓	✓
IEC354	Mini Project-I or Internship Assessment	✓	✓	✓	✓
IEC401	Computer Organisation and Operating Systems		✓	✓	✓
IEC402	Network Analysis and Synthesis			✓	✓
IEC403	Signal System	✓	✓	✓	✓
IEC451	Computer Organisation Lab			✓	✓
IEC452	Network Analysis and Synthesis Lab				✓
IEC453	Signal System Lab				✓
IEC454	Instrumentation and Sensor Lab	✓	✓		
IOE035/IOE044	Sensor and Instrumentation	✓	✓	✓	✓
IOE038/IOE048	Analog Electronics	✓	✓	✓	✓
IOE049	Communication Engineering	✓	✓	✓	✓
IEC501	Integrated Circuits	✓	✓	✓	✓
IEC502	Microprocessor & Microcontroller	✓		✓	✓
IEC503	Principles of Communication	✓	✓	✓	✓
IEC551	Integrated Circuits Lab	✓	✓	✓	✓
IEC552	Microprocessor & Microcontroller Lab	✓		✓	✓
IEC553	Communication Engineering Lab I	✓	✓	✓	✓
IEC554	Mini Project/Internship	✓	✓	✓	✓
IEC054	Advance Digital Design using Verilog		✓	✓	✓

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IEC055	Optical Communication		✓	✓	✓
IEC601	Digital Communication	✓	✓	✓	✓
IEC602	Control System	✓	✓	✓	✓
IEC603	Microwave and Radar Engineering	✓	✓	✓	✓
IEC063	Data Communication Networks		✓		✓
IEC064	Antenna Theory and Design	✓	✓	✓	✓
IEC651	Communication Engineering Lab II	✓	✓	✓	✓
IEC652	Control System Lab	✓	✓	✓	✓
IEC653	Microwave and Antenna design lab	✓	✓	✓	✓
KEC072	VLSI Design		✓	✓	✓
KEC074	Microwave and RADAR Engineering	✓	✓	✓	✓
KEC076	Wireless and Mobile Communication	✓	✓	✓	✓
KEC751B	VLSI Design Lab			✓	✓
KEC751D	Microwave and RADAR Engineering Lab			✓	✓
KEC752	Mini Project or Internship Assessment	✓	✓	✓	✓
KEC753	Project-I	✓	✓	✓	✓
KEC851	Project-II	✓	✓	✓	✓

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B. Tech. (Electronics and communication Engineering)

Semester- I/II

Course Code	IEC101/IEC201	Title of the Course	FUNDAMENTALS OF ELECTRONICS ENGINEERING
Total Credits of the Course	03	Hours per Week	03

Course Objectives:	1. Understand the V-I Characteristic of PN diode & Zener Diode and it's operation in forward and reverse resistance. Know the characteristics of Half wave and Full wave rectifier with and without filters. 2. Know the characteristics of BJT anf JFET & MOSFET. 3. Understand characteristic of operational amplifier in Inverting and Non-inverting mode. 4. Understand the implementation of Boolean function using logic gates. Learn about verification of truth tables of various logic gates. 5. Learn about Fundamentals of Communication Engineering & Fundamental and Overview of wireless communication and cellular communication.

Course Content

Unit	Description	Weightage (%)
1.	**Semiconductor Diode**: Ideal and practical Diodes V-I characteristics,, Diode Equivalent Circuits, Zener Diodes breakdown mechanism (Zener and avalanche) **Diode Application:** Diode Applications, Half and Full Wave rectification, Clippers, Clampers, Zener diode as shunt regulator, Voltage-Multiplier Circuits **Special Purpose two terminal Devices:** Light-Emitting Diodes, Photo Diodes, Varactor Diodes, Tunnel Diodes.	20%
2.	**Bipolar Junction Transistor:** Transistor Construction and Characteristic, Operation, Amplification action. Common Base, Common Emitter, Common Collector Configuration. **Field Effect Transistor:** Construction and Characteristic of JFETs. Transfer Characteristic. MOSFET (MOS) (Depletion and Enhancement) Type, Transfer Characteristic.	20%
3.	**Operational Amplifiers:** Introduction, Op-Amp basic, Practical Op-Amp Circuits Inverting Amplifier, Non-inverting Amplifier, Unit Follower, Summing Amplifier, Integrator, Differentiator	20%

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4.	**Digital Electronics:** Number system & representation, Code Conversion, Binary arithmetic, Introduction of Basic and Universal Gates, using Boolean algebra simplification of Boolean function. K Map Minimization.	20%
5.	**Fundamentals of Communication Engineering:** Basics of signal representation and analysis, Electromagnetic spectrum. Elements of a Communication System. Need of modulation and typical applications. Fundamentals of amplitude modulation and demodulation techniques. **Introduction to Wireless Communication:** Fundamental and Overview of wireless communication and cellular communication. Different generations and standards in cellular communication systems	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Describe the concept of PN Junction and devices.	3
CO2	Explain the concept of BJT, FET and MOSFET.	2
CO3	Apply the concept of Operational amplifier to design linear and non-linear applications.	3
CO4	Perform number systems conversions, binary arithmetic and minimize logic functions.	3
CO5	Describe the fundamentals of communication Engineering.	2

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	1		1							2	1	
CO2	3	3	1	1		1							1		1
CO3	3	1	1			1							1	1	
CO4	3	1	1			1							1	1	1
CO5	3	1	1			1							2	1	

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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested References:

1	Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2	2. George Kennedy, "Electronic Communication Systems", McGraw Publication
3	3. David A. Bell, "Electronic Devices and Circuits", Oxford UniversityPress.
4	4. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill.
5	A. Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018.

On-line resources to be used if available as reference material

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electricronics and Communication Engineering)

Semester- I/II

Course Code	IEC151/IEC251	Title of the Course	Basic Electronics Engineering Lab
Total Credits of the Course	01	Hours per Week	02

Course Objectives:	1. Understand the working principle of CRO, Function Generator and Digital Multimeter. 2. Learn about the testing of components and understand the PN diode operation in forward and reverse bias. 3. Know the characteristics of Half wave and Full wave rectifier with and without filters. 4. Understand V-I Characteristic of Zener Diode and it's forward and reverse resistance. 5. Know the characteristics of transistors in Common Emitter configuration. 6. Understand characteristic of operational amplifier in Inverting and Non-inverting mode. 7. Learn about verification of truth tables of various logic gates. **8.** Understand the implementation of Boolean function using logic gate

IEC151/IEC251 Basic Electronics Engineering Lab		**L**	**T**
		0	0	2
Course Outcomes			***KL***
Upon the completion of this course, the student will be able to:			
CO1	**L1: Knowledge-** *recalls* the basic concept of basic components -digital Multimeter, CRO and other device components.		**1**
CO2	**L2: Understand-** *Understand* the working principle of PN Diode.		**2**
CO3	**L3: Applying-** *develop* the concept of Half wave and full wave rectifiers and its application like clipper, clampers *etc.*		**3**
CO4	**L4: Analysing** -*study* the V-I Characteristic of Zener Diode.		**4**
CO5	**L5: Observed-** *analyze* the characteristic of BJT in CE configuration.		**5**
CO6	**L6: Study-** of Operational Amplifier.		**6**
CO7	**L7: Verification-** of different digital logic gates		**7**
CO8	**L8: Implementation** of Boolean function		**8**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

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CO1	3	3	1	2		3		1	2				1	1
CO2	3	3	1	1				1	2				1	1
CO3	3	3	2	1				1	2				1	1
CO4	2	3	1	1	2			1	2				1	1
CO5	2		1						1					
CO6														
CO7														
CO8														

LIST OF EXPERIMENTS

Part A:

Suggestive List of Experiments

1. Study of various types of Active & Passive Components based on the ir ratings.
2. Identification of various types of Printed Circuit Boards (PCB) and soldering Techniques.
3. PCB Lab: a. Artwork & printing of a simple PCB. b. Etching & drilling of PCB
4. Soldering shop:

(i) Soldering and disordering of Resistor in PCB.
(ii) Soldering and disordering of IC in PCB.
(iii) Soldering and disordering of Capacitor in PCB

Part B:

1. Study of Lab Equipment: CRO, Multimeter, and Function Generator, Power supply-
2. Study of Components Active, Passive Components and Bread Board.
3. P-N Junction diode: Characteristics of PN Junction diode - Static and dynamic resistance measurement from graph.
4. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.
5. Characteristics of Zener diode: V-I characteristics of zener diode, Graphical measurement of forward and reverse resistance.
6. Characteristic of BJT: BJT in CE configuration. 7. Characteristic of FET: FET in CS configuration.
8. To study Operational Amplifier as Adder and Subtractor
9. Verification of Truth Table of Various Logic Gate.
10. Implementation of the given Boolean function using logic gates in both SOP and POS forms.

Part (C): PartA	**PCB Lab**: a. Artwork & printing of a simple PCB. b. Etching & drilling of PCB	This practical is not possible by virtual lab. It will be conducted only in physical mode
Part B	Study of Lab Equipment's and Components: CRO, Multi meter, Function Generator, Power supply- Active, Passive Components Bread Board.	NA, These test equipment can be Demonstrated online from any lab of ECE department

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(D) Experiments available on virtual lab Experiment Description	Link
PN Junction on diode: Characteristics of PN Junction diode-Static and dynamic resistance measurement from graph.	http://vlabs.iitkgp.ernet.in/be/exp5/index.html
Applications of PN Junction diode: Half & Full wave rectifier- Measurement of V_{rms},V_{dc}, and ripple factor.	http://vlabs.iitkgp.ernet.in/be/exp6/index.html http://vlabs.iitkgp.ernet.in/be/exp7/index.html
Characteristics of Zener diode: V-I characteristics of Zener diode, Graphical measurement of forward and reverse resistance.	http://vlabs.iitkgp.ernet.in/be/exp10/index.html
Characteristic of BJT: BJT in CE configuration.	http://vlabs.iitkgp.ernet.in/be/exp11/index.html
To study Operational Amplifier as Adder and Subtractor	http://vlabs.iitkgp.ernet.in/be/exp17/index.html http://vlabs.iitkgp.ernet.in/be/exp18/index.html
Verification of Truth Table of Various Logic Gate	https://de-iitr.vlabs.ac.in/digital- electronics-iitr/exp/truth-table-gates/
Implementation of the given Boolean function using logic gates in both SOP and POS forms.	https://de-iitr.vlabs.ac.in/digital-electronics-iitr/exp/realization-of-logic-functions/

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electronics circuits, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	IEC301	Title of the Course	Electronics Devices & Circuits
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. Understand the semiconductor physics and quantum mechanics 2. Knowledge about Energy band diagram and current in semiconductor material 3. Knowledge about the different types of diode and their characteristics 4. Understand the working of MOS capacitor, MOSFET, BJT and their characteristics

Course Content

Unit	Description	Weightage (%)
1.	Energy bands in intrinsic and extrinsic silicon, carrier transport, diffusion current, drift current, mobility and resistivity, sheet resistance, design of resistors. Excess Carriers in Semiconductors: Optical absorption, luminescence, carrier life time and photo conductivity, diffusion of carriers. Junction Properties: Equilibrium conditions, biased junctions, steady state conditions, reverse bias break down, transient and AC conditions.	20%
2.	BJT amplifier models: Voltage amplifier, current amplifier, transconductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc.,	20%
3.	High frequency transistor models, design procedure for particular specifications, low frequency analysis of multistage amplifiers MOSFET: Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier	20%
4.	Feedback: The general feedback structure, properties of negative feedback, the four basic feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.	20%
5.	Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.	20%

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Suggested References:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. D. Neamen , D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, "Fundamentals of Solid State Electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford univ. press, 2011.
6. Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Understand the principles of semiconductor Physics	Apply
CO2	Understand and utilize the mathematical models of semiconductor junctions.	Analyze
CO3	Understand carrier transport in semiconductors and design resistors.	Analyze
CO4	Utilize the mathematical models of MOS transistors for circuits and systems.	Analyze
CO5	Analyse and find application of special purpose diodes.	Apply

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
IEC301.1(CO1)	3	-	-	-	-	-	-	-	-	-	-	-
IEC301.2(CO2)	2	3	3	-	-	-	-	-	-	-	-	-
IEC301.3(CO3)	-	3	3	-	-	-	-	-	-	-	-	-

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IEC301.4(CO4)	-	3	3	3	-	-	-	-	-	-	-	-
IEC301.5(CO5)	3	-	-	-	3	-	-	-	-	-	-	3
Average	**2.5**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**3**

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC351**	**Title of the Course**	Electronics Devices & Circuit Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	1. Understand the working principle of CRO, Function Generator and Digital Multimeter. 2. Learn about the testing of components and understand the PN diode operation in forward and reverse bias. 3. Know the characteristics of Half wave and Full wave rectifier with and without filters. 4. Know the characteristics of transistors in CB, CE, CS and CD configurations. 5. Understand various types of operational amplifier and oscillators

List of Experiments:

1.Characteristic of BJT: BJT in CE configuration- graphical measurement of hparameters from input and output characteristics. Measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
2. Study of Multi-stage amplifiers: Frequency response of single stage and multistage amplifiers.
3. Feedback topologies: Study of voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc.
1. Field effect transistors: Single stage common source FET amplifier –plot of gain in dB vs frequency, measurement of bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
5. Metal Oxide Semiconductor Field Effect Transistors: Single stage MOSFET amplifier plot of gain in dB Vs frequency, measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
6. Oscillators: Study of sinusoidal oscillators:
(i) RC oscillators (phase shift, Wien bridge etc.).
(ii) Study of LC oscillators (Hartley, Colpitt, Clapp etc.),
7. Study of non-sinusoidal oscillators.
8. Measurement of Op-Amp parameters: Common mode gain, differential mode gain, CMRR, slew rate.
Simulation of amplifier circuits studied in the lab using any available simulation software and measurement of bandwidth and other parameters with the help of simulation software.

