JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY
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Criteria	2 Teaching-learning and Evaluation
Key Indicator	2.6 Student Performance and Learning Outcomes
Metric	2.6.1 The institution has stated learning outcomes (generic and programme specific) / graduate attributes which are integrated into assessment process and widely publicized through the website and other documents

COs of All Courses – Department of Electronics & Communication Engineering

(BTech- ECE)

Semester: I

SNo	Course Codes	Course Name	Course Outcomes
1.	21B11HS111	English	From HSS Department
2.	21B17HS171	English Lab	From HSS Department
3.	18B11MA111	Engineering Mathematics-I	CO-1 - Evaluate partial derivatives with its physical significance and expand functions of several variables. CO-2 - Find maxima and minima of functions of several variables with / without constraints. CO-3 - Find areas and volumes of solids using multiple integration. CO-4 - Understand the calculus of vectors and vector valued functions with their physical significance. CO-5 - Use Laplace transforms and inverse Laplace transforms to solve IVP CO-6 - Solve linear systems of equations and perform diagonalization of matrices
4.	18B11PH111	Engineering Physics-I	CO-1 - To learn the fundamental of physical optics CO-2 - To implement the concepts and theory for solving the application related problems of physical optics. CO-3 - To learn the basic and mathematical methods for relativity and related fields. CO-4 - To learn the basic concepts of modern , laser and thermal physics CO-5 - To implement the concept of modern and thermal physics ; analyzing and solving the related problems
5.	18B17PH171	Engineering Physics Lab-I	From PMS Department
6.	19B11CI111	Programming for Problem Solving-II	CO-1 - To formulate simple algorithms for arithmetic and logical problems. CO-2- To translate the algorithms to programs (in C language). CO-3 - To test and execute the programs and correct syntax and logical errors. CO-4 - To implement conditional branching, iteration and recursion. CO-5 - To decompose a problem into functions and synthesize a complete program using divide and conquer approach. CO-6 - To use arrays, pointers and structures to formulate algorithms and programs. CO-7 - To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. CO-7 - To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
7.	18B17GE173	Engineering Graphics	CO-1 - To impart and inculcate proper understanding

		OR	of the theory of projection. CO-2 - To improve the visualization skills CO-3 - To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient CO-4 - To impart the knowledge on understanding and drawing of simple residential/office buildings.
	18B17GE171	Workshop Practices	CO-1 - Study of various carpentry processes and its applications in carpentry CO-2 - Study and practice the use of various carpentry tools for different carpentry processes CO-3 -Study and manufacturing of different wood working joints CO-4 - Study the principles, classification and application of different welding processes CO-5 - Study and Manufacturing of various welding joints using electric arc welding and gas welding
8.	19B17CI171	Programming for Problem Solving Lab-II	CO-1 - Understand the Typical C Program Development Environment, compiling, debugging, Linking and executing. CO-2 - Introduction to C Programming using Control Statements and Repetition Statement CO-3 - Apply and practice logical formulations to solve some simple problems leading to specific applications. CO-4 - Design effectively the required programming components that efficiently solve computing problems in real world.
9.	18B17GE172	Mandatory Induction Program	From other Dept.

Semester: II

SNo	Course Codes	Course Name	Course Outcomes
1.	18B11MA211	Engineering Mathematics-II	CO-1 - Solve problems related to convergence of series CO-2 - Understand basics of Ordinary Differential equation CO-3 - Comprehend series solution with certain special functions e.g. Bessel, Legendre Eqn. CO-4 - understand partial differential Eqn and Solve Heat, wave & Laplace equation CO-5 - Understand Functions of a complex variable, Analytic functions, Mobius Transformation CO-6 - Solve Contour integration and find Taylor's and Laurent's series CO-7 - Evaluate certain real defnite and improper integrals.
2.	18B11PH211	Engineering Physics-II	CO-1 - To learn the fundamentals of vector calculus

