4th Year 8th Semester

National Institute of Technology Raipur												
Course of Study and Scheme of Examination							B. Tech. 8th Semester					Branch:
S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1		Program Elective	3	0	0	20	30		50		100	3
2		Program Elective	3	0	0	20	30		50		100	3
3		Open Elective	3	0	0	20	30		50		100	3
4		Open Elective	3	0	0	20	30		50		100	3
												12

Scheme (Final year for students undergoing Major Internship)

S. No.	Subject Code	Subject Name	Periods per Week			TA	Examination Scheme				Total Marks	Credits
							MSE/MTR		ESE/ESVE			
			L	T	P		Theory	Prac.	Theory	Prac.		
1		Open Elective	3	0	0	20	30		50		100	3
2		Open Elective	3	0	0	20	30		50		100	3
3	EC108701EC	Major Internship	-	-	-	40		20		40	100	6
												12

Program Electives		
Subject Code	Name of Subject	
EC108201EC	Speech & Video Processing	
EC108202EC	Semiconductor Device Modelling	
EC108203EC	Analog IC Design and Simulation	
EC108204EC	Cognitive Radio	
EC108205EC	Advanced Antenna Design	

Open Electives		
Subject Code	Name of Subject	
EC108301EC	Internet of Things	
EC108302EC	Cryptography & Network Security	
EC108303EC	Introduction to Deep Learning	
EC108304EC	VLSI Signal Processing	
EC108305EC	Micro Electromechanical Systems	

Speech and Video Processing

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108201EC

[Pre-requisites: EC104102EC-Digital Signal Processing, EC105301EC-Digital Image Processing]

Course Objectives

1. To understand the basic concept of speech signal processing and modeling as well as its digital representation.
2. To perform the analysis of speech signal in time domain
3. To perform the analysis of speech signal in frequency domain
4. To understand the importance of LPC as a tool for speech coding and analysis, and also understand the basic concepts of speech recognition and its difficulties.

Course Content

Unit I

Introduction to speech processing - its necessity. Digital models for speech signals: process of speech production, acoustic theory of speech production, and models of speech production, auditory knowledge. Digital representation of speech waveform.

Unit II

Time domain methods in speech processing, Analysis and Synthesis of Pole-Zero Speech Models.

Unit III

History of Video Coding, Video Basics: Analogue Video, Digital Video, Image Format, Picture Quality Assessment, Principles of Video Compression: Spatial redundancy reduction, Quantization of DCT Coefficients, Temporal redundancy reduction, Variable length coding, A generic inter frame video codec, Constant and Variable Bit Rates

Unit IV

Video compression standards: H.261, H.263, MPEG 1, MPEG 2, MPEG-4 and MPEG-7.

Course Materials

Required Text: Text books

1. Speech and Audio Processing, S.D Apte, Wiley India Edition , 2015
2. Standard Codecs: Image Compression to Advanced Video Coding, Mohammed Ghanbari, Institution of Engineering and Technology, 2003.

Optional Materials: Reference Books

1. Speech and Audio signal processing: processing and perception of speech and music, Gold Ben, Nelson Morgan, and Dan Ellis, John Wiley & Sons, 2011
2. Multimedia Communications, Fred Halsall, Pearson education, 2001.

Semiconductor Device Modelling

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108202EC

[Pre-requisites: EC103102EC- Microelectronic Devices and Circuits, PH10I005PH- Physics I, PH10I006PH- Physics II]

Course Objectives

1. To understand the basics of semiconductor device physics.
2. To mathematically analyze PN junctions, MOSFETs and MESFETs.
3. To describe various semiconductor device models and parameters.

Course Content

UNIT I

Basic Semiconductor Physics: Crystal lattice, energy band model, density of states, distribution statistics– Maxwell-Boltzmann and Fermi-Dirac, doping, carrier transport mechanisms, - drift, diffusion, thermionic emission, and tunneling; excess carriers, carrier lifetime, recombination mechanisms– SHR, Auger, radiative.