COs	**Course Outcome Statement**	**KL**
CO1	Analyze BJT CE amplifier, measure parameters and study multistage amplifier frequency response.	K3
CO2	Analyze feedback's impact on gain, bandwidth across various topologies.	K4
CO3	Explore FET and MOSFET amplifiers, analyze gain, bandwidth, impedance, signal capacity.	K2
CO4	Learn oscillators: RC, LC, non-sinusoidal types and oscillator principles.	K4
CO5	Measure Op-Amp parameters, explore applications: summing, integrator, differentiator	K5

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	End Semester Practical Examination	50%

Suggested References:
Lab Manuals/On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IEC351.1(CO1)	2	-	-	-	2	-	-	-	-	2	-	2
IEC351.2(CO2)	2	-	-	-	-	-	-	-	-	-	-	-
IEC351.3(CO3)	2	2	-	-	-	2	-	-	-	-	-	2
IEC351.4(CO4)	2	-	1	-	-	-	-	-	-	-	-	2
IEC351.5(CO5)	2	2	2	-	2	2	-	-	-	-	-	2
Average	2	2	1.5	-	2	2	-	-	-	2	-	2

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC302**	**Title of the Course**	Digital Logic Design
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	1. Introduce the concept of digital and Binary system. 2. Design and analyze combination logic circuits. 3. Design and analyze sequential logic circuits. 4. Design and analyze DAC and ADC circuits, identifying the strengths and limitations of different architectures 5. Use Hardware Description Languages (HDLs) to model and simulate digital designs, and understand the design flow from HDL to hardware implementation.

Course Content

Unit	**Description**	**Weightage (%)**
1.	Combinational logic: Signed binary numbers, Binary codes & code conversion, NAND and NOR implementation two level and multilevel Boolean expression, Minimization of Boolean expression using Karnaugh Map & Quine Mc-Clusky method (Tabular method) MSI device like Half and full adders, subtractors, serial and parallel adder, BCD adder, Decoders, Encoders, Multiplexed, DE - multiplexers & Magnitude comparator, display,	20%
2.	Sequential Logic Circuits: Introduction to Sequential logic design: Building blocks like S-R, JK and Master-Slave JK FF, edge triggered FF, characteristics table. Analysis of Clock Sequential circuits: state table, Reduction of state table, Excitation table State Diagram design of clock sequential circuits. Synchronous and asynchronous counters, shift registers, Introduction to finite state machines, design of synchronous FSM, algorithmic state machines charts. Designing synchronous circuits like pulse train generator, pseudo random binary sequence generator, clock generation.	20%
3.	Logic families and semiconductor memories: Introduction to Logic Families, characteristics Logic Families, fan-in, fan-out, Power Dissipation Speed of operation, noise margin, Operating Temperature, Tristate TTL and NAND gate, specifications, propagation delay, , tristate TTL, ECL, CMOS families and their interfacing, MUX implementation using CMOS, memory elements, concept of programmable logic devices like PAL, PLA and FPGA, logic implementation using programmable devices.	20%
4.	Digital-to-Analog converters (DAC): Introductions to Digital-to-Analog converters using Weighted resistor, R-2R ladder and resistor string etc. Analog-To-Digital converters (ADC): Using single slope, dual slope, successive approximation, and flash etc. switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.	20%
5.	Introduction to Hardware Description Languages (HDL): Introduction to HDL, Design flow using HDL (VHDL or Verilog), Behavioral, Dataflow, and Structural modeling, Simulation and verification of digital designs, Introduction to synthesis and implementation tools, Implementation of combinational circuits Adder, subtractor and MUX, Implementation of sequential circuits : Latch, flip flops and counters.	20%

Suggested References:

[1] M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
[2] S.Salivahanan and S.Arivazhagan, "Digital Circuits and Design" 3th edition, 2009.
[3] R.P. Jain, "Modern Digital Electronics," Tata McGraw Hill, 4th edition, 2009
[4] Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018
[5] W.H. Gothmann, "Digital Electronics- An Introduction to Theory and Practice," PHI, 2nd edition, 2006
[6] D.V. Hall, "Digital Circuits and Systems," Tata McGraw Hill,

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Understand the principles Combinational logic:	Apply
CO2	Understand and apply Sequential Logic Circuits:	Analyze
CO3	Understand Logic families and semiconductor memories:	Analyze
CO4	Implement Digital-to-Analog converters (DAC)	Analyze
CO5	Introduction to Hardware Description Languages (HDL):	Apply

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC352**	**Title of the Course**	Digital Logic Design Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	Understand the working principle and design logic gates, combinational and sequential circuits, including counters, using logic gates and integrated circuits (ICs), gaining practical skills in circuit design and analysis.

List of Experiments:

SUGGESTIVE LIST OF EXPERIMENTS

1.Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.

2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.

3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.

4. Implementation and verification of Decoder using logic gates.

5. Implementation and verification of Encoder using logic gates.

6. Implementation of 4:1 multiplexer using logic gates.

7. Implementation of 1:4 demultiplexer using logic gates.

8. Implementation of 4-bit parallel adder using 7483 IC.

9. Design, and verify the 4-bit synchronous counter.

10. Design, and verify the 4-bit asynchronous counter.

COs	**Course Outcome Statement**	**KL**
CO1	Design and analyze combinational logic circuits.	K3
CO2	Design & analyze modular combinational circuits with MUX/DEMUX, decoder, encoder.	K4
CO3	Design & analyze synchronous sequential logic circuits	K2
CO4	Design & build mini project using digital ICs.	K4

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	End Semester Practical Examination	50%

Suggested References:
Lab Manuals/On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC303**	**Title of the Course**	Electromagnetic Field Theory & Wave Propagation
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	This course aims to provide a foundational understanding of electromagnetism and vector calculus. Students will explore vector operations, coordinate transformations, and vector calculus applications. The course covers electrostatic and magnetostatic fields, Maxwell's equations, wave propagation, and electromagnetic wave interactions, preparing students for practical applications in engineering and physics.

Course Content

Unit	**Description**	**Weightage (%)**
1.	Vector Calculus: Scalar and vector fields, vector representation of line, surface, volume integral, gradient, divergence and curl, divergence and Stokes theorem, different coordinate systems. Electrostatic and Magnetostatics: Coulomb's law, surface and volume charges, electrostatic potential, Gaussian law and its applications in field determination, Laplace's and Poisson's equation, Ampere's law, Biot Savart's law, magnetic flux density, magnetic vector potential, magnetic forces, Faraday's law, boundary conditions at electric and magnetic interfaces.	20%
2.	Time Varying Fields and Maxwell's Equations: Displacement current, Maxwell's equation (integral & differential form) - for static, time varying and harmonically varying fields, Poynting theorem and power flow, complex pointing vector, properties of conductor and dielectrics, wave equations for free space and conductors.	20%
3.	Uniform Plane Waves: Uniform plane wave propagation, their transverse nature, reflection by ideal conductor: normal incidence, reflection and transmission with normal incidence at another dielectric, plane wave in lossy dielectric, surface & wave impedance and propagation constant, depth of penetration	20%
4.	Transmission Lines: Parallel plane transmission lines, transmission lines with losses, characteristic impedance, propagation constant, attenuation constant and phase constant, reflection, input impedance in terms of reflection coefficient, standing wave ratio (SWR), voltage maxima and minima, impedance matching devices and its principle, Smith chart.	20%

5.	Ground Wave Propagation: Plane earth reflection, space wave and surface wave, space wave propagation: introduction, field strength relation, effects of imperfect earth, effects of curvature of earth. Sky Wave Propagation: Introduction, structural details of the ionosphere, wave propagation mechanism, refraction and reflection of sky waves by ionosphere, ray path, critical frequency, MUF, LUF, OF, virtual height and skip distance, relation between MUF and the skip distance, multi-hop propagation, wave characteristics	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Apply different coordinate systems and their application in electromagnetic field theory, establish a relation between any two coordinate systems and also understand the vector calculus.	Apply
CO2	Understand the concept of static electric field, current and properties of conductors. Establish boundary conditions and to calculate capacitances of different types of capacitors.	Analyze
CO3	Understand the concept of static magnetic field, magnetic scalar and vector potential.	Analyze
CO4	Understand the forces due to magnetic field, magnetization, magnetic boundary conditions and inductors.	Analyze
CO5	Understand displacement current, time varying fields, propagation and reflection of EM waves and transmission lines.	Apply

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

1	MNO Sadiku, “Elements of Electromagnetic”, Oxford University Press.
2	W.H. Hayt and J. A. Buck, “Engineering Electromagnetic”, McGraw-Hill Education.
3	Joseph A. Edminister, “Schaum's Outline of Electromagnetics”, McGraw-Hill.
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC353**	**Title of the Course**	Circuit Simulation Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This lab aims to teach students to perform various electrical connections, develop small circuits on PCBs, differentiate between electrical wires, cables, and accessories, and demonstrate the layout and safety measures of electrical substations.

List of Experiments:

SUGGESTIVE LIST OF EXPERIMENTS

Implement experiments in part A in the PSPICE platform, while experiments of part B in VHDL/Verilogmodule.

Part A

PSPICE Experiments:

1. Applications of PN Junction diode: Half & Full wave rectifier- Measurement of Vrms, Vdc, and ripple factor.

2.Applications of PN Junction diode: Clipper and Clamper and Voltage Doublers circuit.

3.Characteristics of Zener diode: V-I characteristics of Zener diode, graphical measurement of forward and reverse resistance

4. (a) Transient Analysis of BJT inverter using step input

(b)DC Analysis (VTC) of BJT inverter

5. (a) Transient Analysis of NMOS inverter using step input

(b) Transient Analysis of NMOS inverter using pulse input.

(c) DC Analysis (VTC) of NMOS inverter.

6. Analysis of frequency response of Common Source amplifiers.

Part B :

HDL (using VHDL program module/ VERILOG Module)

VHDL PROGRAMS

1. Design and Simulation of Half and Full Adder using VHDL program module
2. Design and Simulation of 4:1 MUX and 1:4 DMUX using VHDL program module
3. Design and Simulation of BCD to Excess-3 code using VHDL program module
4. Design and Simulation of 8 to 3 encoder and 3 to 8 decoder using VHDL program module
5. Design and Simulation of JK Flip-flop using VHDL program module

COs	Course Outcomes	Cognitive Level
CO1	CO1: Analyze various application of PN junction diode (clipper, clamper, rectifier)	Analyze
CO2	CO2: To implement transient and DC analysis of BJT invertor and NMOS invertor.	Apply
CO3	CO3: To implement adder and multiplexer.	Apply
CO4	CO4: Design encoder, decoder and code converter	Apply
CO5	CO5: Analyze behavior of a JK flip flop.	Analyze

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering)

Semester- IV

Course Code	**IEC401**	**Title of the Course**	Computer Organisation and Operating Systems
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	1. To identify various components of computer and their interconnection 2. To understand design of the CPU, i.e. the ALU and control unit. 3. To compare among various Memory devices as per requirement. 4. To compare among various types of IO mapping techniques 5. To understand the performance issues of cache memory and virtual memory

Course Content

Unit	**Description**	**Weightage (%)**
1.	INTRODUCTION: Computer Architecture, organization and design, Von- Neumann Architecture, basic organization of a computer, Data representation, Fixed and Floating point, Error detection and correction codes. COMPUTER ARITHMETIC: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations.	20%
2.	BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC. Pipeline and Vector processing: Pipeline structure, speedup, efficiency, throughput and bottlenecks. Arithmetic pipeline and Instruction pipeline.	20%
3.	Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micranalysis of networks, waveform synthesis and Laplace Transform to complex waveforms. REGISTER TRANSFER AND MICRO-OPERATIONS: Register Operations, Arithmetic logic shift unit.	

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4.	MEMORY ORGANIZATION: Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Auxiliary memory, Associative memory, Cache Memory, Performance considerations, Virtual memory, Printer, Secondary Storage, RAID	20%
5.	INPUT OUTPUT ORGANIZATION: I/O interface, Memory Mapped I/O, Programmed I/O, Interrupt Initiated I/O, DMA. MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Comprehensive understanding of computer architecture, operations, arithmetic, and error correction.	Understand
CO2	CO2: Mastery of computer organization, design, pipelines, CPUs, and performance trade-offs	Analyze
CO3	CO3: Proficiency in register transfer, micro-operations, control design, and microprogramming.	Analyze
CO4	CO4: Comprehensive grasp of memory systems, hierarchies, cache, virtual memory, and storage	Apply
CO5	Proficiency in I/O methods, multiprocessor features, communication, synchronization, and coherence.	Analyze

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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Suggested References:	
	TEXT BOOKS: 1. M. Moris Mano (2017), Computer System Architecture, revised 3rd edition, Pearson, India. REFERENCE BOOKS: 1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2011), Computer Organization, 5th edition, McGraw Hill, New Delhi, India. 2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy. 3. Anrew S. Tanenbaum (2013), Structured Computer Organization, 6th edition, Pearson,India 4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, McGraw Hill International edition
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- IV

Course Code	**IEC402**	**Title of the Course**	**NETWORKS ANALYSIS & SYNTHESIS**
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	**1.** Apply basics of electrical circuits with nodal and mesh analysis. **2.** Illustrate electrical network theorems. **3.** Understand the concept of Laplace and Fourier transform and transform circuits using Thevenin's and Norton's theorem. **4.** Analyze electrical circuits under transient and steady state conditions.

Pre-requisites: Basic Electronics and Communication Engineering, Basic signal & systems

Course Content

Unit	**Description**	**Weightage (%)**
1.	Node and mesh analysis, matrix approach of network containing voltage & current sources and reactances, source transformation and duality	20%
2.	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tellegen's theorem as appliedto A.C. circuits.	20%
3.	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra	20%
4.	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	20%

5.	Transient behaviour, concept of complex frequency, driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, two-port network and interconnections. Introduction to band pass, low pass, high pass, and band reject filters.	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	CO1: Understand basics electrical circuits with nodal and mesh analysis. CO2: Appreciate electrical network theorems.	understand
CO2	CO3: Apply Laplace transform for steady state and transient analysis. CO4: Determine different network functions.	Analyze
CO3	CO5: Appreciate the frequency domain techniques	Analyze
CO4	CO1: Understand basics electrical circuits with nodal and mesh analysis. CO2: Appreciate electrical network theorems.	Analyze
CO5	CO3: Apply Laplace transform for steady state and transient analysis. CO4: Determine different network functions.	Apply

CO-PO Mapping Matrix/Course Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IEC403.C1	3	3	1	2								

IEC403.C2	3	3	1	2								
IEC403.C3	3	2	1	2								
IEC403.C4	3	2	1	2								
IEC403.C5	3	1	1	2		2						

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested References:

[1] A. Anand Kumar, "Network Analysis and Synthesis," PHI publication, 2019.