			and its applications in electrostatics CO-2 - Knowledge of, physical interpretation, and ability to apply Maxwell's equations to determine field waves, potential waves, energy ,charge conservation conditions and other diverse engineering problems. CO-3 - Able to distinguish Step Index, Graded index fibers and compute mode volume and Implementation of numerical methods for calculating the design parameters of optical fiber. CO-4 - To understand the basics of statistical distributions and use Maxwell Boltzmann distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems CO-5 - To analyze atomic structure, Crystal structure, Crystal axes and planes, X-ray diffraction data and effect of energy bands on electronic behavior of solids. CO-6 - To understand the concepts of modern solid state physics ,various properties of semiconductors and apply Hall effect to calculate allied parameters of semiconductors
3.	18B11PH271	Engineering Physics Lab-II	CO-1 - To Understand different aspects of magnetism and semi conductive properties of materials and their use in design of various devices. CO-2 - To helps the students to understand the concepts of light propagation in optical fiber and introduce them to various losses in optical fiber communication. CO-3 - To demonstrate the scientific results based on observation. CO-4 - Scientific discussion for clear and concise conclusion on particular scientific results. CO-5 - To develop collaborative learning skills
4.	18B11EC211	Electrical Science	CO1 - Understand the basic parameters related to DC and AC circuit. CO2 - Understanding electrical principle, laws, and working of electrical machines. CO3 - Understanding different theorems to analyze DC and AC circuits. CO4 - Understanding sinusoidal steady state analysis of various AC circuits. CO5 - Demonstrate knowledge of and apply the theory of transformers and induction motors.
5.	18B17EC271	Electrical Science Lab	CO1 - Understanding basic electrical sources and measuring devices: Power supply, Multimeter, CRO/DSO and Function Generator. CO2 - Understand the basic working principle of a transformer and the operation of electrical machines. CO3 - Practical implementation of the fundamental electrical theorems and modeling of simple electrical systems.

			CO4 - Accurate measurement of voltage, current, power and impedance of any circuit. CO5 - DC analysis, Transient analysis and Frequency analysis of a given circuit depending on types of elements. CO6 -Teamwork skills for working effectively in groups and develop analytical skills to compare experimental results with theoretical concepts.
6.	18B17GE171	Workshop Practices OR	CO-1 - Study of various carpentry processes and its applications in carpentry CO-2 - Study and practice the use of various carpentry tools for different carpentry processes CO-3 -Study and manufacturing of different wood working joints CO-4 - Study the principles, classification and application of different welding processes CO-5 - Study and Manufacturing of various welding joints using electric arc welding and gas welding
	18B17GE173	Engineering Graphics	CO-1 - To impart and inculcate proper understanding of the theory of projection. CO-2 - To improve the visualization skills CO-3 - To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient CO-4 - To impart the knowledge on understanding and drawing of simple residential/office buildings.
7.	18B17CI211	Data Structures and Algorithms	CO-1 - To gain knowledge on the notions of data structure, Abstract Data Type. CO-2 - For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness. CO-3 - For a given Search problem (Linear Search and Binary Search) student will able to implement it. CO-4 For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity. CO-5 - Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity. CO-6 - Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
8.	18B17CI271	Data Structures and Algorithms Lab	CO-1- To gain knowledge on the notions of data structure, Abstract Data Type CO-2 - To have hands on skills to evaluate different kinds of linked lists and their applications in day to day problem solving. CO-3 - To have hands on skills to evaluate different kinds stacks and their applications and

			implementations in day to day problem solving CO-4 - To have hands on skills to evaluate different kinds queues and their applications and implementations in simulations. CO-5 - To acquire knowledge of various sorting algorithms CO-6 - To learn Searching: Balanced tree, red-black tree, lower bounds for searching CO-7 - To learn to code for operations on Tree or BST (Creation; Traversing like preorder,post-order and in-order; Searching element; finding height etc.) CO-8 - Introduction to Heaps CO-9 - To learn to code for operations on Graphs (Creation; entering info, printing output and deleting; traversal of BFS and DFS algorithm)
9.	21B11HS211	Life Skills & Effective Communication	From HSS Department
10.	21B17HS271	Life Skills & Effective Communication	From HSS Department