UNIT II

Junctions p-n junctions: fabrication, basic operation – forward and reverse bias, DC model, charge control model, I-V characteristic, steady state and transient conditions, capacitance model, reverse-bias breakdown, metal-semiconductor junctions' fabrication, Schottky barriers, rectifying and ohmic contacts, I-V characteristics.

UNIT III

MOS Capacitors and MOSFETs: The MOS capacitor-fabrication, surface charge-accumulation, depletion, inversion, threshold voltage, C-V characteristics – low and high frequency; the MOSFET – fabrication, operation, gradual channel approximation, simple charge control model (SCCM), PaoSah and Schichman – Hodges models, I-V characteristic, second order effects – Velocity saturation, short-channel effects, charge 2 sharing model, hot-carrier effects, gate tunneling; subthreshold operation – drain induced barrier lowering (DIBL) effect.

UNIT IV

MESFETs: MESFETs fabrication, basic operation, Shockley and velocity saturation models, I-V characteristics, high-frequency response, back-gating effect, HEMTs– fabrication, modulation (delta) doping, analysis of III-V heterojunctions, charge control, I-V characteristics.

Course Materials

Required Text: Text books

1. Solid State Electronic Devices, B. Streetman, and S. Banerjee, PHI, 2006.
2. Semiconductor Physics and Devices, Donald A. Neamen, MHE ,2003.

Optional Materials: Reference Books

1. Introduction to Semiconductor Device Modelling, C. M. Snowden, Singapore: World Scientific Publishing Company Pvt Limited, 1998.
2. Semiconductor devices: modelling and technology, N. Das Gupta, A Das Gupta. India: PHI Learning, 2004.

Analog IC Design and Simulation

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108203EC

[Pre-requisites: EC103102EC-Microelectronic Devices and Circuits, EC104104EC-Linear Integrated Circuits and Applications]

Course Objectives

1. To learn Spice Modeling for ckt.
2. To study the basics of analog IC designing.
3. To understand the Frequency response, stability and noise issues in amplifiers.

Course Content

UNIT I:

Introduction to SPICE Simulation, Analysis of complex electronic circuits, simulation and analysis using SPICE, AC/DC operation, DC sweep transfer function, frequency response, feedback control analysis, transient response, device models, simulation and analysis of electronic circuits and systems.

UNIT II

Basic Analog Building Blocks, Switches, Active Resistors, Current and Voltage sources, Current and voltage references, Voltage regulators.

UNIT III

Amplifiers: Basic Amplifiers: CS, CG and source follower, Cascode Amplifiers, High Gain Amplifier Structure.

UNIT IV

Differential Amplifier, Current Mirrors, Operational Amplifiers: Operational Amplifier characteristics, Frequency response, stability and noise issues in amplifiers.

Required Text: Text books

1. CMOS: circuit design, layout, and simulation, R. J. Baker, Wiley, 2008
2. Design of Analog CMOS Integrated Circuits, B Razavi, Tata McGraw-Hill.

Optional Materials: Reference Books

1. Analysis and design of analog integrated circuits, Meyer, Paul R Gray, Hurst, Lewis, Wiley, 2009.
2. CMOS Analog Circuit Design, P. E Allen., D. R Holberg, Oxford University Press, 2012.
3. Introduction to Device Modeling and Circuit Simulation, T. A Fjeldly, T Ytterdal., M. S. Shur, Wiley, 1998.

Cognitive Radio

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108204EC

[Pre-requisites: EC106101EC-Wireless communication, EC106203- Computer Communication Network]

Course Objectives

1. To understand different paradigms of operation of cognitive radio.
2. To analyze and compare different spectrum sensing techniques.
3. To understand different spectrum handoff strategies and analyze their merits.
4. To understand and analyze routing techniques in cognitive radio networks.