[2] A. K Chakrabory," Network Analysis and Synthesis," McGraw Hill publication, 2018.

Reference Books

[3] Franklin F. Kuo, "Network Analysis and Synthesis," Wiley India Education, 2nd Ed., 2006.

[4] Van, Valkenburg, "Network analysis," Pearson, 2019.

[5] Sudhakar, A., Shyammohan, S. P., "Circuits and Network," Tata McGraw-Hill New Delhi, 1994.

[6] A William Hayt, "Engineering Circuit Analysis," 8th Edition, McGraw-Hill Education.

Spoken Tutorial (MOOCs):

1. https://www.youtube.com/watch?v=bnjiLg4xfh8
2. https://www.youtube.com/watch?v=U8riFeiiu3s
3. https://www.youtube.com/watch?v=lkAvgVUvYvY
4. https://www.youtube.com/watch?v=Pq-tUQzeSRw
5. https://www.youtube.com/watch?v=15d-gyoBxIQ

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- IV

Course Code	**IEC403**	**Title of the Course**	Signal System
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	1. To understand the behavior of signals in time and frequency domain 2. To understand the characteristics of LTI systems 3. To give the concepts of signals and systems and its analysis using different transform techniques 4. To understand the Sampling and Reconstruction of signal

Pre-requisites: Basic Electronics and Communication Engineering, Engineering Mathematics

Unit	**Topics**	**Weightage (%)**
1	**SIGNALS AND THEIR REPRESENTATION** Analogy between vectors and signals, Orthogonal signal space, Orthogonality in complex functions, Eigen analysis, Continuous-time and Discrete-time signals, Energy and Power signals, Periodic and Aperiodic signals, Even and Odd signals, Exponential and sinusoidal signals etc., Transformations of the independent variable, Concepts of Unit impulse and Unit sample signals, Signum function. Continuous-time and Discrete-time systems and basic system properties.	20%
2	**LINEAR TIME-INVARIANT (LTI) SYSTEMS AND FOURIER SERIES REPRESENTATION OF PERIODIC SIGNALS** Discrete and Continuous time LTI systems, Convolution Sum, Convolution Integral, Properties of LTI systems, Causal LTI systems described by difference equations, Singularity functions. Continuous-time and Discretetime signals and their Fourier Series representation, Properties of Fourier Series, Dirichlet's Conditions, Complex Fourier Spectrum.	20%
3	**REPRESENTATION OF APERIODIC SIGNALS BY FOURIER TRANSFORMS AND LAPLACE TRANSFORMS** Continuous-time and Discrete-time signals and their Fourier Transforms, Fourier Transforms of periodic signals and standard signals, Properties of Fourier Transforms, System characterized by linear constant coefficient differential equation. Principles of Laplace Transform, The Region of Convergence (ROC), Properties of ROC, Relationship between Laplace Transform and Fourier Transform, Properties of Laplace transform.	20%

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4	**Z-TRANSFORMS** Principles of Z-Transform,The Region of Convergence (ROC), Propertiesof ROC, Relationship between Z-Transform and Fourier Transform, Properties of Z- transform, Inverse Z-transform, Pole zero plot, Power series expansion and Partial Fraction Expansion, Initial value and Final value Theorems, Analysis and characterization of LTI system using Z-Transforms.	20%
5	**SAMPLING AND RANDOM SIGNALS** Representation of Continuous-time signals by its samples, Sampling theorem, Impulse train sampling, Sampling with Zero Order Hold (ZOH), Natural and Flat top sampling, Reconstruction of signal from it's samples using interpolation, Effect of under sampling – Aliasing., Review of Probability Theory, Random signals and their representation, Continuous and Discrete Random variable, their description and examples, Statistical averages.	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Represent the various types of signals & systems and can perform mathematical operations on them.	Understand
CO2	Analyze the response of LTI system to Fourier series and Fourier transform and to evaluate their applications to network analysis.	Analyze
CO3	Analyze the properties of continuous-time signals and systems using Laplace transform and determine the response of linear systems to known inputs.	Analyze
CO4	Implement the concepts of Z transform to solve complex engineering problems using difference equations.	Apply
CO5	Develop and analyze the concept of state-space models for SISO & MIMO systems.	Analyze

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%

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2.	End Semester Examination	70%

Suggested References:	
1	David K. Cheng; "Analysis of Linear System", Narosa Publishing Co.
2	Donald E. Scott, "Introduction to circuit Analysis" Mc. Graw Hill.
3	B. P. Lathi, "Linear Systems & Signals" Oxford University Press
4	J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, "Signals and Systems", Tata Mc. Graw Hill.
5	M. E. Van-Valkenberg; " Network Analysis", Prentice Hall of India.
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC451**	**Title of the Course**	Computer organization and Architecture Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This lab aims to equip students with skills to recognize, sketch, and manipulate basic engineering signals, analyze their properties, and interpret magnitude and phase spectra. Students will also plot poles and zeros, assess system stability and frequency response, and represent systems in state-space form.

List of Experiments:

Part A

1. To realize Half Adder and Full Adder using Basic gates and NAND gates
2. To realize Half Subtractor and Full Subtractor by using Basic gates and NAND gates
3. Design a 4 bit comparator using gates/IC.
4. Design and Implement a 4 bit shift register using Flip flops.
5. To set up and test a 7-segment static display system to display numbers 0 to 9.

Part B

To implement following programs in C language

1. Implement a C program to convert a Hexadecimal, octal, and binary number to decimal number vice versa.
2. Implement a C program to perform Binary Addition & Subtraction.
3. Implement a C program to perform Multiplication of two binary numbers
4. Implement a C program to perform Multiplication of two binary numbers (signed) using Booth's Algorithms.
5. Implement a C program to perform division of two binary numbers (Unsigned) using Restoring division algorithm.
6. Implement a C program to perform division of two binary numbers (Unsigned) using nonrestoring division algorithm.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	To realize Half and full adder and subtractor.	K3
CO2	CO2: To Understand basics of comparators, shift register and 7-segment static display.	K4
CO3	CO3: To implement conversion of various binary system.	K2
CO4	CO4: To implement Binary Addition & Subtraction.	
CO5	CO5: To implement Binary multiplication and division	

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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	End Semester Practical Examination	50%

Suggested References:
Lab Manuals/On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering**)**

Semester- IV

Course Code	**IEC452**	**Title of the Course**	Network Analysis and Synthesis Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course enables students to verify AC network theorems, analyze transient responses, and design two-port networks and filters using simulation tools, culminating in a mini-project involving hardware/simulation implementation.

List of Experiments:

1. Verification of the principle of Superposition with AC sources using simulation tools/hardware implementation.
2. Verification of Thevenin's and Maximum Power Transfer theorems in AC Circuits using simulation tools/ hardware implementation.
3. Verification of Norton theorems in AC Circuits using simulation tools/ hardware implementation.
4. Verification of Tellegen's theorem for two networks of the same topology using simulation tools/ hardware implementation.
5. Determination of Z and h-parameters (DC only) for a network and computation of Y and ABCD Parameters using simulation tools/ hardware implementation.
6. Determination of driving point and transfer functions of a two-port ladder network and verification with theoretical values using simulation tools/ hardware implementation.
7. Determination of transient response of current in RL and RC circuits with step voltage input using simulation tools/ hardware implementation.
8. Determination of transient response of current in RLC circuit with step voltage input for underdamped, critically damped and overdamped cases using simulation tools/ hardware implementation.
9. Determination of image impedance and characteristic impedance of T and Π networks, using O.C. and S.C. tests using simulation tools/ hardware implementation.
10. Verification of parameter properties in inter-connected two-port networks: series, parallel and cascade using simulation tools/ hardware implementation.
11. Determination of frequency response of a Twin–T–notch filter using simulation tools/ hardware implementation.

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12. To determine attenuation characteristics of low pass / high pass active filters using simulation tools/ hardware implementation.
13. Implementation of Mini Project using Analog Electronics and other components using simulation tools/ hardware implementation.

COs	Course Outcomes	Cognitive Level
CO1	Verify various network theorems on the AC network using simulation/hardware implementation.	Evaluate
CO2	Demonstrate transient response of AC circuits using simulation/hardware implementation.	Apply
CO3	Verify properties of parameters of filters and/or two-port networks using simulation/hardware implementation.	Evaluate
CO4	Verify parameter properties in inter-connected two-port networks: series, parallel and cascade using Multisim/ PSPICE.	Evaluate
CO5	Develop a mini project using Analog Electronics and other components by hardware implementation/simulation tools.	Create

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IEC453.C1	3	1	1	1	3				1			
IEC453.C2	3	1		1	3				1			
IEC453.C3	3	1		1	3				1			
IEC453.C4	3	1	1	1	3				1			
IEC453.C5	3	1	3	1	3				3			

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC453**	**Title of the Course**	Signal System Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This lab aims to equip students with skills to recognize, sketch, and manipulate basic engineering signals, analyze their properties, and interpret magnitude and phase spectra. Students will also plot poles and zeros, assess system stability and frequency response, and represent systems in state-space form.

List of Experiments:

1. Plot the Frequency Spectrum of continuous time signals
2. Plot the Frequency Spectrum of discrete time signals
3. Write a program to generate the following discrete sequences: -
(i) Unit Step (ii) Unit Impulse (iii) Unit Ramp (iv) Periodic sinusoidal sequences. Plot all the sequences.
4. Find the Fourier transform of a square pulse. Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences and plot all the sequences. Verify the result by analytical calculation.
6. Write a program to find the Trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.
7. Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.
8. Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.
9. Write a program to find the magnitude and phase response of the first order low pass and high pass filter. Plot the responses in logarithmic scale.
10. Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Recognize, sketch, manipulate and perform basic operations on basic signals commonly used in engineering applications	K3
CO2	Compare signals based on properties like linearity, energy, power and duration.	K4
CO3	Understand and interpret the magnitude and phase spectrum of continuous and discrete time LTI systems	K2

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CO4	Plot and analyze poles and zeros of continuous and discrete LTI systems and determine the performance characteristics, such as stability and frequency response.	K4
CO5	Represent and analyse the systems in state space form.	K5

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	End Semester Practical Examination	50%

Suggested References:
Lab Manuals/On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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Dr. A.P.J. Abdul Kalam Technical University
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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	**IEC454**	**Title of the Course**	Instrumentation and Sensor Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This lab aims to teach the importance of instrument calibration, demonstrate the construction and operation of AC/DC bridges and measuring instruments, and enable students to measure electrical parameters and solve problems in electrical measurements.

List of Experiments:

1. Calibration of AC voltmeter and AC ammeter.
2. Measurement of inductance using Maxwell's Bridge.
3. Measurement of capacitance using Schering Bridge.
4. Measurement of low resistance using Kelvin's Double Bridge.
5. Measurement of Power using CT and PT.
6. Measuring displacement using LVDT.
7. Measuring temperature using thermocouple.
8. Measuring pressure using piezoelectric pick up.
9. Measurement of speed of DC motor by photoelectric pick up.
10. Speed measurement using Hall Effect sensor.
11. PC based data logging of temperature sensor using LabVIEW/ MATLAB.
12. Signal conditioning of Analog signal using LabVIEW/ MATLAB.
13. Implementation of Mini Project using Analog Electronics and other components.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Understand the importance of calibration of measuring instruments.	Understand
CO2	Demonstrate the construction and working of different AC and DC bridges, along with their applications	Apply
CO3	Ability to measure electrical engineering parameters like voltage, current, power & phase difference in industry as well as in power generation, transmission and distribution sectors.	Understand

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CO4	Demonstrate the construction and working of different measuring instruments.	Apply
CO5	Capability to analyze and solving the variety of problems in the field of electrical measurements.	Understand

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	End Semester Practical Examination	50%

Suggested References:
Lab Manuals/On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- III

Course Code	IEC354	Title of the Course	MINI PROJECT OR INTERNSHIP ASSESSMENT
Total Credits of the Course	01	Hours per Week	02

Course Objectives:	The course objectives are to enable students to demonstrate authoritative knowledge and technical accuracy in engineering topics, organize presentations with clear documentation, interpret data effectively, develop solutions through modern tools, and deliver well-prepared, time-bound presentations while addressing audience questions.

COs	Course Outcome Statement	KL
COs	Course Outcome Statement	
CO1	Knowledge Base (Engineering knowledge gained) --Grasp the topic properly and explain all the contents in an authoritative manner with technical accuracy of the discussed points.	Understand
CO2	Organisation of the presentation (problem analysis capability) -- The present tion should be well organized with proper documentation and content should be discussed in a coherent, sequential manner. The figures, written material, program codes, etc. should be clearly visible and minimal typographical errors should be there.	Analyze
CO3	File/PPT (Interpretation of data and synthesis) -- Data/ information is well interpreted through tools/ engineering concept and synthesize to draw a valid conclusion.	Evaluate
CO4	Outcome (Development of Solution & modern tool) -- Demonstrate the outcome of the internship/mini project/industrial training/Internship/Seminar in form of some, project proposal, term paper, programming codes or app development based on the study.	Create
CO5	Presentation Skills (Presentation, time bound discussion and conclusion) -- The talk should be well prepared and smoothly delivered. Students should practice in advance so that there are no interruptions and all aspects of presentation are clear to the presenter. The presentation should be completed in the prescribed time and the audience questions must be addressed well.	Evaluate

Evaluation Pattern	
Details of the Evaluation	Weightage

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1.	Internal Assessment in the form of Skills, Presentation, Report, etc.	100%

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
IEC354.C1	3								2			2		
IEC354.C2		3			2		2		2	3				
IEC354.C3		2		3	2	2	2	3	2	3	3	2		
IEC354.C4			3		2	2	2		2		2			
IEC354.C4								3	3	3	2	3		

Rubrics for Mini Project or Internship assessment/ Internship/Industrial Training/ Seminar

Knowledge Base (Engineering knowledge gained) (20)	Organisation of the presentation (problem analysis capability) (15)	File/PPT (Interpretation of data and synthesis)(20)	Outcome (Development of Solution + modern tool) (15)	Presentation Skills (Presentation, time bound discussion and conclusion) (30)	Total (100)

* If total mark is not 100, then all the marks in rubrics parameter would be scaled accordingly.

