Tulsiramji Gaikwad-Patil College of Engineering and Technology

Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade
Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Department of Electronics and Communication Engineering

Scheme of Instructions: Fourth Year B. Tech. in Electronics and Communication Engineering

Semester VII (As Per NEP 2020)

Sr. No.	Sem	Type	BoS/ Dept	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			Total	ESE Duration Hours
							L	SL	P	Hrs.		CT/IA	CA	ESE	Marks	
1	VII	PCC	EC	BEC34701	Computer Communication Networks	T	4	0	0	4	4	30	10	60	100	3
2	VII	PCC	EC	BEC34702	Wireless Sensor Network	T	4	0	0	4	4	30	10	60	100	3
3	VII	PEC	EC	BEC34703-05	Program Elective -IV	T	4	0	0	4	4	30	10	60	100	3
4	VII	PEC	EC	BEC34806-08	Program Elective -V	T	4	0	0	4	4	30	10	60	100	3
5	VII	MDM	EC	BDS34711	Data Science	T	3	0	0	3	3	30	10	60	100	3
6	VII	MDM	EC	BDS34712	Data Science Lab	P	0	0	2	2	1	0	25	25	50	2
7	VII	PCC	EC	BEC34709	Computer Communication Networks Lab	P	0	0	2	2	1	0	25	25	50	2
8	VII	Project	EC	BEC34710	Project	P	0	0	8	8	4	0	100	100	200	2
Total							**19**	**0**	**12**	**31**	**25**	**150**	**200**	**450**	**800**	**21**

Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC (Program me Core Courses)	PEC (Programme Elective Courses)	(MDM/OEC) Multidisciplinary Minor/ (OEC) Open Elective Course)	SEC (Skill Course)	Humanities Social Science & Management	Experiential Learning Courses	CC (Co-Curricular Courses)
Credits	–	09	08	04	-	–	04	--
Cumulative Sum	16 / 13	47	20	22	08	14	06	04

Progressive Total Credits: 125 + 25 = 150

				June,2026	2.00	Applicable for AY 2026-27 Onwards for 2023-24 Batch Students
Chairperson	Vice Principal /Director (Academics)	Director (Administration)	Principal	Date of Release	Version	

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Department of Electronics and Communication Engineering

Scheme of Instructions: Fourth Year B. Tech. in Electronics and Communication Engineering

Semester VIII (As Per NEP 2020)

SN	Sem	Type	BoS/ Dept	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage				ESE Duration Hours
							L	SL	P	Hrs.		CT/I A	CA	ESE	Total Marks	
1	VIII	RM	EC	BEC34801	Research Methodology (Online)	T	4	0	0	4	4	30	10	60	100	3
2	VIII	Internship/ Industry Project	EC	BEC34802	Internship	P	0	0	24	24	12	0	100	100	200	-
Total							**4**	**0**	**24**	**28**	**16**	**30**	**110**	**160**	**300**	**3**

Course Category	BSC/ ESC (Basic Science Course/ Engineering Science Course.)	PCC (Program me Core Courses)	PEC (Programme Elective Courses)	(MDM/OEC) Multidisciplinary Minor/ (OEC) Open Elective Course)	SEC (Skill Course)	Humanities Social Science & Management	Experiential Learning Courses	CC (Co-Curricular Courses)
Credits	–	-	-	-	-	–	16	--
Cumulative Sum	16 / 13	47	20	22	08	14	22	04

Progressive Total Credits: 150 +16 = 166

				June,2026	2.00	Applicable for AY 2026-27 Onwards for 2023-24 Batch Students
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Department of Electronics and Communication Engineering

Program Elective List for U.G.

Semester V	Semester VI	
Program Elective- I	**Program Elective- II**	**Program Elective- III**
BEC3506: Electromagnetic Field and Antenna	**BEC33605:** Microwave & Radar Engineering	**BEC33608:** Wave guide & Antenna
BEC3507: CMOS VLSI Design	**BEC33606:** Digital Design	**BEC33609:** VLSI Signal Processing
BEC3508: Instrumentation and Control System	**BEC33607:** PLC Fundamental	**BEC33610**: SCADA

Semester VII	Semester VII
Program Elective- IV	**Program Elective- V**
BEC34703: Optical Fiber Communication	**BEC34806:** Mobile Communication
BEC34704: Mixed Signal Design	**BEC34807:** VLSI Testing
BEC34705: Robotics & Automation	**BEC34808**: Distributed Control Systems

Open Elective List for U.G.