Course Content

UNIT- I

Spectrum Sensing: Paradigms of Cognitive Radio, Interweave, Underlay, Overlay, Spectrum Sensing, Matched Filtering (Coherent Detector), Energy Detector, Feature Detection, Comparison, Design Trade-Off and Challenges, Multiband Spectrum Sensing, Cooperative Spectrum Sensing.

UNIT- II

Spectrum Handoff: Spectrum Mobility, Relationship with other Spectrum Management Functions, Spectrum Handoff Strategies, Non-handoff Strategy, Reactive Handoff Strategy, Proactive Handoff Strategy, Hybrid Handoff Strategy, Design Requirements for Spectrum Mobility Management.

UNIT- III

MAC Protocols in Cognitive Radio Networks: Functionality of MAC Protocol in Spectrum Access, Difference between Traditional MAC and CR MAC, Centralized versus Distributed Architectures, Concept of Common Control Channel in CR MAC, Classification of MAC protocols.

UNIT- IV

Routing in Multihop Cognitive Radio Networks: Routing Problems in Cognitive Radio Networks, Classification of Cognitive Radio Networks, Centralized and Basic Distributed Protocols, Distributed Protocols, Control Information, Source- or Destination-Based Routing, Geographical Protocol for Dynamic Networks, Initial Route Setup, Greedy Forwarding, PU Avoidance, Joint Channel-Path Optimization, Opportunistic Cognitive Radio Multihop Protocol.

Course Materials

Required Text: Text books

1. Cooperative Cognitive Radio Networks: The Complete Spectrum Cycle, Mohamed Ibnkahla, CRC Press, 2015.
2. Cognitive Radio Networks, Kwang– Cheng Chen and Ramjee Prasad, Wiley.

Optional Materials: Reference Books

1. Fundamentals of Cognitive Radio, Peyman Setoodeh, Simon Haykin, Wiley, 2017.
2. Cognitive Radio Networks: From Theory to practice, Ahamed Khattab, Dmitri Perkins, Bagdy Byoumi, Springer, 2013.

Advanced Antenna Design

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108205EC

[Pre-requisites: EC104101EC- Electromagnetic field theory, EC106102EC-Microwave Engineering]

Course Objectives

1. To understand the principle of working of different types of antennas
2. To understand the practical applications of different types of antennas

Course Content

UNIT-I

Fundamental Parameters of Antennas: Radiation pattern, isotropic, directional and omnidirectional patterns, filed regions, radiation power density, radiation intensity, beamwidth, directivity, directional pattern, antennaefficiency, gain, beam efficiency, co- and cross-polarization.

Unit- II

Linear Wire Antennas: Introduction, Infinitesimal Dipole, Small Dipole, Finite length dipole, Half-wavelength dipole, Region separation.

Unit- III

Microstrip Antenna Design: Introduction, Rectangular patch, Circular Patch, Quality factor, bandwidth and efficiency, input impedance, coupling, array and feed networks.

Unit- IV

Antenna Array: Linear array; Broadside and end fire arrays, Planar array- Array factor, beamwidth, directivity, example of microstrip patch arrays and feed networks, electronic scanning.

Course Materials

Required Text: Text books

1. Antenna Theory and Design, C. A. Balanis, John Wiley & Sons, 1997.
2. Antennas, J. D. Kraus, McGraw-Hill, 1988.

Optional Materials: Reference Books

1. Microstrip Antenna design Handbook, R. Garg, P. Bharhia, I. Bahl, and A. Ittipiboo, Artech House.
2. Antennas and Wave Propagation, A.R Harish, M Sachidananda, Oxford University Press.