Suggested References:
On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering**)**

Semester- III

Course Code	IOE035/IOE044	**Title of the Course**	Sensor and Instrumentation
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	This course aims to equip students with skills to evaluate measurement errors and use instruments to measure voltage, current, power, and energy. Students will measure resistance, inductance, and capacitance using bridges, understand and calculate errors in instrument transformers, and demonstrate the use of electronic instruments like digital voltmeters and multimeters. Additionally, students will identify transducers for measuring physical quantities such as motion, force, pressure, temperature, flow, and liquid level.

Pre-requisites: Basic Electronics and Communication Engineering

Course Content

Unit	**Description**	**Weightage (%)**
1.	Electrical Measurements: Instruments and Measurement system, Measurement of system performance, Methods of measurement, Errors in Measurement and measurement standards, Review of indicating and integrating instruments: PMMC, Moving Iron and Electrodynamometer Type Voltmeter, Ammeter and Wattmeter.	20%
2.	Measurement of Resistance, Inductance and Capacitance: Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement.	20%
3.	Instrument Transformers: Construction, types and working of Current and Potential transformers, ratio and phase angle errors and testing.	20%
4.	Electronic Measurements: Merits and Demerits of Digital Instruments over Analog Ones: Digital Multimeter, Digital Frequency Meter, Digital Voltmeters (DVMs), Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum and wave analyser, Digital counter, frequency meter.	20%
5.	Instrumentation: Transducers & and sensors, classification and selection of sensors, Electrical Transducers, Strain Gauges, Electromagnetic Flow Meter, Measurement of temperature using Thermistors and Thermocouples, Measurement of displacement using LVDT, Basic Components	20%

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	of Data Acquisition Systems, Concept of smart sensors and virtual instrumentation.	

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Evaluate errors in measurement and identify and use different types of instruments to measure voltage, current, power and energy.	Evaluate
CO2	Apply the knowledge of measurement of electrical quantities resistance, inductance and capacitance with the help of bridges.	Apply
CO3	Understand the working of instrument transformers and calculate the errors in current and potential transformers.	Understand
CO4	Demonstrate the working of electronic instruments like digital voltmeters, multi-meters and frequency meters.	Apply
CO5	Identify the transducers in specific applications for measuring physical quantities like motion, force, pressure, temperature, flow and liquid level.	Understand

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested References:	
1	Prithwiraj Purkait, Budhaditya Biswas and Santanu Das “Electrical and Electronics Measurements and Instrumentation” McGraw Hill Education (India) Private Limited.
2	A K Sawhney, “Electrical & Electronic Measurement & Instrument”, Dhanpat Rai & Sons, India.

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3	BC Nakra & K. Chaudhary, "Instrumentation, Measurement and Analysis," Tata McGraw Hill.
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- IV

Course Code	IOE038/IOE048	**Title of the Course**	Analog Electronics
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	The course objectives are to apply transistor biasing and thermal stability concepts, develop and design amplifiers, active filters, and oscillators, analyze and design combinational and sequential logic circuits, and implement synchronous sequential circuits and converters.

Pre-requisites: Basic Electronics Engineering

Course Content

Unit	Description	Weightage (%)
1.	**UNIT I** BJT amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features.bandwidth product.	20%
2.	**UNIT II** Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, calculation with practical circuits, concept of stability, gain margin and phase margin.	20%
3.	Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.) and and non-sinusoidal oscillators	20%
4.	Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR Active filters: Low pass, high pass, band pass and band stop, design guidelines.	20%
5.	Op-Amp design: design of gain stages and output stages, compensation. Op-Amp applications: precision rectifier, Schmitt trigger and its applications.	20%

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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	1. Understand the characteristics transistors and FET as amplifiers.	Apply
CO2	2. Design and analyze Feedback design amplifiers.	Evaluate
CO3	3. Design sinusoidal and non-sinusoidal oscillators.	Analyze
CO4	4. Understand performance of differential amplifier.	Analyze
CO5	5. Design OP-AMP based circuits.	Analyze

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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Suggested References:	
	Text Books :- 1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, Oxford University Press, 6th Ed 2. Boylestad / Nashelsky, "Electronic Devices and Circuit Theory", edition 7, prentice Hall Reference book: 3. Rashid, “Microelectronic Circuits : Analysis and Design”, Oxford University Press, 6th Ed
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- IV

Course Code	IOE039/IOE049	**Title of the Course**	Communication Engineering
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	1. Define various fundamental aspects of the communication systems. 2. Understand various modulation & demodulation techniques used in communication systems. 3. Interpret various radio transmitter & receiver circuits and different types of noise in communication systems. 4. Analyze various parameters such as modulation index, channel capacity, transmission efficiency, S/N ratio etc. used in communication systems.

Pre-requisites: Basic Electronics Engineering

Course Content

Unit	Description	Weightage (%)
1.	**Introduction** Overview of communication system, communication channel, Need for modulation, Review of signals and system, frequency domain representation of signals, principles of amplitude modulation systems- DSB, SSB and VSB modulations.	20%
2.	**Continuous wave Modulation** Angle modulation representation of FM and PM signals, spectral characteristics of angle modulated signals. FM Modulators and Demodulators, FM Broadcasting.	20%
3.	**Random Processes and Noise** Review of probability and random process, Gaussian and white noise characteristics, noise in amplitude modulation systems, noise in frequency modulation systems, pre-emphasis and de-emphasis, threshold effect in angle modulation.	20%
4.	**Pulse Modulation** Pulse modulation, sampling process, pulse amplitude and pulse code modulation (PCM), differential pulse code modulation. Delta modulation, noise considerations in PCM, time division multiplexing, digital multiplexers.	20%
5.	**Digital modulation schemes**- phase shift keying, frequency shift keying, quadrature amplitude modulation, continuous phase modulation and minimum shift keying.	

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Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	CO1: Compare different analog modulation schemes for their efficiency and bandwidth.	Apply
CO2	CO2: Analyze the behavior of a communication system in presence of noise.	Evaluate
CO3	CO3: Investigate pulsed modulation system and analyze their system performance.	Analyze
CO4	CO4: Investigate various multiplexing techniques.	Analyze
CO5	CO5: Analyze different digital modulation schemes and compute the bit error performance.	Analyze

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
IOE039.C1	3	3	1	1								1
IOE039.C2	3	3	3	2								1
IOE039.C3	3	3	3	2								1
IOE039.C4	3	3	3	2								1
IOE039.C5	3	3	3	2								1

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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested References:

Text Books :-
1. P Ramakrishna Rao., “Communication Systems”, Mc Graw Hill Education
2. Haykin S., "Communications Systems," John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering," Pearson Education, 2002.
Reference books :-
4. Taub H. and Schilling D.L., "Principles of Communication Systems,” Tata McGraw Hill, 2001.
5. Wozencraft J. M. and Jacobs I. M., “Principles of Communication Engineering,” John Wiley, 1965.
6. B.P. Lathi.,”Modern Digital and Analog Communication Systems” fourth edition.
7. Barry J. R., Lee E. A. and Messerschmitt D. G., “Digital Communication,” Kluwer Academic Publishers, 2004.

On-line resources to be used if available as reference material

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- V

Course Code	IEC501	Title of the Course	INTEGRATED CIRCUITS
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	The course objectives are to apply transistor biasing and thermal stability concepts, develop and design amplifiers, active filters, and 741 IC Op-Amp, analyze and design combinational and sequential logic circuits, and implement synchronous sequential circuits and Integrated Circuit Timer.

Pre-requisites: Basic Electronics Engineering

Course Content

Unit	Description	Weightage (%)
1.	The 741 IC Op-Amp: General operational amplifier stages (bias circuit, the input stage, the second stage, the output stage, short circuit protection circuitry), device parameters, DC and AC analysis of input stage, second stage and output stage, gain, frequency response of 741, a simplified model, slew rate, relationship between ft and slew rate	20%
2.	II Linear Applications of IC Op-Amps: Op-Amp based V-I and I-V converters, instrumentation amplifier, generalized impedance converter, simulation of inductors. Active Analog filters: Sallen Key second order filter, Designing of second order low pass and high pass Butterworth filter, Introduction to band pass and band stop filter, all pass active filters, KHN Filters. Introduction to design of higher order filters.	20%
3.	Frequency Compensation & Nonlinearity: Frequency Compensation, Compensation of two stage Op-Amps, Slewing in two stage Op-Amp. Nonlinearity of Differential Circuits, Effect of Negative feedback on Nonlinearity. Non-Linear Applications of IC Op-Amps: Basic Log–Anti Log amplifiers using diode and BJT, temperature compensated Log-Anti Log amplifiers using diode, peak detectors, sample and hold circuits. Op-amp as a comparator and zero crossing detector, astable multivibrator & monostable multivibrator. Generation of triangular waveforms, analog multipliers and their applications.	20%
4.	Digital Integrated Circuit Design: An overview, CMOS logic gate circuits basic structure, CMOS realization of inverters, AND, OR, NAND and NOR gates. Latches and Flip flops: the latch, CMOS implementation of SR flip-flops, a simpler CMOS implementation of the clocked SR flip-flop, CMOS implementation of J-K flipflops, D flip- flop circuits.	20%

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5.	Integrated Circuit Timer: Timer IC 555 pin and functional block diagram, Monostable and Astable multivibrator using the 555 IC. Voltage Controlled Oscillator: VCO IC 566 pin and functional block diagram and applications. Phase Locked Loop (PLL): Basic principle of PLL, block diagram, working, Ex-OR gates and multipliers as phase detectors, applications of PLL.	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	1. Explain complete internal analysis of Op-Amp 741-IC.	Apply
CO2	2. Examine and design Op-Amp based circuits and basic components of ICs such as various types of filter.	Evaluate
CO3	3. Implement the concept of Op-Amp to design Op-Amp based non-linear applications and wave-shaping circuits.	Analyze
CO4	4. Analyse and design basic digital IC circuits using CMOS technology	Analyze
CO5	5.Describe the functioning of application specific ICs such as 555 timer ,VCO IC 566 and PLL.	Analyze

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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Suggested References:	
	Text Book:
1	Microelectronic Circuits, Sedra and Smith, 7th Edition, Oxford, 2017.
2	Behzad Razavi: Design of Analog CMOS Integrated Circuits, TMH
3	Gayakwad: Op-Amps and Linear Integrated Circuits, 4th Edition Prentice Hall of India, 2002.
4	Franco, Analog Circuit Design: Discrete & Integrated, TMH, 1st Edition.
5	Salivahnan, Electronics Devices and Circuits, TMH, 3rd Edition, 2015
6	Millman and Halkias: Integrated Electronics, TMH, 2nd Edition, 2010
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- V

Course Code	**IEC502**	**Title of the Course**	**Microprocessor and Microcontroller**
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	This course aims to provide students with a thorough understanding of the basic architecture of 8085 and 8086 microprocessors, their programming models, and interfacing techniques with external peripherals. Additionally, students will explore the architecture of the 8051 microcontroller and compare advanced microprocessors and microcontrollers for various applications.

Course Content

Unit	**Description**	**Weightage (%)**
1.	**Unit I: Types of Microprocessor Architecture:** Harward & Princeton. **Intel 8085 microprocessor:** Internal architecture (ALU, System bus, Registers, Timing & control unit, Address/data bus de-multiplexing). **Intel 8086 microprocessor:** Internal architecture, Pin Diagram, Memory Addressing, Interrupts.	20%
2.	**Unit II:** Fundamental of Programming: Program structure & programming techniques for microprocessors, 8085 Addressing modes, 8085 Instruction set, Assembly language programming of 8085 microprocessor with examples (arithmetic operations on 8-bit numbers – add, subtract, multiply, divide, square & square root etc, largest/ smallest number; ascending/ descending order).	20%
3.	**Unit III: I/O Interface:** 8255 PPI, architecture, various modes of operation & control words, interfacing of 8255. **Interfacing with I/O devices:** Keyboard, display, stepper motor, D/A & A/D converter **Serial communication standards:** Serial data transfer schemes, 8251 USART architecture & interfacing.	20%
4.	**Unit IV: Introduction to microcontrollers:** 8051 microcontroller - internal architecture, signals, I/O ports, memory organization & interfacing, timing and control, port operations.	20%
5.	**Unit V- 8051 Real Time Control:** 8051 timers and counters, interrupts in 8051.	20%

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	Comparison of Microprocessor, Microcontroller, PIC and ARM processors and their application areas.	

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Demonstrate the basic architecture of 8085 & 8086 microprocessors.	**K2**
CO2	Illustrate the programming model of microprocessors & write program using 8085 Microprocessor.	**K3**
CO3	Interface different external peripheral devices with 8085 microprocessor.	**K3**
CO4	Comprehend the architecture of 8051 microcontroller.	**K2**
CO5	Compare advance level microprocessor & microcontroller for different Applications.	**K4**

	CO-PO Mapping Matrix/Course Articulation Matrix													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
IEC502.C1	3		2	1		2	1							
IEC502.C2	3		2	1		2	1					1		
IEC502.C3	3		2	1		2	1					1		
IEC502.C4	3		2	1		2	1					1		
IEC502.C5	3		2	1		2	1							

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested Textbooks/Reference Books:

1	Brey, Barry B. "INTEL Microprocessors" Prentice Hall (India).
2	Aditya P Mathur, "Introduction to Microprocessor" Tata McGraw Hill.
3	M. Rafiquzzaman, "Microprocessors- Theory & applications", Pearson India.