Open Elective-I (SEM-III)		
Sr. No	**Course code**	**Course**
1	B$$323XX	Basic Electronics and Communication

Open Elective-II (SEM-IV)		
Sr. No	**Course code**	**Course**
1	B$$324XX	Evolution in Communication Technologies

Open Elective-III (SEM-V)		
Sr. No	**Course code**	**Course**
1	B$$335XX	ICT in Rural Sector

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34701: Computer Communication Networks

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE: 03 Hrs.		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: Explain the fundamentals of Computer Network and Network topologies.
CO2: Apply Flow control & Error control protocols of Data Link Layer with ARQ.
CO3: Illustrate the concept of IP Addressing techniques and Routing protocols of Network Layer.
CO4: Analyze the transport layer services, protocol Headers and congestion control protocols.
CO5: Determine the function of Application Layer and Presentation layer protocols.

Course Contents

Unit I	Introduction to Networks, Network Topology, Network Devices Types of communication: - simplex, half duplex, full duplex, Network Classification: - LAN, MAN, WAN, Network Architecture, Protocols, OSI Reference Model, TCP/IP Reference Model. Transmission Media: -Guided Media, Unguided
Unit II	Design Issues, Framing methods, Flow Control and Error Control, Stop-and-wait flow control, Sliding-window flow control, Stop-and-wait ARQ, Go-back-N ARQ, Selective- repeat ARQ, HDLC, MAC sub layer: ALOHA
Unit III	Network layer duties, Routers, IP addressing and its classification, IPv4 address, IPv6 address, Mask and Subnet, Routing algorithms like shortest path routing, Dijkstra's algorithm, Bellman Ford Algorithm, Distance Vector Routing, Dynamic Routing. Routing protocols
Unit IV	Transport layer services, Connection oriented & Connectionless, Three-way handshaking, UDP model, TCP: - TCP header format, comparison between UDP and TCP, Need of Congestion control, Principal of congestion, Quality of Service (QoS), Token bucket and leaky bucket algorithm
Unit V	Application Layer: DNS, Electronic Mail, File Transfer (FTP), WWW, HTTP, SNMP, SMTP. Introduction to Cryptography, Secret key algorithm, public key algorithm, Digital Signature, Enterprise network security: DMZ, NAT

Text Books

T.1	Computer Networks: Andrew Tanenbaum, 4th Edition, PHI.
T.2	Computer Communication Networks: Frouzan, 4th Edition, Tata Mc-Graw Hill
T.3	William Stallings, "computer Networks and Cryptography", 3rd edition, Pearson Education

Reference Books

R.1	Telecommunication Switching systems & Networks: *Vishwanathan , 3rd Edition,PHI.*
R.2	Computer Communication: W. Stanlling
R.3	Communication Networks: Leon-Gracia

Useful Links

1	https://nptel.ac.in/courses/106/105/106105080/
2	https://nptel.ac.in/courses/117/105/117105076/
3	http://nptel.ac.in/courses/117103064

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34702: Wireless Sensor Networks

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE: 03 Hrs		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: Illustrate challenges and technologies for wireless networks
CO2: Analyse architecture and sensors of WSN Communication
CO3: Determine the communication, energy efficiency, computing, storage and transmission of Network Sensors
CO4: Analyse infrastructure and simulations in Wireless Sensor Network
CO5: Describe the concept of programming the in WSN environment

Course Contents

Unit I	**Overview of Wireless Sensor Networks:** Single Node Architecture Hardware Components Network Characteristics unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks Types of wireless sensor networks.
Unit II	**Architectures:** - Network Architecture Sensor Networks Scenarios Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments introduction to Tiny OS and nesC Internet to WSN Communication
Unit III	**Networking Sensors**: - MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy Efficient Routing, Geographic Routing
Unit IV	**Infrastructure Establishment: -** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.
Unit V	**Sensor Network Platforms and Tools:** Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node level software platforms, Node level Simulators, State centric programming.

Text Books

T.1	Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
T.2	Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks An Information Processing Approach", Elsevier, 2007
T.3	Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley & Sons Publications, 2011.