Internet of Things

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108301EC

[Pre-requisites: EC104105EC- Analog Communication, EC105101EC- Digital Communication, EC105102EC-Microprocessors and Microcontrollers, EC106203EC- Computer Communication and Networking]

Course Objectives

1. To understand the vision of IoT from a global context.
2. To understand the application of IoT.
3. To use Devices, Gateways and Data Management in IoT.
4. To Build state of the art architecture in IoT application Case study

Course Content

UNIT-I

Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models & APIs

Unit- II

M2M to IoT : A Basic Perspective–Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.
M2M to IoT: An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations

Unit- III

IoT Reference Architecture-
Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world- Introduction, Technical design Constraints. Functional View, Information View, Deployment and Operational View, Other Relevant architectural views of IOT.

Unit- IV

IoT Applications for Value Creations: Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Course Materials

Required Text: Text books

1.IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry; 1st Edition, Pearson India Pvt. Ltd, , 2018.
2. Internet of Things: A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, 1st Edition, Universities Press (India) Pvt. Ltd, 2015
3.From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle 1st Edition, Academic Press, 2014

Optional Materials: Reference Books

1. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, John Wiley and Sons, Ltd., 2014.
2. Learning Internet of Things, Peter Waher, Packt Publishing, 2015.

Cryptography and Network Security

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108302EC

[Pre-requisites: NA]

Course Objectives

1. To understand the concepts of various Encryption, Authentication and Digital Signature Algorithms.
2. To learn about network and system level security.

Course Content

UNIT I

INTRODUCTION: OSI Security Architecture, Classical Encryption techniques, Cipher Principles, Data Encryption Standard – Block Cipher Design Principles and Modes of Operation - Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality, Lightweight Cryptography.

UNIT II

PUBLIC KEY CRYPTOGRAPHY : Key Management - Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography - Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA, PKI.

UNIT III

AUTHENTICATION AND HASH FUNCTION: Authentication requirements – Authentication functions Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures, Authentication Protocols – Digital Signature Standard.

UNIT IV

NETWORK AND SYSTEM LEVEL SECURITY: Authentication Applications: Kerberos – X.509, Authentication Service, Electronic Mail Security – PGP – S/MIME - IP Security – Web Security, Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems, Hardware trojan.

Course Materials

Required Text: Text books

1. Cryptography And Network Security – Principles and Practices, William Stallings, Prentice Hall of India, Third Edition, 2003.

Optional Materials: Reference Books

1. Network Security Private Communication in a public world, Charlie Kaufman, Radia Perlman & Mike Speciner, Prentice Hall of India Private Ltd., New Delhi.
2. Cryptography and Network Security, Atul Kahate, Tata McGraw-Hill, 2003.
3. Applied Cryptography, Bruce Schneier, John Wiley & Sons Inc, 2001.
4. The Hardware Trojan War: Attacks, Myths, and Defenses, Mark M. Tehranipoor, Springer International Publishing, 2017.
5. Networked RFID Systems and Light weight Cryptography Raising Barriers to Product Counterfeiting, Damith C. Ranasinghe, Peter H. Cole, Springer Berlin Heidelberg, 2008.

Introduction to Deep Learning

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108303EC

[Pre-requisites: NA]

Course Objectives

1. To identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
2. To understand the concepts of feed forward networks, convolutional networks, recurrent neural networks etc.
3. To understand various optimization algorithms such as gradient descent, adam, adagrad, RMSprop etc.
4. To implement deep learning algorithms and solve real-world problems.

Course Content

UNIT-I

Deep Feedforward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms.

Unit- II

Regularization for Deep Learning: Parameter Norm Penalties, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Early Stopping, Parameter Tying and Parameter Sharing, Dropout Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.

Unit- III

Convolutional Networks: The Convolution Operation, Pooling, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Convolutional Networks, and the History of Deep Learning: LeNet, AlexNet, VGGNet.

Unit- IV

Sequence Modeling: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Deep Recurrent Networks, The Challenge of Long-Term Dependencies, The Long Short-Term Memory and Other Gated RNNs.

Course Materials

Required Text: Text books

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016.

Optional Materials: Reference Books

1. Neural Networks: A Systematic Introduction, Raul Rojas, 1996
2. Pattern Recognition and Machine Learning, C.M. Bishop, Springer, 2006.

