DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

B. TECH. FOURTH YEAR

ELECTRONICS ENGINEERING
ELECTRONICS AND COMMUNICATION ENGINEERING
ELECTRONICS AND TELECOMMUNICATION ENGINEERING

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2025-26]

B.Tech. VII Semester
Electronics and Communication Engineering

S. No.	Course Code	Course Title	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credits
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BEC701	VLSI Design	Offline	3	0	0	20	10	30	-	70	-	100	3
2	BEC071-074	Departmental Elective-IV	Offline	3	0	0	20	10	30	-	70	-	100	3
3	BOEM**	Open Elective-II	Offline/ MOOCs	3	0	0	20	10	30	-	70	-	100	3
4	BEC751	VLSI Design Lab	Offline	0	0	2	-	-	-	50	-	50	100	1
5	BEC752	Mini Project or Internship Assessment*		0	0	4	-	-	-	100	-	-	100	2
6	BEC753	Project-I		0	0	10	-	-	-	150	-	-	150	5
7	BEC754	Start-up and Entrepreneurial Activity Assessment#		0	0	4	-	-	-	100	-	-	100	2
		Total		**9**	**0**	**20**							**750**	**19**
		*The Mini Project or internship (5 - 6 weeks) conducted during summer break after VI semester and will be assessed during VII semester. #The Startup and Entrepreneurial Activity Assessment will be done in 7th semester under which a student will have to undergo a startup/entrepreneurship activity of at least 60 hours till 6th semester												

Course Code	Course Title
	Department Elective-I
BEC-071	Wireless & Mobile Communication
BEC-072	Information Theory & Coding
BEC-073	Microwave & Radar Engineering
BEC-074	Drone Systems: Design, Control & Navigation

B.Tech. VIII Semester
Electronics and Communication Engineering

Sr. No.	Subject Code	Subject	Learning Mode	Periods			Evaluation Scheme				End Semester		Total	Credits
				L	T	P	CT	TA	Total	PS	TE	PE		
1	BOEM**	Open Elective-III	MOOCs	3	0	0	20	10	30	-	70	-	100	3
2	BOEM**	Open Elective-IV	MOOCs	3	0	0	20	10	30	-	70	-	100	3
3	BEC851	Project-II		0	0	18	-	-	-	100	-	350	450	10
		Total		6	0	18							650	16

The Internal Assessment of MOOCs will be done by the respective institute and the External Assessment (End Semester Examination) will be done by the University.

B.Tech 4rd Year
VII Semester
Syllabus

BEC-701	VLSI Design	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**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.	8
II	**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.	8
III	**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.	8
IV	**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,	8
V	**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.	8

Text Book:

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.

Reference Books:

1. R. J. Baker, H. W. Li, and D. E. Boyce , " CMOS circuit design, layout, and simulation", Wiley-IEEE Press,2007.
2. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design" , Jaico Publishing House.

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

1. Express the concept of VLSI design and CMOS circuits and delay study.
2. Analyze mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits.
3. Design and analyze various combinational & sequential circuits based on CMOS technology.
4. Examine power logic circuits and different semiconductor memories used in present day technology.
5. Interpret faults in digital circuits, Fault Models and various Testing Methodologies.

BEC-751	VLSI Design Lab	0L:0T:2P	1 Credit

SUGGESTIVE 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.

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

1. Designing of logic gates.
2. Implementation of combinational and sequential circuits using CMOS logic.
3. Analyze amplifier circuits.
4. Design sequential circuits such as flip flop.
5. Do the layout designing for physical analysis of the MOS transistor and MOS based circuits.

BEC-071	Wireless and Mobile Communication	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**Wireless Communication Fundamentals:** 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.	8
II	**Spread Spectrum and Diversity:** 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.	8
III	**Equalization and Multiple Access:** 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.	8
IV	**Cellular Networks:** 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.	8
V	**Other Wireless Networks:** 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.	8

Text Books:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications, Second Edition.
2. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications, first edition.
3. T L Singal, "Wireless Communications", McGraw Hill Publications, 2010.

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.

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

1. Express the basic knowledge of mobile radio & cellular communication fundamentals and their application to propagation mechanisms, path loss models and multi-path phenomenon.
2. Analyze the performance of various voice coding and diversity techniques.
3. Apply the knowledge of wireless transmission basics to understand the concepts of equalization and multiple access techniques.
4. Examine the performance of cellular systems being employed such as GSM, CDMA and LTE using various theoretical and mathematical aspects.
5. Express basic knowledge of Mobile Adhoc networks and the existing & upcoming data communication networks in wireless and mobile communication domain.