Reference Books

R.1	Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and Applications”, John Wiley, 2007
R.2	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003

Useful Links

1	https://nptel.ac.in/courses/106/105/106105160/
2	https://onlinecourses.swayam2.ac.in/arp19_ap52/preview

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34703: Optical Fibres Communication

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE:03Hrs.		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: Understand the basic elements and ray theory of optical Fiber.
CO2: Analyze the different kinds of losses, signal distortion in optical wave.
CO3: Classify optical source materials, LED structure, LASER diodes & optical receiver operation performance.
CO4: Analyze the architecture and components of analog links & Digital links.
CO5: Demonstrate the operational principle of WDM, SONET and optical Amplifiers.

Course Contents

Unit I	**Introduction to Optical Fiber:** Principle of optical Fiber communication, Block diagram, Advantages and applications, Ray model, Total internal reflection phenomenon, Acceptance angle, acceptance cone, Numerical aperture. Structures and characteristics of various Fibers such as step index, graded index, Single mode and multi-mode Fibers
Unit II	**Transmission Characteristics of Optical Fibers:** Introduction, Attenuation, absorption, Scattering Losses, bending Losses, dispersion, Intra modal dispersion, Inter modal dispersion, Fiber alignment and joint loss, single mode Fiber joints, Fiber splices, Fiber connectors and Fiber couplers
Unit III	**Optical Sources:** LED, Types of LED, LED Power and quantum efficiency. LASER - Principle of operation, Fabry-Perot laser and its properties. **Optical Receivers:** Photo detector - PIN diode, Avalanche Photodetectors, Structures and Properties, Introduction to optical Receiver, its operation, receiver sensitivity, quantum limit, Eye diagrams, Coherent detection
Unit IV	**Analog and Digital links:** Analog Links-Introduction, overview of analog links, RF over Fiber, key link parameters, Radio over Fiber links, Digital Links-Introduction point-to-point links, System considerations, link power budget, Rise time budget
Unit V	**Optical Networks:** WDM concepts, overview of WDM operation principles, WDM standards, Elements of optical networks, SONET/SDH. Optical Interfaces, SONET/SDH Rings and Networks, High speed light wave Links, optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA

Text Books

T.1	Optical Fiber Communication by Gerd Keiser 4th Ed, MGH,2008-1
T.2	Optical Fiber Communications by John M. Senior Pearson Education, 3rd Impression,2007

Reference Books

R.1	Fiber optic communication by Joseph C Palais 4th Edition, Pearson Education
R.2	Textbook on Optical Fiber Communication & Its Application by S.C.Gupta PHI Publication
R.3	Optical communication & Networks by M.N.Bandopadhyay, PHI Publications

Useful Links

1	https://youtu.be/K4S9p-mMq3o?si=LSmjgKmVCyv6BEO1
2	https://youtu.be/KIPFP8wke9M?si=3FE5K6Pj6_kzSEBs
3	https://youtu.be/lWC18op2yU8?si=eoP1757HR6tBJmW5

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34704: Mixed Signal Design

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE:03Hrs.		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: Apply Optimize mixed-signal designs for power, area, noise, and speed while considering process variations and real-world limitations.

CO2: Use current research trends and advanced techniques in mixed-signal VLSI, including high-speed ADCs, low-power DACs, and system-on-chip integration.

CO3: Evaluate and design fundamental analog building blocks such as amplifiers, current mirrors, comparators, and operational transconductance amplifiers (OTAs) for mixed-signal systems.

CO4: Find out and explain the basic principles of analog, digital, and mixed-signal circuits in VLSI systems.

CO5: Solve and design fundamental analog building blocks such as amplifiers, current mirrors, comparators, and operational transconductance amplifiers (OTAs) for mixed-signal systems.