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4	B. Ram, "Advanced Microprocessor & Interfacing" Tata McGraw Hill.
5	Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family Architecture Programming & Design" Pearson India.
6	Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan (Oxford university press).
7	Gaonkar, Ramesh S, "Microprocessor Architecture, programming and applications with the 8085" Pen ram International Publishing 5th Ed.
8	Avtar Singh & Walter A. Triebel "8088 & 8086 Microprocessor" Pearson Education.
9	Ray, A.K. & Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.
10	AK Gautam, "Advanced Microprocessors", Khanna Publishers.
11	8051 Microcontroller – K. Ayala (Cengage learning).
On-line resources to be used if available as reference material	
Relevant review articles / research papers / handouts of latest development in the subject (if available)	

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B. Tech. (Electronics and Communication Engineering)

Semester- V

Course Code	**IEC503**	**Title of the Course**	Principles of Communication
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:

1. Define various fundamental aspects of the communication systems.
2. Understand various modulation & demodulation techniques used in communication systems.
3. Interpret various radio transmitter & receiver circuits and different types of noise in communication systems.
4. Analyze various parameters such as modulation index, channel capacity, transmission efficiency, S/N ratio etc. used in communication systems.1

Unit	Topics	Lectures
I	**Random Variables:** Concept of Probability, Random variables, Statistical averages, Random process, Power Spectral Density & Autocorrelation Function of Random Processes, Gaussian Random Process.	10
II	Overview of Communication system, Communication channels, Need for modulation, Baseband and Pass band signals, Amplitude Modulation: Double sideband with Carrier (DSB-C), Double side band without Carrier DSB-SC, Single Side Band Modulation SSB, Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator, Radio Transmitter and Receiver.	
III	Pulse Modulation, Digital Transmission of Analog Signals: Sampling Theorem and its applications, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation, Their generation and Demodulation, Digital Representation of Analog Signals Pulse Code Modulation (PCM), PCM System	8
IV	Differential Pulse Code Modulation, Delta Modulation. Adaptive Delta Modulation, Voice Coders, Sources of Noises, Frequency domain representation of Noise, Super position of Noises, Linear filtering of Noises, Mathematical Representation of Noise.	8
V	Noise in Amplitude Modulation: Analysis, Signal to Noise Ratio, Figure of Merit. Noise in Frequency Modulation: Pre-emphasis, De-Emphasis and SNR Improvement, Phase Locked Loops Analog and Digital. Issues in digital transmission: Frequency Division Multiplexing Time Division Multiplexing, T1 Digital System, TDM Hierarchy.	8

Text Book: 1. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw Hill.
2. Rishabh Anand, Communication Systems, Khanna Publishing House, Delhi

Reference Books:

1. B.P.Lathi,"ModernDigitalandAnalogcommunicationSystems",3rd Edition, Oxford University Press.
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley India.
3. H.P.Hsu& D. Mitra "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Understand the fundamentals of communication systems, including modulation techniques, and analyze the functioning of radio transmitters and receivers.
2. Apply pulse modulation techniques and understand the digital transmission of analog signals.
3. Analyze differential pulse code modulation techniques and its effects on communication systems.
4. Evaluate advanced modulation techniques and noise sources, including their frequency domain representation and filtering.
5. Analyze the impact of noise on amplitude and frequency modulation systems, and understand techniques for SNR improvement and phase-locked loops.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
IEC503.C1	3	3	1	1								1
IEC503.C2	3	3	3	2								1
IEC503.C3	3	3	3	2								1
IEC503.C4	3	3	3	2								1
IEC503.C5	3	3	3	2								1

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- V

Course Code	**IEC551**	**Title of the Course**	**INTEGRATED CIRCUITS LAB**
Total Credits of the Course	**01**	**Hours per Week**	**02**

SUGGESTIVE LIST OF EXPERIMENTS:

1. Design the following using Op-Amp: ***(Through Virtual Lab Link 1)***
   a) A unity gain amplifier.
   b) An inverting amplifier with a gain of "A".
   c) A non-inverting amplifier with a gain of "A"
1. Study and design Log and antilog amplifiers.
2. Voltage to current and current to voltage convertors.
3. Second order filters using operational amplifier for: ***(Through Virtual Lab Link 1)***
   a) Low pass filter of cutoff frequency 1 KHz.
   b) High pass filter of frequency 12 KHz.
4. Realization of Band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
5. Study and design voltage comparator and zero crossing detectors.
6. Function generator using operational amplifier (sine, triangular & square wave).
7. Design and construct astable multivibrator using IC 555 and
   a) Plot the output waveform
   b) Measure the frequency of oscillation ***(Through Virtual Lab Link 2)***
8. Design and construct a monostable multivibrator using IC 555 and
   a) Plot the output waveform
   b) Measure the time delay ***(Through Virtual Lab Link 2)***
9. Implement Schmitt Trigger Circuit using IC 555. ***(Through Virtual Lab Link 2)***
10. Implement voltage-controlled oscillator using IC566 and plot the waveform.

    (Through Virtual Lab Link 2)
11. Study and design ramp generator using IC 566.

Virtual Lab Link:

1. http://vlabs.iitkgp.ernet.in/be/exp17/index.html
2. http://hecoep.vlabs.ac.in/Experiment8/Theory.html?domain=Electronics andCommunicati ons&lab=Hybrid%20Electronics%20Lab

Available on: http://www.vlab.co.in/broad-area-electronics-and-communications

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Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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Semester- V

Course Code	**IEC552**	**Title of the Course**	**MICROPROCESSOR AND MICROCONTROLLER LAB**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course aims to provide students with a comprehensive understanding of microprocessor systems, including data flow, assembly language programming, and peripheral interfacing. Students will develop logical approaches to design and implement microprocessor-based systems.

SUGGESTIVE LIST OF EXPERIMENTS:

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers. ***(Through Virtual Lab Link)***
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.

(Through Virtual Lab Link)

3. To perform multiplication and division of two 8 bit numbers using 8085. ***(Through Virtual Lab Link)***
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program using 8086 to arrange an array of data in ascending and descending order.

(Through Virtual Lab Link)

6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8086 instruction set.
7. To convert given Hexadecimal number into its equivalent BCD number and vice versa using 8086 instruction set.
8. To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes.
9. To write a program to initiate 8251 and to check the transmission and reception of character.
10. Serial communication between two 8085 through RS-232 C port.
11. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
12. Write a program to generate 10 kHz square wave using 8051.
13. Write a program to show the use of INT0 and INT1 of 8051.
14. Write a program for temperature & to display on intelligent LCD display.

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php

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Available on: http://www.vlab.co.in/broad-area-electronics-and-communications

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Use techniques, skills, modern engineering tools, instrumentation and software/hardware appropriately to list and demonstrate arithmetic and logical operations on 8 bit data using microprocessor 8085.
2. Examine 8085 & 8086 microprocessor and its interfacing with peripheral devices.
3. State various conversion techniques using 8085 & 8086 and generate waveforms using 8085.
4. Implement programming concept of 8051 Microcontroller.
5. Design concepts to Interface peripheral devices with Microcontroller so as to design Microcontroller based projects.

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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Semester- V

Course Code	**IEC553**	**Title of the Course**	Communication Engineering Lab I
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course aims to provide students with a comprehensive understanding of DSB/ SSB amplitude modulation, Pulse code modulation and demodulation, FM radio receiver, study frequency modulation.

SUGGESTIVE LIST OF EXPERIMENTS:

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2. To study amplitude demodulation by linear diode detector.
3. To study frequency modulation and determine its modulation factor.
4. To study PLL 565 as frequency demodulator.
5. To study sampling and reconstruction of Pulse Amplitude modulation system.
6. To study the Sensitivity, Selectivity, and Fidelity characteristics of super heterodyne receiver.
7. To study Pulse Amplitude Modulation.
a) using switching method
b) by sample and hold circuit
8. To demodulate the obtained PAM signal by 2nd order LPF.
9. To study Pulse Width Modulation and Pulse Position Modulation.
10. To study Pulse code modulation and demodulation technique.
11. To study Delta modulation and demodulation technique.
12. Design and implement an FM radio receiver in 88-108 MHz

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Create and visualize various discrete/digital signals using MATLAB/Scilab.
2. Implement and test the basic operations of Signal processing.
3. Examine and analyse the spectral parameters of window functions.
4. Design IIR and FIR filters for band pass, band stop, low pass and high pass filters.
5. Design the signal processing algorithms using MATLAB/Scilab.

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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Semester- V

Course Code	IEC054	Title of the Course	ADVANCED DIGITAL DESIGN USING VERILOG
Total Credits of the Course	03	Hours per Week	03
Course Objectives:	This course aims to provide students with a comprehensive understanding of Mixed Logic, Logic Representation, Combinational Circuit Design, Synchronous Sequential Circuits Design, Factoring, Decomposition, programmable logic families.		

Unit	Topic	Lectures
I	Introduction to Mixed Logic, Logic Representation and Minimization with cost, Multiple output minimization, Entered Variable K- Map including don't care handling, XOR Pattern Handling.	8
II	Combinational Circuit Design, Multiplexers, Decoders, Encoders, Code Comparators, Adders, Subtractors, Multipliers, Introduction to Verilog, Behavioral and Structural specification of logic circuits, Boolean function implementation using Verilog, Timing Analysis, Hazard Detection and Elimination	8
III	Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi- level minimization and optimization.	8
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis incombinational and sequential systems, Path Sensitization method, Boolean Difference Method, Initial State Method.	8
V	Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures,Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.	8

Text Books:

1. Richard F. Tinder, "Engineering Digital Design", Academic Press.
2. Parag K. Lala, "Digital system Design Using PLDs", PHI India Ltd.
3. Stephen Brown and ZvonkoVranesiv, "Fundamental of Digital Logic with Verilog Design", Tata McGraw Hill.

Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication..
2. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
3. Alexander Miczo, "Digital Logic Testing and Simulation",Wiley Interscience.

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COURSE OUTCOME: After completion of the course student will be able to

1. Describe mixed logic circuits and their implementation.
2. Implement combinational circuits using mixed logic and Verilog.
3. Design sequential circuits using mixed logic and Verilog with mapping of Algorithm.
4. Understand faults and its elimination in sequential and combinational circuits.
5. Understand the working of programmable logic families.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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B. Tech. (Electronics and Communication Engineering)

Semester- V

Course Code	IEC055	Title of the Course	OPTICAL COMMUNICATION
Total Credits of the Course	03	Hours per Week	03

Unit	Topics	Lectures
I	**Introduction to Optical Communication:** Optical Spectral Band with Operating Windows, General Communication System, Optical Communication System with its advantages. **Optical Fiber Waveguides:** Ray Theory of Transmission with TIR, Acceptance Angle, Numerical Aperture and Skew Rays, Electromagnetic Mode Theory for Optical Propagation, Modes in a Planar Guide, Phase and Group Velocity, Phase Shift with Total Internal Reflection, Evanescent Field, Goos-Haenchen Shift, Cylindrical Fiber Modes, Mode Coupling, Step Index fibers Vs Graded Index fibers, Single Mode Fibers- Cut off wavelength, MFD & Spot Size.	08
II	**Signal Loss in Optical Fibers:** Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect. **Dispersion:** Introduction with its types: Chromatic / Intramodal Dispersion (Material and Waveguide Dispersion), Intermodal dispersion (for MSI and MGI fibers), Overall (Total) Fiber Dispersion in Multimode and Singe Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization & Fiber Birefringence.	08
III	**Optical Sources: LEDs-**Introduction to LEDs & Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth. **Laser Diodes-**Introduction, Optical Feedback & Laser Oscillations, Resonant Frequencies, Laser Modes, and Threshold Condition for Laser Oscillation, Laser Diode Rate Equations, Semiconductor injection Laser- Efficiency, Laser Single Mode operation, Reliability of LED & ILD.	08
IV	**Power Launching in Fiber:** Source to Fiber Power Launching and Coupling Techniques, Power Launching Vs Wavelength, Equilibrium Numerical Aperture. **Photo Detectors:** Introduction, Physical Principles of Photodiodes: The PIN Photo Detector, Avalanche Photodiodes, Temperature Effect on Avalanche Gain, Detector Response Time, Photo Detector Noise: Noise Sources, Signal to Noise Ratio, Comparison of Photo Detectors, Fundamental Receiver Operation with Digital Signal Transmission.	08
V	**Digital Receiver Performance:** Probability of Error / BER, Receiver Sensitivity & The Quantum Limit, Error Control Techniques, Eye Diagram Pattern Features, Coherent Detection: Homodyne Detection and Heterodyne Detection, Digital links: Point to Point Links, Power Penalties, Multichannel & Multiplexing Transmission Techniques, basic concept of Free Space Optics (FSO) based Communication System.	08

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Text Book:

1. John M. Senior, "Optical Fiber Communications", Pearson, 3rd Edition, 2010.
2. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, 5th Edition, 2013.
3. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd Edition, 2004.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Define and explain the basic concepts and theory of optical communication.
2. Describe the signal losses with their computation and dispersion mechanism occurring inside the optical fiber cable.
3. Differentiate the optical sources used in optical communication with their comparative study.
4. Identify different optical components on receiver side; assemble them to solve real world problems related to optical communication systems.

Evaluate the performance of an optical receiver to get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- V

Course Code	**IEC554**	**Title of the Course**	**MINI PROJECT OR INTERNSHIP ASSESSMENT**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	The course objectives are to enable students to demonstrate authoritative knowledge and technical accuracy in engineering topics, organize presentations with clear documentation, interpret data effectively, develop solutions through modern tools, and deliver well-prepared, time-bound presentations while addressing audience questions.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Knowledge Base (Engineering knowledge gained) --Grasp the topic properly and explain all the contents in an authoritative manner with technical accuracy of the discussed points.	Understand
CO2	Organisation of the presentation (problem analysis capability) -- The presentation should be well organized with proper documentation and content should be discussed in a coherent, sequential manner. The figures, written material, program codes, etc. should be clearly visible and minimal typographical errors should be there.	Analyze
CO3	File/PPT (Interpretation of data and synthesis) -- Data/ information is well interpreted through tools/ engineering concept and synthesize to draw a valid conclusion.	Evaluate
CO4	Outcome (Development of Solution & modern tool) -- Demonstrate the outcome of the internship/mini project/industrial training/Internship/Seminar in form of some, project proposal, term paper, programming codes or app development based on the study.	Create
CO5	Presentation Skills (Presentation, time bound discussion and conclusion) -- The talk should be well prepared and smoothly delivered. Students should practice in advance so that there are no interruptions and all aspects of presentation are clear to the presenter. The presentation should be completed in the prescribed time and the audience questions must be addressed well.	Evaluate

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage

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1.	Internal Assessment in the form of Skills, Presentation, Report, etc.	100%

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
IEC554.C1	3								2			2	2	2
IEC554.C2		3			2		2		2	3			2	2
IEC554.C3		2		3	2	2	2	3	2	3	3	2	3	2
IEC554.C4			3		2	2	2		2		2		2	3
IEC554.C4								3	3	3	2	3	2	3

Rubrics for Mini Project or Internship assessment/ Internship/Industrial Training/ Seminar

Knowledge Base (Engineering knowledge gained) (20)	Organisation of the presentation (problem analysis capability) (15)	File/PPT (Interpretation of data and synthesis)(20)	Outcome (Development of Solution + modern tool) (15)	Presentation Skills (Presentation, time bound discussion and conclusion) (30)	Total (100)

* If total mark is not 100, then all the marks in rubrics parameter would be scaled accordingly.