Semester: III

SNo	Course Codes	Course Name	Course Outcomes
1.	21B11HS312	Interpersonal Dynamics, Values and Ethics	From HSS Department
2.	18B11MA314	Probability Theory and Random Processes	From Mathematics Department
3.	18B11EC313	Electronic Devices & Circuits	CO-1- Understand the construction and working of a diode and its application as an electronic switch. Its use in clipper and clamper circuits as a wave shaping electronic component. CO-2- Understand the construction and working of a BJT and the different biasing networks used to stabilize the operating point for it to work in the active region or saturation and cut off region. CO-3 - Small signal analysis of BJT using the transistor and hybrid equivalent models. Estimation of various parameters (gain, input/output impedance) of CE and CB configurations. CO-4 - Understand the construction and working of a JFET, Depletion type and enhancement type MOSFET. Applications of JFET, and CMOS in design of logic gates. CO-5- Understanding the various biasing schemes for FET amplifiers, and FET small signal analysis using Ac equivalent model. CO-6- Understanding the Low-frequency response of BJT amplifier, Low- frequency response of FET amplifier, High frequency transistor models,

			frequency response of single stage and multistage amplifiers.
4.	18B17EC373	Electronic Devices & Circuits Lab	CO-1- Understand the V-I characteristics of diodes and its application as a switch and in wave shaping circuits. CO-2- Design of voltage regulator circuits using zener diode and half wave / full wave rectifiers using PN junction diodes. CO-3 - Understand the V-I characteristics of BJTs and its use in design of voltage and current amplifiers CO-4- Understand the Drain and transfer characteristics of FETs and its use in design of logic gates. CO-5 -Design of single stage RC coupled amplifiers using BJTs and verifying the AC equivalent model for them. CO-6 - Study the frequency response of BJTs and FETs
5.	18B11EC412	Fundamentals of Signals & Systems	CO-1 - Classify signals and systems based on their properties and determine the mathematical representations of signals and systems. CO-2 - Explain the role of convolution in the analysis of LTI systems and also able to formulate and solve differential /difference equations describing LTI systems. CO-3 - Analyze the spectral characteristics of signals using Fourier analysis and analyze system properties based on impulse response and Fourier analysis. CO-4 - Apply the Laplace transform and Z- transform for analysis of continuous-time and discrete-time signals and systems. CO-5 - Understand the process of sampling and the effects of under sampling.
6.	18B17EC472	Fundamentals of Signals & Systems Lab	CO-1 - Understand basics of MATLAB syntax, functions and programming. CO-2 - Generate and characterize various continuous and discrete time signals. CO-3 - Perform the basic operations on the signals. CO-4 - Design and analyze linear time-invariant (LTI) systems and compute its response. CO-5 - Analyze the spectral characteristics of signals using Fourier analysis. CO-6 - Analyze the systems using Laplace transform and Z-transform.
7.	18B11EC312	Digital Electronics & Logic Design	CO-1 - Have a thorough understanding of the fundamental concepts and techniques used in digital electronics. CO-2 - To understand and examine the structure of various number systems and its application in digital design. CO-3 - The ability to understand, analyze and design various combinational and sequential circuits.

			CO-4 - Ability to identify basic requirements for a design application and propose a cost effective solution. CO-5 - The ability to identify and prevent various hazards and timing problems in a digital design. CO-6 - To develop skill to build, and troubleshoot digital circuits.
8.	18B17EC372	Digital Electronics & Logic Design Lab	CO-1 - To acquire knowledge about electronic components and hardware devices required for designing digital electronics circuits. CO-2 - Foster ability to identify, analyze and design combinational circuits. CO-3 - Foster ability to design various synchronous and asynchronous sequential circuits. CO-4 - To acquire knowledge about internal circuitry and logic behind any digital system. CO-5 - To develop skill to build, and troubleshoot digital circuits.
9.	21B11HS311	Professional Communication Practice	From HSS Department

Semester: IV

SNo	Course Codes	Course Name	Course Outcomes
1.	18B11HS411	Finance and Accounts	From HSS Department
2.	18B11MA413	Discrete Mathematics	From Mathematics Department
3.	18B17EC474	Python Lab	CO-1- To understand the python program development environment, debugging, and executing. CO-2 - To understand the usage of control statements in python program. CO-3 - To practice programming in python for solving some simple problems leading to specific applications. CO-4 - Able to design a project on python.
4.	18B11EC411	Analog Integrated Circuits	CO-1 - Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques. CO-2 - Elucidate and design the linear and non-linear applications of an opamp and special application ICs. CO-3 - Explain and compare the working of multivibrators using special application IC 555 and general purpose opamp CO-4 - Develop skills to design simple filter circuits and various amplifiers and can solve problems related to it. CO-5 - Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.
5.	18B17EC471	Analog Integrated Circuits Lab	CO-1- Understand basics of different electronics circuits using op amps.