Course Contents

Unit I	**Introduction to Mixed-Signal VLSI:** Overview of VLSI design, Importance of mixed-signal systems in modern electronics, Challenges in mixed-signal design, Design flow for mixed-signal circuits, Examples of mixed-signal systems.
Unit II	**Analog Circuit Fundamentals for Mixed-Signal Design:** CMOS technology review, MOSFET operation, small-signal models, Analog building blocks, Current mirrors and biasing circuits, Operational amplifiers (OTAs), Comparators and differential amplifiers, Noise analysis and frequency response, Switched-capacitor circuits
Unit III	**Data Conversion Principle**s: Analog-to-Digital Converters (ADCs), Sampling theorem, quantization, aliasing, Types of ADCs: Flash, Pipeline, Successive Approximation (SAR), Sigma-Delta, Performance metrics: Resolution, SNR, ENOB, INL/DNL, Digital-to-Analog Converters (DACs), Trade-offs in ADC/DAC design
Unit IV	**Mixed-Signal System Design:** Integration of analog and digital blocks, Clocking, synchronization, and timing issues, Switched-capacitor circuits in mixed-signal systems, Phase-Locked Loops (PLLs) and clock generation, Signal integrity and noise coupling, Layout considerations for mixed-signal ICs.
Unit V	**Simulation and Verification**: Introduction to simulation tools, Cadence Virtuoso, Synopsys Custom Designer Behavioural modelling of mixed-signal, circuits Verification techniques: Functional verification, Monte Carlo analysis, mismatch simulation, Interpreting simulation results: Frequency response, transient response, noise analysis

Text Books

T.1	"Design of Analog CMOS Integrated Circuits" – Behzad Razavi
T.2	"CMOS Analog Circuit Design" – Phillip E. Allen & Douglas R. Holberg
T.3	"Analog and Digital Signal Processing in VLSI" – Willy Sansen

Reference Books

R.1	"Data Converters: A Design Handbook" – Walt Kester (Analog Devices)
R.2	"Analog Integrated Circuit Design" – Tony Chan Carusone, David A. Johns, Kenneth W.Martin
R.3	"Principles of CMOS VLSI Design: A Systems Perspective" – Neil H.E. Weste & David Harris

Useful Links

1	https://nptel.ac.in/courses/108/105/108105047/
2	https://www.synopsys.com/implementation-and-signoff/custom-analog-mixed-signal.html

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34705: Robotics and Automation

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15Marks
Tutorial	-	**CT-2**	15Marks
Total Credit	4	**CA**	10Marks
Duration of ESE:03Hrs.		**ESE**	60Marks
		Total	100Marks

Course Outcome:

CO1: Understand the robotics design and implementation.

CO2: Gain the knowledge on fundamentals of robotic programming.

CO3: Comprehend, classify and analyze the behavior of different types of sensors and actuators.

CO4: Illustrate the ROS fundamentals.

CO5: Design robotic applications using ROS.

Course Contents

Unit I	**Robotics Introduction:** Robot Introduction-Seven criteria of Defining a Robot, Robot Controllers-Major Components, Robot Vocabularies-Robotics Middleware Basics.
Unit II	**Programming the Robot's Sensors:** A close look at Sensors, Programming the Robot's Sensors, Programming the Actuators, Building Robot's Soft-bot.
Unit III	**Robot Operating System (ROS):** ROS Basics - ROS Equation, History of ROS, Sensors and Robots Supporting ROS, ROS Architecture and Concepts, ROS File-system Level, ROS Computation Graph Level, ROS Community Level.
Unit IV	**ROS Fundamentals:** Ubuntu Linux for Robotics-Ubuntu Graphical User Interface, Shell Commands, C++ and Python for Robotic Programming-Basic Concepts with Examples.
Unit V	**ROS Programming:** Creating ROS Workspace and Package, Using ROS Client Libraries, Programming Embedded Board Using ROS-Interfacing Arduino with ROS, ROS on a Raspberry Pi.

Text Books

T.1	Lentin Joseph, Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, 1st Edition, A Press, 2018
T.2	Jonathan Cacace; Lentin Joseph, Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System, 2nd Edition, Packt Publishing, 2018.

Reference Books

R.1	Hughes, C. and Hughes, T. Robot programming: a guide to controlling autonomous robots. Que Publishing, 2016.
R.2	Quigley, M. Gerkey, B. and Smart, W. D. Programming Robots with ROS: A practical introduction to the Robot Operating System. O'Reilly Media, Inc". 2015
R.3	Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, Lentin Joseph, ROS Programming: Building Poerful Robots. Packt Publishing, 2018.