Suggested References:
On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering) Semester- VI

Course Code	**IEC601**	**Title of the Course**	Digital Communication
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	The course objectives are to apply Digital Modulation, Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK. Digital Receiver, Information Theory, Measure of information-information, entropy, mutual information, mutual entropy.

Unit	Topics	Lectures
I	**Digital Communication Basics:** Introduction to Digital communication systems, PSD of Line Coding schemes, Pulse shaping, Scrambling, Eye diagram, Gram-Schmidt orthogonalization scheme.	8
II	**Digital Modulation:** Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK. Constellation diagram, Introduction to M-ary communication.	8
III	**Digital Receiver:** Optimum threshold detection, Concept of Matched Filters, BER analysis of BASK, BFSK, BPSK, Introduction of Spread spectrum communication (DS-SS, FH-SS).	8
IV	**Digital Passband** of Correlators to Noisy Input, Coherent Detection of Signals in Noise, Correlation **Transmission**: Geometric Interpretation of Signals, Response of Bank Receivers,	8
V	**Information Theory:** Measure of information-information, entropy, mutual information, mutual entropy, Source encoding (Shannon-Fano, Huffman), Shannon's channel capacity theorem, Introduction to error correction and detection, Linear block codes, Cyclic codes (systematic, non-systematic), Convolution coding and Viterbi decoding.	8

Text Books:

1. B.P. Lathi, "Modern Digital and Analog communication Systems", 4th Edition, Oxford University Press.
2. John G. Proakis, "Digital Communications", 5th Edition, TMH.
3. H. Taub, D L Schilling, Gautam Saha, "Principles of Communication", 4th Edition, TMH.
4. Singh & Sapray, Communication Systems, 3th Edition, TMH.

Reference Books:

1. Simon Haykin, "Communication Systems", 5th Edition, Wiley India.

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2. (Schaum's Outline Series) H P HSU & D Mitra, "Analog and Digital Communications", TMH, 3rd Edition.

Course Outcomes: At the end of this course students will demonstrate the ability:

1. To formulate basic statistics involved in communication theory.
2. To demonstrate the concepts involved in digital communication.
3. To explain the concepts of digital modulation schemes.
4. To analyze the performance of digital communication systems.
5. To apply the concept of information theory and coding in digital systems.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%
On-line resources to be used if available as reference material		
Relevant review articles / research papers / handouts of latest development in the subject (if available)		

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Dr. A.P.J. Abdul Kalam
Technical University, U P.
Lucknow

B. Tech. (Electronics and Communication Engineering)
Semester- VI

Course Code	IEC602	Title of the Course	CONTROL SYSTEM
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	This course provides a comprehensive understanding of **control system concepts**, stability analysis, time and frequency response analysis, and the design of feedback control systems using **PID** and compensation techniques.

Course Content

Unit	Description	Weightage (%)
1.	**Unit I: Control System Concepts:** Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, Determination of transfer function by block diagram reduction techniques and signal flow method using Mason's gain formula, Basic Characteristics of negative feedback control systems. **Control System Components:** Constructional and working concept of AC & DC servomotor, synchros.	20%
2.	**Unit II: Time Response Analysis:** Standard test signals, time response analysis of first and second order systems, time response specifications of second order system for unit step & unit ramp input, location of roots of characteristics equation and corresponding time response, steady state errors and error constants.	20%
3.	**Unit III: Stability and Algebraic Criteria:** Concept of stability and its necessary conditions, Routh-Hurwitz criteria and its special cases & limitations. **Root Locus Technique:** Salient features & procedure of plotting root locus plot, root contours, determination of stability of a closed loop system using root locus technique.	20%
4.	**Unit IV: Frequency Response Analysis:** Frequency Response analysis from transfer function model, Construction of polar and inverse polar plots. **Stability in Frequency Domain:** Nyquist stability criterion, Determination of gain and phase margin from Bode & Nyquist Plots, Correlation between time and Frequency Responses.	20%
5.	**Unit V: Introduction to Design:** The design problems and preliminary considerations of lead, lag and lead-lag	20%

	compensation networks, design of closed loop systems using compensation techniques in time and frequency domains. **Basic modes of feedback control:** Proportional, Derivative, Integral, PID & Industrial controllers	

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Obtain transfer functions to predict the correct operation of open loop and closed loop control systems and identify the basic elements, structures and the characteristics of feedback control systems.	**K3**
CO2	Measure and evaluate the performance of basic control systems in time domain.	**K3**
CO3	Analyze the stability of linear time-invariant systems in time domain using Routh-Hurwitz criterion and root locus technique.	**K4**
CO4	Determine the stability of linear time-invariant systems in frequency domain using Nyquist criterion and Bode plot.	**K3**
CO5	Design different type of compensators to achieve the desired performance of control System by root locus and Bode plot method. Develop and analyze the various types of controllers.	**K3**

	CO-PO Mapping Matrix/Course Articulation Matrix													
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
IEC602.C1	3	3		2		3							2	1
IEC602.C2	3	3	3	2	3	1							1	2
IEC602.C3	3	3	3	3	2	3							2	2
IEC602.C4	3	2	1	3	3	3							2	3
IEC602.C5	2	3	3	3	1	3							2	3

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage

1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

Suggested References:

1	Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems" (Schaums Outlines Series), 3rd Edition, McGraw Hill, Special Indian Edition, 2010.
2	Norman S. Mise, Control System Engineering, Wiley Publishing Co.
3	M. Gopal, Control Systems Engineering, New Age International Publishers.
4	R. T. Stefani, B. Shahian, C. J. Savant and G.H. Hostetter, "Design of Feedback Control Systems" Oxford University Press.
5	A. K. Jairath, Problems and Solutions of Control Systems: With Essential Theory (CBS Problems and Solutions Series).

On-line resources to be used if available as reference material

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VI

Course Code	**IEC603**	**Title of the Course**	**Microwave and RADAR Engineering**
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:

1. An understanding of microwave waveguides,
2. An understanding of passive & active devices, tubes and network analysis.
3. An ability to design microwave matching networks.
4. An ability to perform microwave measurements.
5. An understanding of RADARs and its applications.

Pre-requisite: Engineering Mathematics, Engineering Electromagnetics.

Units	**Topics**	**Lectures**
Unit 1	**Wave Guide:** Rectangular Wave guide and Circular Wave guide – Solutions of Wave equations, TE and TM modes in rectangular waveguides, Cutoff frequency, propagation constant, phase velocity, group velocity, characteristic wave impedance, waveguide wavelength, degenerate mode, Dominant Mode TE_{10}, Power transmission, Excitation of modes in waveguide, Wave guide Cavities.	**8 L**
Unit 2	**Passive microwave devices:** Microwave Junctions and Couplers, Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits, Terminations, Attenuators, Phase Shifters, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.	**8 L**
Unit 3	**Microwave tubes :** Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications.	**8 L**
Unit 4	**Microwave Measurements:** Measurement of Insertion Loss, Frequency, Cavity Q, Dielectric Constant, Scattering Parameters, Noise Factors, Return Loss, Impendence; VSWR Metering and Measurement, High Power Measurement; Power Meters, Microwave Amplifiers.	**8 L**
Unit 5	**Introduction to RADAR systems:** RADAR Block diagram, RADAR Range equation, Probability of detection of false alarm, Integration of RADAR pulses, RADAR cross section of targets, MTI RADAR, CW RADAR.	**8 L**

Text Books:

1. Samuel Y. Liao, “Microwave Devices & Circuits”, 3rd Edition, Prentice Hall of India Publication, 1995.
2. David M. Pozar, “Microwave Engineering,” Fourth Edition, Wiley, 2017.
3. M.I. Skolnik, “Introduction to Radar Engineering “, 3rd Edition, Tata McGraw Hill Publication, 2001.

Reference Books:

1. A Das and S.K. Das, “Microwave Engineering”, 1st Edition, Tata McGraw Hill Publication, 2000.
2. S Vasuki, D Margaret Helena, R Rajeswari, “Microwave Engineering”, McGraw Hill Publication 2015.
3. Robert E. Collin, “Foundations for Microwave Engineering”, Second Edition, Wiley, 2017.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Analyze various parameters and characteristics of the transmission line and waveguide and also use of wave guide component as per applications.
2. Describe, analyze and design simple microwave circuits and devices e g couplers, Attenuators, Phase Shifter and Isolators. Student will also understand the microwave propagation in ferrites.
3. Analyze the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves.
4. Acquire knowledge about the handling and measurement of microwave equipment.
5. Differentiate different Radars, find applications and use of its supporting systems.

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VI

Course Code	**IEC651**	**Title of the Course**	**COMMUNICATION ENGINEERING Lab II**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course enables students to analyze and compare the performance of Line Coding, digital modulation and demodulation, and evaluate DSSS Modulation, FSSS Modulation, including the use of MATLAB , Linear Block Codes.

SUGGESTIVE LIST OF EXPERIMENTS:

Part A

1. To study Eye diagram patterns of various digital pulses.
2. To study the inter symbol interference.
3. To study generation of Unipolar RZ & NRZ Line Coding.
4. To study generation of Polar RZ & NRZ Line Coding.
5. To study generation of Bipolar RZ & NRZ Line Coding.
6. Implementation and analysis of BASK modulation and demodulation
7. Implementation and analysis of BFSK modulation and demodulation
8. Implementation and analysis of BPSK modulation and demodulation. *(Through Virtual Lab)*
9. Implementation and analysis of QPSK modulation and demodulation. *(Through Virtual Lab)*
10. To simulate M-ary Phase shift keying technique using MATLAB.
11. To study generation and detection of DPSK using MATLAB.
12. Implementation and analysis of Delta modulation and demodulation.
13. Implementation and analysis of DSSS Modulation, Demodulation & BER measurement.
14. Implementation and analysis of FHSS Modulation, Demodulation & BER measurement.
15. To study encoding and decoding of Linear Block Codes
16. To study the working of Convolution encoder.

Part **B**

1. To study simple dipole λ 2 antenna and to calculate beam-width, front / back ratio, and gain of the antenna. 10.
2. To study folded dipole antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
3. To study λ 2 phase array end-fire antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
4. To study broadside array antenna and to calculate beam-width, front / back ratio, and gain of the antenna.

Virtual Lab Link: https://vlab.amrita.edu/?sub=1&brch=201

Course Outcomes: At the end of this course students will demonstrate the ability:

1. To formulate basic concepts of pulse shaping in digital communication.
2. To identify different line coding techniques and demonstrate the concepts.
3. To design equipments related to digital modulation and demodulation schemes.
4. To analyze the performance of various digital communication systems and evaluate the key parameters.
5. To conceptualize error detection & correction using different coding schemes in digital communication.

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VI

Course Code	**IEC652**	**Title of the Course**	**CONTROL SYSTEM LAB**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course enables students to analyze and compare the performance of **control system components**, assess **system stability** using time and frequency domain methods, and evaluate **open and closed-loop systems**, including the use of state-space analysis and software simulations for control system design.

SUGGESTIVE LIST OF EXPERIMENTS:

1. Introduction to MATLAB Control System Toolbox.
2. Determine transpose, inverse values of given matrix.
3. Plot the pole-zero configuration in s-plane for the given transfer function.
4. Determine the transfer function for given closed loop system in block diagram representation.
5. Create the state space model of a linear continuous system.
6. Determine the State Space representations of the given transfer function.
7. Determine the time response of the given system subjected to any arbitrary input.
8. Plot unit step response of given transfer function and find delay time, rise time, peak time, peak overshoot and settling time.
9. Determine the steady state errors of a given transfer function.
10. Plot root locus of given transfer function, locate closed loop poles for different values of k.
11. Plot bode plot of given transfer function. Also determine gain and phase margins.
12. Plot Nyquist plot for given transfer function. Also determine the relative stability by measuring gain and phase margin.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Classify different tools in MATLAB along with the basic matrix operations used in MATLAB.
2. Evaluate the poles and zeros on s-plane along with transfer function of a given system.
3. Construct state space model of a linear continuous system.
4. Evaluate the various specifications of time domain response of a given system.
5. Appraise the steady state error of a given transfer function.
6. Examine the relative stability of a given transfer function using various methods such as root locus, Bode plot and Nyquist plot.

CO-PO Mapping Matrix/Course Articulation Matrix

	CO-PO Mapping Matrix/Course Articulation Matrix													
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
IEC652.C1	2	1	1	2					2				1	1
IEC652.C2	2	1	1	2					2				1	1
IEC652.C3	2	1	1	2					2				1	1
IEC652.C4	2	1	1	1	2				2				1	1
IEC652.C5	2	1	1	1	2				2				1	1

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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Semester- VI

Course Code	**IEC653C**	**Title of the Course**	**Microwave and Antenna Design Lab**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course enables students to analyze and compare the performance of microwave test bench, reflex klystron, magic Tee., Gunn diode, Directional coupler, Circulators/Isolator, Doppler radar

SUGGESTIVE LIST OF EXPERIMENTS:

1. To study microwave test bench.
2. To study the characteristics of reflex klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working on TE01 mode.
4. To study measurement of reflection coefficient and standing wave ratio using double minima method.
5. (a) To study isolation and coupling coefficient of a magic Tee.
   (b) To measure coupling coefficient, Insertion loss & Directivity of a Directional coupler.
6. To study V-I characteristic of Gunn diode.
7. To measure an unknown impedance with Smith chart.
8. (a) To measure attenuation and insertion loss of a fixed and variable attenuator.
   (b) To measure isolation and insertion loss of a three port Circulators/Isolator.
9. Study of Attenuator (Fixed and Variable type).
10. To Study working of Doppler radar, and measure the velocity of the object moving in the Radar range.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Describe working on microwave testing bench.
2. Practically demonstrate the Characteristics of Reflex klystron using Microwave bench setup.
3. Demonstrate the performance of the Gunn diode using Microwave bench setup.
4. Perform measurement of Frequency, attenuation, VSWR, Impedance of microwave passive device using Klystron Bench Setup.
5. Interpret the basics of Smith chart for solution of transmission line problems and impedance matching.