			CO-2 - Learn how to generate different frequencies using various oscillators. CO-3 - Design different types of filters. CO-4 - Design Schmitt Trigger using op amp. CO-5 - Learn the generation of different waveforms using op amp. CO-6 - Study the working of op amp as multivibrator.
6.	18B11EC311	Automatic Control Systems	CO-1- The ability to analyze any physical system using mathematical model. CO-2- The skill to analyze the response of any LTI system. CO-3 -The ability to design control system with desired specifications both in time and frequency domain. CO-4- The ability to derive, interpret and solve problems using modern state space control methods for continuous time and discrete time systems. CO-5- The skill to apply advance control schemes for various applications.
7.	18B17EC371	Automatic Control Systems Lab	CO-1- Understanding of mathematical modeling of electrical-mechanical systems and knowing their behavior. CO-2- The skill to analyze the response of any LTI system using software tools. CO-3 - The ability to design any system with desired specifications both in time and frequency domain and analyze systems using different techniques. CO-4- Design of different types of controller and tuning their parameters to get optimized results.
8.	18B11EC413	Modern Analog and Digital Communication	CO-1 - To familiarize students with the fundamentals of analog and digital communication systems. CO-2 - To familiarize students with basic techniques used for modulation and demodulation of signal. CO-3 - Understanding of various approaches to convert analog signal to digital signal. CO-4 - Analyze mathematical background for communication signal analysis. CO-5 - To analyze performance of a communication system.
9.	18B17EC473	Modern Analog and Digital Communication Lab	CO-1 - Understand basic elements of a communication system. CO-2 - Able to design analog modulation circuits as amplitude and frequency modulation. CO-3 -Design various line coding techniques. CO-4 -Design the circuit to convert analog signals to digital signals. CO-5 - Design different digital modulation circuits.
10.		Environmental Studies	From Other Department

Semester: V

SNo	Course Codes	Course Name	Course Outcomes
1.	18B11HS511	Project Management and Entrepreneurship	From HSS Department
2.	18B11EC511	Principles of Digital Signal Processing	CO-1- To interpret, represent and process discrete/digital signals and systems. CO-2 - To acquire thorough understanding of frequency domain analysis of discrete time signals. CO-3 - To acquire the ability to design & analyze DSP systems like FIR and IIR Filter etc. CO-4 - To deal with practical implementation issues such as computational complexity, hardware resource limitations as well as cost of DSP systems or DSP Processors. CO-5 - To apply important algorithmic design paradigms and method of analysis.
3.	18B17EC571	Principles of Digital Signal Processing Lab	CO-1 - Understand the basics of Lab VIEW Programming and code compressor studio. CO-2 - Generate the discrete time signals using sampling and conversion of analog signals in to digital signals. CO-3 - Analyze the FFT Algorithm based frequency domain representation. CO-4 - Design the FIR and IIR filter for specified parameters. CO-5 - Apply the adaptive filtering for systems identification. CO-6 - Perform the linear and circular convolution using DSP kit to get the LTI system response.
4.	18B11EC512	Microprocessor and Interfacing	CO-1 - Understand Standard Architecture of Intel Microprocessors. CO-2 - Learn the instruction set of Intel 80x86 processors and to gain proficiency in assembly language programming. CO-3 - Know the concepts associated with interfacing a microprocessor to memory and to I/O devices and to learn the programming of peripheral I/O devices. CO-4 - Learn the control components of a microprocessor based system though the use of interrupts. CO-5 - Acquaint with the background knowledge for understanding next-generation CPUs
5.	18B17EC572	Microprocessor and Interfacing Lab	CO-1- Gain proficiency with using assembly language to develop microprocessor based applications. CO-2 - Learn control components of a microprocessor based system though the use of interrupts. CO-3 - Gain practical experience in programming memory and peripheral devices like timers/counters, parallel peripheral devices, serial communication interfaces and I/O devices.