VLSI Signal Processing

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108304EC

[Pre-requisites: EC106103EC-VLSI Design, EC104102EC-Digital Signal Processing]

Course Objectives

1. To provide sound foundation of digital signal processing (DSP) architectures and designing efficient VLSI architectures for DSP systems.
2. To make the students to implement DSP algorithm in an optimized method.

Course Content

UNIT I

Transformations for retiming: Folding and unfolding DSP programs. Bit level arithmetic structures- parallel multipliers, interleaved floor plan and bit plan based digital filters. Bit serial multipliers. Bit serial filter design and implementation, Canonic signed digit arithmetic, Distributed arithmetic.

UNIT II

Redundant arithmetic: redundant number representations, carry free radix 2 addition and subtraction, Hybrid radix 4 addition. Radix 2 hybrid redundant multiplication architectures, data format conversion. Redundant to nonredundant converter. Numerical strength reduction.

UNIT III

Synchronous pipelining: clocking styles, clock skew and clock distribution in bit level pipelined VLSI designs. Wave pipelining, constraint space diagram and degree of wave pipelining. Implementation of wave-pipelined systems. Asynchronous pipelining.

UNIT IV

Scaling versus power consumption: Power analysis, power reduction techniques, power estimation techniques. Low power IIR filter design. Low power CMOS lattice IIR filter.

Course Materials

Required Text: Text books

1. VLSI Digital Signal Processing Systems: Design and Implementation, K K Parhi, John Wiely, 2007
2. Digital Signal Processing, J. Proakis, PHI, Second edition.

Optional Materials: Reference Books

1. DSP Integrated Circuits, Lars Wanhammar, Academic Press, First edition, 1999
2. VLSI Design Methodologies for Digital Signal Processing Architectures. United States: Springer, 2012.

Micro Electromechanical Systems

[8th Semester, Fourth Year]

Course Description

Offered by Department	Credits	Status	Code
Electronics & Communication Engineering	3-0-0, (3)	ELECTIVE	EC108305EC

[Pre-requisites: NA]

Course Objectives

1. To have a concept on the scope and recent development of the science and technology of microsystems;
2. To gain the physical knowledge underlying the operation principles and design of microsystems;
3. To learn some typical or potentially applicable microsystems at the frontier of the development of the field

Course Content

UNIT I

Historical Background: Silicon Pressure sensors, Micromachining, Micro Electromechanical Systems Micro-fabrication and Micromachining: Integrated Circuit Processes, Bulk Micromachining.

UNIT II

Isotropic Etching and Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes (LIGA) Physical Microsensors. Classification of physical sensors, Integrated, Intelligent, or Smart sensors, Sensor Principles and Examples: Thermal sensors, Electrical Sensors, Mechanical Sensors, Chemical and Biosensors.

UNIT III

Electromagnetic and Thermal micro actuation, Mechanical design of micro actuators, Micro actuator examples: microvalves, micropumps, micromotors. Micro actuator systems: Success Stories, Ink-Jet printer heads, Micro-mirror TV Projector Surface Micromachining.

UNIT IV

One or two sacrificial layer processes, Surface micromachining requirements, Polysilicon surface micromachining, Other compatible materials, Silicon Dioxide, Silicon Nitride, Piezoelectric materials, Surface Micromachined Systems: Success Stories, Micromotors, Gear trains, Mechanisms.

Course Materials

Required Text: Text books

1. MEMS, Nitaigour, Premchand, Mahalik, Tata McGraw-Hill Education, 2007.
2. RF MEMS and their Applications, Varadan, Vinoy, Jose, Wiley, 2003.

Optional Materials: Reference Books

1. Smart Material Systems and MEMS: Design and Development Methodologies, Varadan, Vinoy, Gopalakrishnan, Wiley, 2006.
2. VLSI Technology, Sze, 2/E. India: McGraw-Hill Education (India) Pvt Limited, (2003).