BEC-072	Information Theory & Coding	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**Entropy**: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Fano's Inequality.	8
II	**Asymptotic Equipartition Property**: Asymptotic Equipartition Property Theorem. **Consequences of the AEP:** Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Optimality of Huffman Codes, Shannon– Fano–Elias Coding.	8
III	**Channel Capacity:** Channel Capacity for Various Binary Channels, Symmetric Channels, Properties of Channel Capacity, Preview of Channel Coding Theorem, Jointly Typical Sequences, Channel Coding Theorem, Channel capacity Theorem.	8
IV	**Block Codes:** Introduction to block codes, Single-parity check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft- decision decoding, Automatic-repeat-request schemes. **Linear Block codes:** Definition of linear Block Codes, Generator matrices, Standard array, Parity-check matrices, Error detection and correction.	8
V	**Convolution codes:** Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi Algorithm, Binary Cycle Codes, BCH codes. RS codes, Golay codes.	8

Text Books:

1. Bose, Information Theory, Coding and Cryptography, McGraw-Hill Education, 3rd Edition, (2016).
2. Joy A. Thomas, Thomas M. Cover, "Elements of information theory", Wiley-Interscience; 2nd edition (July 18, 2006).
3. S. Gravano, "Introduction to Error Control Codes" OUP Oxford (24 May 2001).
4. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990).
5. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley, 2005.

Reference Books:

1. Simon Haykin, "Digital communication", John Wiley.
2. Ranjan Bose, "ITC and Cryptography", Tata McGraw-Hill.
3. Roberto Togneri, Christopher J.S deSilva, "Fundamentals of Information Theory and Coding Design", CRC Press.

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

1. Explain each block involved in digital communication thoroughly with applications.
2. Apply the knowledge of basic concepts of probability and entropies to analyze the behavior of a communication system.
3. Analyze the use of source coding and evaluating all the techniques of source coding.
4. Examine the significance of channel coding and evaluating all available techniques of channel coding and decoding with challenges.
5. Examine various error control coding techniques.

BEC-073	Microwave & Radar Engineering	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**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.	10
II	**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, Circ ulators. S parameter analysis of all components.	8
III	**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.	7
IV	**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.	7
V	**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

Text Books:

1. 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.

Reference Books:

1. A Das and S.K. Das, "Microwave Engineering", 1st Edition, Tata McGraw Hill Publication, 2000.

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.

BEC-074	Drone Systems: Design, Control & Navigation	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	**UAV Miniaturization:** Design Challenges and Technological Opportunities, Aerial Network Characteristics: Dynamic Topology, Delay Constraints, Intermittent Links, Aerial Communication Techniques: Radar Identification & Limitations Beyond Radar: ADS-B, Optical & Acoustic Tracking, Aerial Voice & Data Communication.	8
II	**Modern Control Theory for UAV Systems:** Introduction to State-Space Modeling, State Transition Matrix and Time Response, Canonical Forms & Transformations, Significance of Eigenvalues: Real Distinct, Repeated, Complex, Application to UAV Stability & Control Systems.	8
III	**UAV Aerodynamics, Propulsion & Navigation:** Coordinate Systems: Earth-fixed & Body-fixed Frames, UAV Aerodynamics: Wing Configuration, Lift & Drag, Airframe Configuration & Endurance, Vibration, Noise, and Gliding Characteristics; UAV Propulsion: Propeller & Motor Modeling, Electric vs. Hybrid Propulsion Systems.	8
IV	**UAV Control Systems & Autonomy:** UAV Controllability & Observability Concepts, UAV Flight Control System Overview, Position Control: Euler Angles and Rotation Matrix as Outputs, Control Strategies: Autonomous vs. Semi-Autonomous Flight, Inner-loop vs. Outer-loop Control, Safety Mechanisms: Failsafe Design, Redundancy and Recovery in Autonomous Flights.	8
V	**Drone Safety, Legal Framework & Future Trends:** National and International Safety Guidelines: DGCA Drone Rules 2021 (India), Airspace Classification & Permissions, Pilot Training, UIN, UAS Traffic Management (UTM), NPNT Compliance & Geo-fencing Technologies, Innovations in Drone Miniaturization & Battery Technologies.	8

Text Books:

1. Reg Austin, Unmanned Aircraft Systems: UAV Design, Development and Deployment, Wiley, 2010.
2. Robert C. Nelson, Flight Stability and Automatic Control, McGraw-Hill, 2nd Edition, 1998.
3. Brian L. Stevens, Frank L. Lewis, Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, Wiley, 3rd Edition, 2015.

Reference Books:

1. Paul G. Fahlstrom, Thomas J. Gleason, Introduction to UAV Systems, UAV Systems Inc., 4th Edition, 2012.
2. Andreas M. Savvaris, Kostas P. Valavanis, Unmanned Aircraft Systems: Theory and Practice, Springer, 2020.
3. DGCA (Directorate General of Civil Aviation, India), Drone Rules 2021 – Government of India (available online).

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

1. Understand the constraints and opportunities in UAV miniaturization and aerial networking.
2. Understand how to represent drone systems using state-space models and use basic control theory to analyze their stability.
3. Analyze the aerodynamic behaviour and propulsion trade-offs in UAV design and navigation.
4. Recognize UAV control systems using modern control techniques for both autonomous and semi-autonomous operations.
5. Identify the rules and safety practices for drone operation in India and globally, including licensing, geofencing, and UAS traffic management.