			CO-4 - Gain practical experience in programming with coprocessor and DMA controller. CO-5 - Develop a microprocessor based system, using assembly language programming concepts, for handling a real life task
6.	18B11EC513	Electromagnetic Waves	CO-1 -To apply vector calculus to static electric-magnetic fields in different engineering situations. CO-2 -To analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems. CO-3 - To examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering. CO-4 - To analyze the nature of electromagnetic wave propagation in guided medium which are used in microwave applications. CO-5 - To analyze the wave propagation on two wire transmission lines and to study the applications of transmission lines in real time applications.
7.		Science Elective	From Other Department
8.	**Professional Elective-I**		
	18B1WEC534	Network Analysis and Synthesis	CO-1- Understand the need and foundation of network analysis. CO-2- Analyze two port networks, filters and attenuators CO-3 -Analysis of problem solving, knowledge and reasoning CO-4 -Study of application domains for network analysis and synthesis.
	18B1WEC535	Communication Engineering	CO-1- Students will be familiar with the various fields/trends of communications like Satellite communication, Information theory and coding, and spread spectrum technique related to radio and telecommunication. CO-2- To analyze the error performance of digital modulation systems in the presence of noise. CO-3- Design link power budget for satellite communication. CO-4- Design the channel based on given constraint using information theory. CO-5- Apply various codes like linear block codes, convolution codes etc. for channel performance analysis. CO-6- Analyze the performance of spread spectrum systems in jamming environment.
	18B1WEC536	Fundamentals of Digital Image Processing	CO-1- Analyze general terminology of digital image processing. CO-2- Examine various types of images, intensity transformations and spatial filtering. CO-3- Develop Fourier transform for image processing in frequency domain. CO-4- Evaluate the methodologies for image

			segmentation, restoration etc. CO-5- Implement image process and analysis algorithms. CO-6- Apply image processing algorithms in practical applications.
	20B1WEC534	AVR Based Embedded System Design	CO-1- Students will be equipped with the automation and brief history of robots and their applications. CO-2- Students will be able to learn basic principles of robotic technology, configurations, control and programming of robots. CO-3- Students will be equipped with the principles of various sensors, actuators and their applications in robots. CO-4 -Students will be able to understand the concept of dynamics and control for a typical pick and place robot.
	20B1WEC571	AVR Based Embedded System Design Lab	CO-1- Identify different components of embedded systems and robotics using Firebird-V robotic research platform. CO-2- To develop embedded C/C++ programs in different embedded systems programming platforms and gain practical exposure to interface various IO devices with Firebird-V robot. CO-3- To acquire hands-on learning and experience through appropriate Sensors and Machine vision system for a real-time operation. CO-4- Develop an AVR microcontroller based robotic system, using embedded C language programming concepts for handling a real life task.

Semester: VI

SNo	Course Codes	Course Name	Course Outcomes
1.	18B11EC611	Wireless and Data Communication	CO-1- Understand the basics of wireless communication system and various wireless standards. CO-2 - Have the basic knowledge of computer networks and its applications in communication engineering. CO-3 - Understand the behavior of wireless channel. CO-4 - Have the knowledge of data sharing and their protocols. CO-5 - Brief the recent protocols and standards of various communication networks. CO-6 - Get familiar with the recent wireless communication systems.
2.	18B11EC612	VLSI Technology	CO-1- Understand the static and dynamic behavior of MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) and the secondary effects of the MOS transistor model. CO-2 - To be aware about the trends in semiconductor

			technology, and how it impacts scaling and its effect on device density, speed and power consumption.CO-3 - To understand MOS transistor as a switch and its capacitance. CO-4 - Student will be able to design digital systems using MOS circuits (Static and Switching characteristics of inverters). CO-5 - Able to learn Layout, Stick diagrams, Fabrication steps. CO-6 - Understand the concept behind ASIC (Application Specific Integrated Circuits) design and the different implementation approaches used in industry.
3.	18B11EC671	**Mini Project**	
4.	18B17EC672	VLSI Technology Lab	CO-1 - Apply the techniques of design, simulation and synthesis of digital circuits to design FPGA based systems or/and ASICs using Xilinx design tools CO-2 - Explain and design the test benches for verification of the given IP core or HDL based design. CO-3 - Able to explain the System Modeling with Tasks and Functions CO-4 - Design digital circuits for implementing a signal processing algorithm using different Verilog modeling styles.
5.	18B17EC673	Advance Communication Lab	CO-1- Understand the basics of LabView, MATLab and WiCOMM-T kit CO-2 - Understand the design, application and practical implementation of various digital modulation techniques. CO-3 - Gain practical experience of the functioning of advance communication systems. CO-4 - Analyze the performance of communication systems.
6.		Open Elective-I/MOOCs (HSS Elective)	From HSS Departments
7.	**Professional Elective-II**		
	18B1WEC631	Digital Filter Design and Applications	CO-1- Understand the basics of the digital Filters. CO-2- Design and analysis of the FIR filters. CO-3- Design and analysis of the IIR filters. CO-4- Understand the limitation of IIR and FIR Filters in implementation. CO-5- Study the applications of digital filters.
	18B1WEC632	Intelligent Control Systems	CO-1- Obtain a basic understanding of artificial intelligence techniques and know how these techniques are applied to engineering problems. CO-2- Select appropriately from a range of techniques when implementing control systems. CO-3 -Know control-theoretic foundations such as stability and robustness in the frame work of intelligent systems and control. CO-4 -Design and develop control system using