Useful Links

1	https://onlinecourses.nptel.ac.in/noc22_ee93/preview
2	https://onlinecourses.nptel.ac.in/noc22_ee90/preview

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34806: Mobile Communication

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE:03Hrs		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: Understand the evolution and basic principles of mobile communication systems.

CO2: Describe various wireless propagation mechanisms.

CO3: Explain spread spectrum and OFDM techniques.

CO4: Analyze modern cellular network structures.

CO5: Identify security challenges in mobile communication.

Course Contents

Unit I	**Introduction to Mobile Communication:** Evolution of mobile communication systems (1G to 5G), Basic concepts and applications of mobile communication, Cellular concept: frequency reuse, handoff strategies, Cellular system design fundamentals Multiple access techniques: FDMA, TDMA, CDMA, OFDMA
Unit II	**Wireless Propagation & Channel Modelling:** Free space propagation model Reflection, diffraction, and scattering Path loss models (Okumura, Hata model), Shadowing and multipath fading, Doppler effect and delay spread, Small-scale and large-scale fading
Unit III	**Modulation Techniques for Mobile Systems:** Analog modulation: AM, FM basics, Digital modulation: ASK, FSK, PSK, QPSK, QAM, Spread spectrum techniques: DSSS, FHSS OFDM (Orthogonal Frequency Division Multiplexing) Error control coding basics.
Unit IV	**Mobile Communication Systems & Standards:** GSM architecture and operation CDMA and IS-95, LTE and 4G architecture, Introduction to 5G networks Satellite communication basics, Wireless LANs and PANs (Wi-Fi, Bluetooth)
Unit V	**Advanced Topics in Mobile Communication:** Handoff management and mobility, management Power control techniques, Security issues in mobile communication, QoS (Quality of Service) in wireless networks, Emerging trends: IoT, 5G applications, smart cities.

Text Books

T.1	Principles of Mobile Communication by Gordon L. Stüber, springer publication 2018
T.2	Mobile Communication Systems by J. D. Parsons & J. G. Gardiner Pearson Education publication

Reference Books

R.1	Mobile Communications by Jochen H. Schiller 4th Edition, Addison-Wesley
R.2	Mobile Communications Handbook & by Jerry D. Gibson, CRC Publication.

Useful Links

1	https://youtu.be/iIjwzxnD-b0?si=23-wbCPJAoT9R1i
2	https://youtu.be/PNMuf8twHqw
3	https://youtu.be/lWC18op2yU8?si=eoP1757HR6tBJmW5

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BEC34807: VLSI Testing

Teaching Scheme	
Lectures	4 hrs/week
Tutorial	-
Total Credit	4
Duration of ESE: 03 Hrs.	

Examination Scheme	
CT-1	15 Marks
CT-2	15 Marks
CA	10 Marks
ESE	60 Marks
Total	100 Marks

Course Outcome:

CO1: Understand fault models and testing basics.

CO2: Analyze fault detection and simulation techniques.

CO3: Apply test pattern generation methods.

CO4: Implement Design for Testability (DFT) techniques.

CO5: Evaluate testing strategies for memory and delay faults.

Course Contents

Unit I	**Introduction to VLSI Testing:** Importance of testing in VLSI, Challenges in testing complex ICs, Types of faults: permanent, intermittent, transient, Fault tolerance vs. fault detection, Overview of test methodologies: functional vs. structural testing
Unit II	**Fault Modelling:** Stuck-at faults, Bridging faults, Delay faults (transition and path delay faults), Open and short faults, Fault equivalence and dominance
Unit III	**Test Generation and Fault Coverage:** Principles of Automatic Test Pattern Generation (ATPG), Exhaustive vs. random testing, Combinational ATPG algorithms, Sequential ATPG, Fault coverage metrics and analysis
Unit IV	**Design for Testability (DFT):** Scan design: scan chains, scan flip-flops, Test points insertion, Controllability and observability, Boundary scan (IEEE 1149.1 JTAG standard), Trade-offs in DFT: area, performance, and testability
Unit V	**Built-In Self-Test (BIST):** Concepts of BIST, Pseudorandom test pattern generation (LFSRs), Signature analysis and MISR (Multiple Input Signature Register), Memory BIST (MBIST), BIST for combinational and sequential circuits

Text Books

T.1	VLSI Test Principles and Architectures – Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen
T.2	Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits – M. L. Bushnell & V.
T.3	VLSI Testing and Design for Testability – A. Chrispin Jiji et al.