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering)

Semester- VI

Course Code	IEC063	Title of the Course	DATA COMMUNICATION NETWORKS
Total Credits of the Course	03	Hours per Week	03

Unit	Topics	Lectures
I	**Introduction to Networks & Data Communications:** Goals and Applications of Networks ,The Internet, Protocols & Standards, Layered Tasks, OSI reference Model, TCP / IP, Addressing, Line Coding Review.	8
II	**Physical Layer**: Transmission Media- Guided and unguided, Network Topology Design, **Data Link Layer**: Error detection and Correction, Framing, Flow and Error Control Protocols, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol	8
III	**Multiple Access:** RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16.	8
IV	**Network Layer:** Design Issues. Routing Algorithms. Congestion control Algorithms. Internetworking –TCP/IP, IP Packet, IPv4 and IPv6 Protocols, IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses.	8
V	**Transport Layer Protocol:** UDP and TCP, ATM, Cryptography, Network Security**,** Session Layer-Design issues. **Application Layer:** File Transfer, Electronic mail, HTTP, WWW, SMTP, Cryptography, Network Security.	8

Text Books:

1. B. A. Forouzan, "Data Communications and Networking", 5th Edition,TMH, 2017.

Reference Books:

1. S. Tanenbaum, "Computer Networks", 4th Edition, Pearson, 2013.
2. W. Stallings, "Data and Computer Communication", 8th Edition, Pearson, 2007.

Course Outcomes: At the end of this course students will demonstrate the ability to:

1. Identify the issues and challenges in the architecture of a network.
2. Analyze the services and features of various protocol layers in data layer.
3. Demonstrate the knowledge of multiple access to design a access technique for a particular application.

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4. Realize protocols at different layers of a network hierarchy.
5. Recognize security issues in a network and various application of application layer.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%
On-line resources to be used if available as reference material		
Relevant review articles / research papers / handouts of latest development in the subject (if available)		

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B. Tech. (Electronics and Communication Engineering)

Semester- VI

Course Code	**IEC064**	**Title of the Course**	**Antenna Theory and Design**
Total Credits of the Course	**03**	**Hours per Week**	**03**

Course Objectives:

1. Understand basic terminology and concepts of antennas.
2. To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
3. Analyze the electric and magnetic field emission from various basic antennas and mathematical Formulation of the analysis.
4. To have knowledge on antenna operation and types as well as their usage in real time filed. Aware of the wave spectrum and respective band based antenna usage.
5. To understand the various methods involved in the measurement of antenna

parameters. Pre-requisite: Engineering Mathematics, Electromagnetic Field Theory

Unit 1	**Antennas Basics:** Introduction, Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle) Ω_A, Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The Radio Communication Link, Fields from Oscillating Dipole, Antenna Field Zones, Shape Impedance Considerations, Linear, Elliptical and Circular Polarization, Poynting Vector for Elliptically and Circularly Polarized Waves, The polarization Ellipse and the Poincare Sphere, Signal to Noise Ratio (SNR), Antenna Temperature, Antenna Impedance, Front-to-Back Ratio, Antenna Theorems.	**8 L**
Unit 2	**Point Sources and Antenna Arrays:** Point Source, Power Patterns, Power Theorem and its Application to an Isotropic Source, Radiation Intensity, Field Patterns, Phase Patterns, Arrays of Two Isotropic Point Sources, Non-isotropic but Similar Point Sources and the Principle of Pattern Multiplication, Pattern Synthesis by Pattern Multiplication, Linear Arrays of n-Isotropic Point Sources of Equal Amplitude and Spacing, Linear Broadside Arrays with Non-uniform Amplitude Distributions, Linear Arrays with Non-uniform Amplitude Distributions, Continuous Arrays, Huygens's Principle.	**8 L**
Unit 3	**Electric Dipoles and Arrays of Dipole:** Short Electric Dipole, The Fields of a Short Dipole, Radiation Resistance of Short Electric Dipole, Thin Linear Antenna, Radiation Resistance of $\lambda/2$ Antenna, Array of Two Driven $\lambda/2$ Elements: Broadside Case and End-Fire Case, Horizontal Antennas	**8 L**

	Above a Plane Ground, Vertical Antennas Above a Plane Ground, Yagi-Uda Antenna Design, Long- Wire Antennas, Folded Dipole Antennas.	
Unit 4	**Practical Antenna Design**: Criteria for an Antenna Design, Antenna for Low Frequencies, Marconi Antenna, Hertz Antenna, Radio Direction Finding, Loop Antenna, Antenna for Medium Frequencies, Long Wire or Harmonic Antenna, Travelling Wave Antenna, Antenna for High Frequencies, Rhombic Antenna, Log-periodic Antenna, Helical Antenna, Parabolic Reflector, Horn Antenna, Lens Antenna, Slot Antenna, Smart Antennas and Techniques, 5G Massive MIMO Antenna.	**8 L**
Unit 5	**Antenna Measurements:** Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Measurement of Different Antenna Parameters: Directional Pattern, Gain, Phase, Polarization, Impedance, Efficiency, and Current Distribution. Large millimeter and submillimeter antennas, Electrically small antennas.	**8 L**

Text Books:

1. Kraus, John D., Ronald J. Marhefka, and Ahmad S. Khan. Antennas and wave propagation. Tata McGraw-Hill Education, 2006.
2. Balanis, Constantine A. Antenna theory: analysis and design. John Wiley & sons, 2016.
3. Prasad, K. D. "Antenna and wave propagation." (No Title) (2003).

Reference Books:

4. Raju, G. S. N. Antennas and wave propagation. Pearson Education India, 2006.

NPTEL Lectures Link:

1. https://youtu.be/fAg0mrwLH9Y

2. https://www.digimat.in/nptel/courses/video/108101092/L01.html
3. https://www.digimat.in/nptel/courses/video/108101092/L02.html
4. https://www.digimat.in/nptel/courses/video/108101092/L03.html
5. https://youtu.be/wKL6WsEOl00

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Course Outcomes (COs): After completion of this course student will be able to:

1. Be aware of antenna parameter considerations.
2. Analyze the antenna and evaluate fields under various conditions and formulate the electric as well as magnetic fields equation sets for far-field and near-field conditions.
3. Understand the array system of different antennas and field analysis under application of different currents to the individual antenna elements.
4. Appraise the design issues, and apply the concept to design some practical antennas.
5. Design and prepare a set-up for antenna parameter measurement for testing the effectiveness of designed antenna.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	30%
2.	End Semester Examination	70%
On-line resources to be used if available as reference material		
Relevant review articles / research papers / handouts of latest development in the subject (if available)		

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VI

Course Code	**IEC653**	**Title of the Course**	Microwave and Antenna design lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	The objective of this course is to provide students with a comprehensive understanding This course aims to introduce students to the fundamentals of microwave test bench , microwave sources reflex klystron, Gunn diode, microwave components magic Tee, rectangular waveguide, Directional coupler, Circulators/Isolator.

List of Experiments:

Experiment List	Contact Hours

1. To study microwave test bench.
2. To study the characteristics of reflex klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working on TE01 mode.
4. To study measurement of reflection coefficient and standing wave ratio using double minima method.
5. (a) To study isolation and coupling coefficient of a magic Tee.
(b) To measure coupling coefficient, Insertion loss & Directivity of a Directional coupler.
6. To study V-I characteristic of Gunn diode.
7. To measure an unknown impedance with Smith chart.
8. (a) To measure attenuation and insertion loss of a fixed and variable attenuator.
(b) To measure isolation and insertion loss of a three port Circulators/Isolator.
9. Study of Attenuator (Fixed and Variable type).
10. To Study working of Doppler radar, and measure the velocity of the object moving in the Radar range.

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COs	Course Outcomes	Cognitive Level
CO1	Describe working on microwave testing bench.	Understand
CO2	Practically demonstrate the Characteristics of Reflex klystron using Microwave bench setup.	Apply
CO3	Demonstrate the performance of the Gunn diode using Microwave bench setup.	Remember
CO4	Perform measurement of Frequency, attenuation, VSWR, Impedance of microwave passive device using Klystron Bench Setup.	Analyse
CO5	Interpret the basics of Smith chart for solution of transmission line problems and impedance matching.	Apply

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE653.C1	3	2			2			1				
IEC653.C2	3	2	2	1	2			1				
IEC653.C3	3	2	3		2			1				

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles to real-world electrical circuits and machines, promoting practical understanding and problem-solving skills

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering)

Semester- VII

Course Code	**KEC072**	**Title of the Course**	VLSI Design
Total Credits of the Course	**03**	**Hours per Week**	**03**

Course Objectives:	This course aims to equip students with the skills to identify and assess energy conservation opportunities in electrical and mechanical systems, understand related legislation, and apply energy-saving techniques. Students will learn to conduct energy audits, implement demand-side management (DSM) and energy management information systems (EMIS), and recommend cost-effective measures for enhancing energy efficiency.

Course Content

Unit	Description	Weightage (%)
1.	**Introduction: VLSI Design flow, general design methodologies; critical path and worst case timing analysis, overview of design hierarchy, layers of abstraction, integration density and Moore's law, VLSI design styles, packaging, CMOS Logic, Propagation Delay definitions, sheet resistance.**	20%
2.	**Interconnect Parameters: Resistance, Inductance, and Capacitance, skin effect and its influence, lumped RC Model, the distributed RC Model, transient Response, RC delay model, Linear Delay Model, Logical Effort of Paths, Scaling.**	20%
3.	**Dynamic CMOS design: steady-state behavior of dynamic gate circuits, noise considerations in dynamic design, charge sharing, cascading dynamic gates, domino logic, np-CMOS logic, problems in single-phase clocking, two phase non-overlapping clocking scheme, Sequential CMOS Logic Circuits, Layout design.**	20%

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4.	**Semiconductor Memories: Dynamic Random Access Memories (DRAM), Static RAM, non-volatile memories, flash memories, Pipeline Architecture. Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling**	20%
5.	**Introduction to Testing: Faults in digital circuits. Modeling of faults, Functional Modeling at the Logic Level, Functional Modeling at the Register, Structural Model and Level of Modeling. Design for Testability, Ad Hoc Design for Testability Techniques, Controllability and Observability, Introduction to Built-in-self-test (BIST) Concept.**	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement(s)**	**KL**
COs	**Course Outcome Statement**	
CO1	Express the concept of VLSI design and CMOS circuits and delay study.	**K1**
CO2	Analyze mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits.	**K1**
CO3	Design and analyze various combinational & sequential circuits based on CMOS technology.	**K2**
CO4	Examine power logic circuits and different semiconductor memories used in present day technology.	**K3**
CO5	Interpret faults in digital circuits, Fault Models and various Testing Methodologies.	**K2**

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CO-PO Mapping Matrix/Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
KEC072.C1	3		3									1
KEC072.C2	2		3									1
KEC072.C3		2			2	2						1
KEC072.C4	3		3									1
KEC072.C5	3											3

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	33.33%
2.	End Semester Examination	66.67%

Suggested Textbooks/Reference Books:

1	Sung-Mo Kang & Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis & Design”,Mcgraw Hill, 4th Edition.
2	Neil H.E.Weste, David Money Harris, “CMOS VLSI Design – A circuits and Systems Perspective” Pearson, 4th Edition.
3	D. A. Pucknell and K. Eshraghian, “Basic VLSI Design: Systems and Circuits”, PHI, 3rd Ed.,1994.
4	R. J. Baker, H. W. Li, and D. E. Boyce , " CMOS circuit design, layout, and simulation", Wiley-IEEE Press,2007.
5	M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design" , Jaico Publishing House.

On-line resources to be used if available as reference material

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- VII

Course Code	**KEC074**	**Title of the Course**	Microwave and RADAR Engineering
Total Credits of the Course	**03**	**Hours per Week**	**03**

Course Objectives:	**This course aims to equip students with the skills to understand transmission line and waveguide, microwave devices, tubes e.g. Klystron, Reflex Klystron, Magnetron, Microwave Measurements: Measurement of Insertion Loss and working principle of MTI RADAR, CW RADAR.**

Course Content

Unit	Description	Weightage (%)
1.	**Transmission Line: Transmission line equations & solutions, reflection and transmission coefficient, standing wave, standing wave ratio, line impedance and admittance, Introduction to strip lines, Microstrip Transmission line (TL).** **Wave Guide: Rectangular Wave guide -Field Components and Parameters, TE, TM Modes, Dominant Mode, Circular Waveguides: TE, TM modes. Wave Velocities, Wave guide Cavities.**	20%
2.	**Passive microwave devices: Microwave Junctions and Couplers, Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits, Terminations, Attenuators, Phase Shifters, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.**	20%
3.	**Microwave tubes : Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Their Schematic, Principle of Operation, Performance Characteristic and their applications**	20%

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4.	**Microwave Measurements: Measurement of Insertion Loss, Frequency, Cavity Q, Dielectric Constant, Scattering Parameters, Noise Factors, Return Loss, Impendence; VSWR Metering and Measurement, High Power Measurement; Power Meters, Microwave Amplifiers.**	20%
5.	**Introduction to RADAR systems: RADAR Block diagram, RADAR Range equation, Probability of detection of false alarm, Integration of RADAR pulses, RADAR cross section of targets, MTI RADAR, CW RADAR.**	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement(s)**	**KL**
COs	**Course Outcome Statement**	
CO1	Analyze various parameters and characteristics of the transmission line and waveguide and also use of wave guide component as per applications.	**K1**
CO2	Describe, analyze and design simple microwave circuits and devices e g couplers, Attenuators, Phase Shifter and Isolators. Student will also understand the microwave propagation in ferrites.	**K1**
CO3	Analyze the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves.	**K2**
CO4	Acquire knowledge about the handling and measurement of microwave equipment.	**K3**
CO5	Differentiate different Radars, find applications and use of its supporting systems	**K2**

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CO-PO Mapping Matrix/Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
KEC074.C1	3		3									1
KEC074.C2	2		3									1
KEC074.C3		2			2	2						1
KEC074.C4	3		3									1
KEC074.C5	3											3

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	33.33%
2.	End Semester Examination	66.67%

Suggested Textbooks/Reference Books:

1	V Liao, S.Y., " Microwave Devices & Circuits", 3rd Edition, Prentice Hall of India Publication, 1995.
2	Sushrut Das, "Microwave Engineering", 1st Edition, Oxford University Publication, 2015.
3	M.I. Skolnik, "Introduction to Radar Engineering ", 3rd Edition, Tata McGraw Hill Publication, 2001.
4	A Das and S.K. Das, "Microwave Engineering", 1st Edition, Tata McGraw Hill Publication, 2000.

On-line resources to be used if available as reference material

Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering)

Semester- VII

Course Code	**KEC076**	**Title of the Course**	Wireless and Mobile Communication
Total Credits of the Course	**03**	**Hours per Week**	**03**

Course Objectives:	1. To illustrate the working of a cellular network and discuss issues related to cellular network design. 2. To List the different modes of communication and explain the evolution of different mobile communication technologies 3. Learn about Equalization Techniques 4.Evaluate and develop the concept of GSM 5. Design various types of Adaptive Filtering

Course Content

Unit	**Description**	**Weightage (%)**
1.	Evolution of mobile radio communication fundamentals. General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing; Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modeling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modeling.	20%
2.	Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques, Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation	20%

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3.	Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms; Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC- FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.	20%
4.	GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA Based Standards: IS 95 to CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication.	
5.	Introduction to Mobile Adhoc Networks, Bluetooth, Wi-Fi Standards, WiMax Standards, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G & 5G and concept of NGN.	20%

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Express the basic knowledge of mobile radio & cellular communication fundamentals and their application to propagation mechanisms, path loss models and multi-path phenomenon.	K1
CO2	Analyze the performance of various voice coding and diversity techniques.	K2
CO3	Apply the knowledge of wireless transmission basics to understand the concepts of equalization and multiple access techniques.	K2
CO4	Examine the performance of cellular systems being employed such as GSM, CDMA and LTE using various theoretical and mathematical aspects.	K2
CO5	Express basic knowledge of Mobile Adhoc networks and the existing & upcoming data communication networks in wireless and mobile communication domain.	K2

CO-PO Mapping Matrix/Course Articulation Matrix:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
KEC076.C1	3	2	1	1	-	-	-	-	-	-	-	-
KEC076.C2	3	2	1	1	-	1	-	-	-	-	-	1
KEC076.C3	3	2	1	1	-	-	-	-	-	-	-	-

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KEC076.C4	3	1	2	2	-	-	-	-	-	-	-	1
KEC076.C5	3	3	2	2	1	-	-	-	-	-	-	-

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	33.33%
2.	End Semester Examination	66.67%
Suggested Textbooks/Reference Books:		
1	T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications,	
2	Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications, first edition.	
3	T L Singal, "Wireless Communications", McGraw Hill Publications, 2010.	
4	S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.	
5	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.	
On-line resources to be used if available as reference material		
Relevant review articles / research papers / handouts of latest development in the subject (if available)		

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VII

Course Code	**KEC751B**	**Title of the Course**	VLSI Design Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course aims to introduce students to the fundamentals of logic gates, combinational e.g. half adder, full adder and sequential circuits e.g. flip flop, amplifier circuits.

List of Experiments:

1. Design and analysis of basic of logic Gates: AND, OR, NOT, NAND, NOR, XOR, XNOR.
2. Design and implementation of Half adder and Full adder using CMOS logic.
3. To simulate the schematic of the common drain amplifier.
4. To simulate the schematic of the differential amplifier.
5. To simulate the schematic of the operational amplifier.
6. Design of 3-8 decoder using MOS technology.
7. Design a 4:1 Multiplexer.
8. Design and implementation of Flip Flop circuit.
9. Layout design of PMOS, NMOS transistors.
10. Layout design of CMOS inverter and its analysis.

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COs	Course Outcomes	Cognitive Level
CO1	Designing of logic gates.	Understand
CO2	Implementation of combinational and sequential circuits using CMOS logic.	Apply
CO3	Analyze amplifier circuits.	Remember
CO4	Design sequential circuits such as flip flop.	Analyse
CO5	Do the layout designing for physical analysis of the MOS transistor and MOS based circuits	Apply

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles of logic gates, combinational e.g. half adder, full adder and sequential circuits e.g. flip flop, amplifier circuits, CMOS, promoting practical understanding and problem-solving skills.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VII

Course Code	**KEC751D**	**Title of the Course**	Microwave and RADAR Engineering Lab
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	This course aims to introduce students to the fundamentals of microwave test bench , microwave sources reflex klystron, Gunn diode, microwave components magic Tee, rectangular waveguide, Directional coupler, Circulators/Isolator.

List of Experiments:

1. To study microwave test bench.
2. To study the characteristics of reflex klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working on TE01 mode.
4. To study measurement of reflection coefficient and standing wave ratio using double minima method.
5. a) To study isolation and coupling coefficient of a magic Tee.b) To measure coupling coefficient, Insertion loss & Directivity of a Directional coupler.
6. To study V-I characteristic of Gunn diode.
7. To measure an unknown impedance with Smith chart.
8. a) To measure attenuation and insertion loss of a fixed and variable attenuator.b) To measure isolation and insertion loss of a three port Circulators/Isolator.
9. Study of Attenuator (Fixed and Variable type).
10. To Study working of Doppler radar, and measure the velocity of the object moving in the Radar range.

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COs	Course Outcomes	Cognitive Level
CO1	Describe working on microwave testing bench.	Understand
CO2	Practically demonstrate the Characteristics of Reflex klystron using Microwave bench setup.	Apply
CO3	Demonstrate the performance of the Gunn diode using Microwave bench setup.	Remember
CO4	Perform measurement of Frequency, attenuation, VSWR, Impedance of microwave passive device using Klystron Bench Setup.	Analyse
CO5	Interpret the basics of Smith chart for solution of transmission line problems and impedance matching.	Apply

Teaching-Learning Methodology	The course will utilize a combination of **interactive lectures** and **laboratory-based experiments** to reinforce theoretical concepts. Hands-on activities will allow students to apply learned principles of microwave test bench , microwave sources reflex klystron, Gunn diode, microwave components promoting practical understanding and problem-solving skills.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	50%
2.	End Semester Examination	50%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VII

Course Code	**KEC752**	**Title of the Course**	**MINI PROJECT OR INTERNSHIP ASSESSMENT**
Total Credits of the Course	**01**	**Hours per Week**	**02**

Course Objectives:	The course objectives are to enable students to demonstrate authoritative knowledge and technical accuracy in engineering topics, organize presentations with clear documentation, interpret data effectively, develop solutions through modern tools, and deliver well-prepared, time-bound presentations while addressing audience questions.

COs	**Course Outcome Statement**	**KL**
COs	Course Outcome Statement	
CO1	Knowledge Base (Engineering knowledge gained) --Grasp the topic properly and explain all the contents in an authoritative manner with technical accuracy of the discussed points.	Understand
CO2	Organisation of the presentation (problem analysis capability) -- The presentation should be well organized with proper documentation and content should be discussed in a coherent, sequential manner. The figures, written material, program codes, etc. should be clearly visible and minimal typographical errors should be there.	Analyze
CO3	File/PPT (Interpretation of data and synthesis) -- Data/ information is well interpreted through tools/ engineering concept and synthesize to draw a valid conclusion.	Evaluate
CO4	Outcome (Development of Solution & modern tool) -- Demonstrate the outcome of the internship/mini project/industrial training/Internship/Seminar in form of some, project proposal, term paper, programming codes or app development based on the study.	Create
CO5	Presentation Skills (Presentation, time bound discussion and conclusion) -- The talk should be well prepared and smoothly delivered. Students should practice in advance so that there are no interruptions and all aspects of presentation are clear to the presenter. The presentation should be completed in the prescribed time and the audience questions must be addressed well.	Evaluate

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage

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1.	Internal Assessment in the form of Skills, Presentation, Report, etc.	100%

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
KEC752.C1	3								2			2	2	2
KEC752.C2		3			2		2		2	3			2	2
KEC752.C3		2		3	2	2	2	3	2	3	3	2	3	2
KEC752.C4			3		2	2	2		2		2		2	3
KEC752.C4								3	3	3	2	3	2	3

Rubrics for Mini Project or Internship assessment/ Internship/Industrial Training/ Seminar

Knowledge Base (Engineering knowledge gained) (10)	Organisation of the presentation (problem analysis capability) (7.5)	File/PPT (Interpretation of data and synthesis)(10)	Outcome (Development of Solution + modern tool) (7.5)	Presentation Skills (Presentation, time bound discussion and conclusion) (15)	Total (50)

* If total marks are not 50, then all the marks in rubrics parameter would be scaled accordingly.

Suggested References:
On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject (if available)

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VII

Course Code	**KEC753**	**Title of the Course**	**PROJECT-I**
Total Credits of the Course	**04**	**Hours per Week**	**04**

Course Objectives:	This course aims to equip students with the ability to design and justify project objectives and proposals by analyzing relevant literature, address societal and environmental impacts, and demonstrate sustainable development practices. Students will also develop technical implementation and innovation skills, enhance data collection and analysis proficiency, and improve oral presentation and communication abilities to effectively present their work.

COs	**Course Outcomes**	**Cognitive Level**
CO1	Project Planning & Proposal development -- To **formulate, design**, and **justify** clear, feasible project objectives and proposals by **analysing** and **synthesizing** relevant literature and background information.	Evaluate
CO2	Social relevance of project – To **analyze** the impact of developed solutions in societal and environmental contexts, **demonstrate** the knowledge of, and need for sustainable development.	Analyse
CO3	Technical Implementation & Innovation-- To **implement** complex technical solutions and **apply** innovative problem-solving skills in their project execution.	Evaluate
CO4	Data Collection & Analytical Skill -- To **collect** accurate data proficiently and **performing** thorough and correct analysis to **evaluate** and **interpret** data for meaningful insights and conclusions.	Evaluate
CO5	Oral Presentation & Communication Skill-- To **deliver** clear and organized oral presentations and **respond** confidently to questions to demonstrate effective communication skills.	Apply

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
KEC753.C1		3		3									3	

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KEC753.C2						3	3					2		
KEC753.C3	3		3		2								2	
KEC753.C4				3										1
KEC753.C5								1	2	3				

Rubrics for B. Tech Project I (KEC753)

Group No.	Student's Name	Roll no.	Project Planning & Proposal development (25)	Social relevance of project (20)	Technical Implementation & Innovation(25)	Data Collection & Analytical Skill (15)	Oral Presentation & Communication Skill (15)	Total (100)

* If total mark is not 100, then all the marks in rubrics parameter would be scaled accordingly.

	Performance Criteria				
Student's Performance	Project Planning & Proposal development (25)	Social relevance of project (20)	Technical Implementation & Innovation(25)	Data Collection & Analytical Skill (15)	Oral Presentation & Communication Skill (15)
Below Average	15 - 16	10 - 12	15 - 16	08 - 09	08 - 09
Average	17 -19	13 -15	17 -19	10 -11	10 -11
Good	20 - 23	16 - 18	20 - 23	12- 13	12- 13
Outstanding	24 - 25	19 - 20	24 - 25	14 - 15	14 - 15

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	100%
2.	End Semester Examination	0%

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B. Tech. (Electronics and Communication Engineering**)**

Semester- VIII

Course Code	**KEC851**	**Title of the Course**	**PROJECT-II**
Total Credits of the Course	**09**	**Hours per Week**	**09**

Course Objectives:	This course aims to equip students with the ability to design and justify project objectives and proposals by analyzing relevant literature, address societal and environmental impacts, and demonstrate sustainable development practices. Students will also develop technical implementation and innovation skills, enhance data collection and analysis proficiency, and improve oral presentation and communication abilities to effectively present their work.

COs	**Course Outcomes**	**Cognitive Level**
CO1	Project Planning & Proposal development -- To **formulate, design**, and **justify** clear, feasible project objectives and proposals by **analysing** and **synthesizing** relevant literature and background information.	Evaluate
CO2	Social relevance of project – To **analyze** the impact of developed solutions in societal and environmental contexts, **demonstrate** the knowledge of, and need for sustainable development.	Analyse
CO3	Technical Implementation & Innovation-- To **implement** complex technical solutions and **apply** innovative problem-solving skills in their project execution.	Evaluate
CO4	Data Collection & Analytical Skill -- To **collect** accurate data proficiently and **performing** thorough and correct analysis to **evaluate** and **interpret** data for meaningful insights and conclusions.	Evaluate
CO5	Oral Presentation & Communication Skill-- To **deliver** clear and organized oral presentations and **respond** confidently to questions to demonstrate effective communication skills.	Apply

CO-PO Mapping Matrix/Course Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
KEC851.C1		3		3									3	

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KEC851.C2						3	3					2		
KEC851.C3	3		3		2								2	
KEC851.C4				3										1
KEC851.C5								1	2	3				

Rubrics for B. Tech Project II (KEC851)

Group No.	Student's Name	Roll no.	Project Planning & Proposal development (25)	Social relevance of project (20)	Technical Implementation & Innovation(25)	Data Collection & Analytical Skill (15)	Oral Presentation & Communication Skill (15)	Total (100)

* If total mark is not 100, then all the marks in rubrics parameter would be scaled accordingly.

	Performance Criteria				
Student's Performance	Project Planning & Proposal development (25)	Social relevance of project (20)	Technical Implementation & Innovation(25)	Data Collection & Analytical Skill (15)	Oral Presentation & Communication Skill (15)
Below Average	15 - 16	10 - 12	15 - 16	08 - 09	08 - 09
Average	17 -19	13 -15	17 -19	10 -11	10 -11
Good	20 - 23	16 - 18	20 - 23	12- 13	12- 13
Outstanding	24 - 25	19 - 20	24 - 25	14 - 15	14 - 15

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (CT+AT+TAQ)	25 %
2.	End Semester Examination	75 %

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