Reference Books

R.1	Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits – M. L. Bushnell, V. D. Agrawal
R.2	Contactless VLSI Measurement and Testing Techniques – Selahattin Sayil
R.3	LSI Testing Digital and Mixed Analogue Digital Techniques – Stanley L. Hurst

Useful Links

1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-374-analog-integrated-circuit-design-spring-2009/
2	https://www.synopsys.com/implementation-and-signoff/custom-analog-mixed-signal.html

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Final Year (Semester VII) B.Tech. Electronics & Communication Engineering

BEC34808: Distributed Control Systems

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	0 Hrs/week	**CT-2**	15 Marks
Total Credit	4	**TA**	10 Marks
Duration of ESE: 03 Hrs.		**ESE**	60 Marks
		Total	100 Marks

Course Outcomes (CO)

Students will be able to

CO1: Explain the architecture and components of Distributed Control Systems.
CO2: Analyze hardware and software aspects of DCS implementation.
CO3: Evaluate communication networks and protocols used in DCS.
CO4: Apply control strategies for industrial automation processes.
CO5: Assess advanced applications, safety, and security aspects of DCS.

Course Contents

Unit I	**Introduction to Distributed Control Systems:** Evolution from centralized to distributed control, Basic concepts and advantages of DCS, Architecture of DCS: hierarchical levels, Components: Controllers, I/O modules, operator stations, Comparison with PLC and SCADA systems.
Unit II	**DCS Hardware and Software: Field** instruments and interfacing, Input/Output systems and signal conditioning, Controller hardware and redundancy, DCS software: configuration, programming, and databases, Human Machine Interface (HMI).
Unit III	**Communication in DCS: Data** communication fundamentals, Network topologies and protocols, Fieldbus technologies (FOUNDATION Fieldbus, Profibus), Industrial Ethernet, Communication security issues.
Unit IV	**Control Strategies and Implementation:** Basic and advanced control strategies control in DCS, Cascade, feedforward, and ratio control, Sequence control and batch processing, Alarm management and trending,
Unit V	**Advanced Topics and Applications:** Safety Instrumented Systems (SIS), Reliability and fault tolerance, Cybersecurity in DCS, Integration with SCADA, PLC, and IoT, Case studies: Power plant, oil & gas, chemical industries.

Text Books

T.1	Distributed Control Systems: Their Evaluation and Design – Michael P. Lukas
T.2	Distributed Control Systems – S. Smaili / M. A. Laughton
T.3	Process Control: A Practical Approach – Myke King

Reference Books

R.1	Distributed Embedded Control Systems: Improving Dependability with Coherent Design – M. Colnarič, D. Verber, W. A. Halang
R.2	Computer-Based Industrial Control – Krishna Kant
R.3	Industrial Automation and Control – S. K. Singh

Useful Links

L.1	https://onlinecourses.nptel.ac.in/noc22_cs66/preview?utm
L.2	https://onlinecourses-archive.nptel.ac.in/noc18_ee41/preview

BOS Chairman

Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441108
NAAC Accredited (A+ Grade) & NBA Accredited
(An Autonomous Institute Affiliated to RTM Nagpur University, Nagpur)

Fourth Year (Semester-VII) B.Tech. Electronics & Communication Engineering

BEC34709: Computer Communication Network Lab

Teaching Scheme		Examination Scheme	
Lectures	2 Hr/Week	**CT**	-
Tutorials	-	**CA**	25 Marks
Total Credits	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02Hrs	

Course Outcomes:

1	**Examine** the fundamentals of Computer Network devices & network.
2	**Analyze** data link layer & HDLC in packet tracer.
3	**Determine** the routing algorithm in the Computer Network.
4	**Examine** the structure of transmission Control Protocol (TCP) & User Datagram Protocol (UDP).
5	**Demonstrate** FTP server and DNS server on Packet Tracer.

Sr. No.	List of Experiment	CO
1	Examine the operation of Network Devices.	CO1
2	Implement computers within a Local Area Network (LAN).	CO1
3	Analyze data link layer traffic simulation using packet tracer.	CO2
4	Analyze High Level Data Link Control on packet tracer.	CO2
5	Implement IP static routing on packet tracer.	CO3
6	Execute OSPF Routing Protocol using Cisco Packet Tracer. (Link State Routing).	CO3
7	Implement TCP Protocol on Packet Tracer.	CO4
8	Implement UDP Protocol on Packet Tracer.	CO4
9	Execute FTP Server Using CISCO Packet Tracer.	CO5
10	Implement DNS server in cisco packet tracer.	CO5

Text Books

T.1	Computer Networks: Andrew Tanenbaum, 4th Edition, PHI.
T.2	Computer Communication Networks: Frouzan, 4th Edition, Tata Mc-Graw Hill
T.3	William Stallings, “computer Networks and Cryptography”, 3rd edition, Pearson Education

Reference Books

R.1	Telecommunication Switching systems & Networks: *Vishwanathan , 3rd Edition,PHI.*
R.2	Computer Communication: W. Stanlling
R.3	Communication Networks: Leon-Gracia

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B.Tech. Fourth Year (Semester-VII) Electronics and Communication Engineering

BDS34711: Data Science

Teaching Scheme		Examination Scheme	
Lectures	4 Hrs/week	**CT-1**	15 Marks
Tutorial	-	**CT-2**	15 Marks
Total Credit	4	**CA**	10 Marks
Duration of ESE:03 Hrs.		**ESE**	60 Marks
		Total	100 Marks

Course Outcome:

CO1: **Apply** toolboxes in data science

CO2: **Understand** statistics, measure, learn inference frequency approach

CO3: **Analyze** data using statistical and visualization methods.

CO4: **Develop** and evaluate regression models.

CO5: **Optimize** models using validation and parameter tuning techniques.

Course Contents

Unit I	**Introduction to Data Science** Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. Architecture of data, data acquisition.
Unit II	**Data Collection and Data Pre-Processing** Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.
Unit III	**Exploratory Data Analytics Descriptive** Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, PivotTable, Heat Map, Correlation Statistics, ANOVA
Unit IV	**Model Development** Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making, Feature Engineering
Unit V	**Model Evaluation** Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search

Text Books

T.1	VLSI Test Principles and Architectures – Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen
T.2	Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits – M. L. Bushnell & V.
T.3	VLSI Testing and Design for Testability – A. Chrispin Jiji et al.

Reference Books

R.1	Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits – M. L. Bushnell, V. D. Agrawal
R.2	Contactless VLSI Measurement and Testing Techniques – Selahattin Sayil
R.3	LSI Testing Digital and Mixed Analogue Digital Techniques – Stanley L. Hurst

Useful Links

1	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-374-analog-integrated-circuit-design-spring-2009/
2	https://nptel.ac.in/courses/108/105/108105047/
3	https://www.synopsys.com/implementation-and-signoff/custom-analog-mixed-signal.html

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Fourth Year (Semester-VII) B.Tech. Electronics & Communication Engineering

BDS34712: Data Science Lab

Teaching Scheme		Examination Scheme	
Lectures	2 Hr/Week	**CT**	-
Tutorials	-	**CA**	25 Marks
Total Credits	1	**ESE**	25 Marks
		Total	50 Marks
		Duration of ESE: 02Hrs	

Course Outcomes:

1	**Understand** basic concepts of data science and key issues
2	**Understand** data collection and pre-processing
3	**Apply** statistical analytics on datasets
4	**Implement** regression models on datasets.
5	**Implement** model evaluation and validation of datasets.

Sr. No.	List of Experiment	CO
1	Perform and implement various control structures in Python	CO1
2	Apply the data frames in python for data reading, preparation and pre-processing	CO1
3	Perform the analysis of various dataset and plot histogram on it.	CO2
4	Study and implement various clustering models on data sets	CO3
5	Study and Implement Polynomial Regression with Python Implementation	CO3
6	To Implement Stock market prediction using python	CO3
7	Introduction of Num Pie.	CO4
8	Introduction of Panda	CO4
9	Case Study-1	CO4
10	Mini Project/ Case study	CO5

Text Books

T.1	CathyO 'Neiland Rachel Schutt," Doing Data Science", O'Reilly,2015
T.2	Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGIGlobal

Reference Books

R.1	Jojo Moolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT,2016.
R.2	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

BOS Chairman