			artificial intelligence techniques and exposure to many real world control problems
	18B1WEC633	Optical Communication Systems	CO-1- Understand basics of optical communication systems. CO-2 -The principles that govern optical communication systems. CO-3- Behavior of light as electromagnetic waves in different types of fibers. CO-4- The hardware components required to implement optical communication systems. CO-5 -To efficiently design an optical communication system for practical purpose. CO-6- The practical techniques involved in optical communication systems.
8.	**Professional Elective-III**		
	18B1WEC746	Microwave Theory and Techniques	CO-1- To identify different microwave components and their applications. CO-2 -To study the performance of specialized microwave tubes such as klystrons. CO-3 -To understand the principle of operation of magnetrons, traveling wave tubes and BWOs. CO-4- To understand the working principle of microwave solid state devices and their applications. CO-5 -To design of microwave filters, amplifiers and oscillators. CO-6 -To learn about microwave power, VSWR, impedance and attenuation measurements.
	18B1WEC745	Next Generation Communication Systems	CO-1- Understand the basics of communication system and various standards used in different generation. CO-2 -Understand the modeling of channel used in communication. CO-3 -Analyze the effect of various parameters on the performance of communication system. CO-4- Demonstrate the various techniques for performance improvement of communication system CO-5- Apply advanced techniques to next generation communication system
	18B1WEC744	FPGA based Instrumentation System Design	CO-1 -Explain the concept and basic structures of Field Programmable Gate Array (FPGA), and techniques to implement programmable logic circuits using typical FPGA design flow. CO-2- Implementing basic arithmetic circuits and ASICs for simple DSP functions, such as filters using user defined or vendor provided IP cores. CO-3 -Determining circuit speed, checking timing violations and techniques to fix the timing violations. CO-4- Design issues in cross clock domains communication in high-speed ASIC design. CO-5- Break any given algorithm to sub-modules and implement the same on FPGA using HDLs and various IP cores.

	18B1WEC743	Optimum Array Processing	CO-1- Extrapolate the fundamentals of arrays, signal models in various domains. CO-2 -Apply the principal techniques of smart beam conformation and estimation of the direction multichannel arrival. CO-3 -Design in array processing algorithms that solve specific problems in the field of communications. CO-4- Evaluate the advantages of using multiple antennas for the reception and/or transmission of radio navigation. CO-5 -Analyze the implications at system level of the use of antenna arrays in different applications.
9.	**Professional Elective-IV**		
	18B1WEC742	Antenna and Wave Propagation	CO-1- Comprehend the fundamental theory and concepts of radiation, antenna and significance of antenna parameters. CO-2- Assess the power and usefulness of UHF, VHF and Microwave Antennas, microstrip patch antennas their requirements, specifications, characteristics and design relations. CO-3 -To define and distinguish between different phenomenon of wave propagation (ground wave, space wave and sky wave), their frequency dependence, and estimate their characteristics, identifying their profiles and parameters involved. CO-4- Reveal different applications of the various types of antenna to solve engineering and other problems
	18B1WEC736	OFDM and Applications	CO-1- Learn the fundamentals of OFDM communication system. CO-2- Performance analysis of OFDM signals over AWGN and wideband channels. CO-3- Demonstrate the challenging issues in OFDM system. CO-4- Apply OFDM to the practical communication systems.
	18B1WEC737	Robotic Systems and Control	CO-1- Students will be equipped with the automation and brief history of robot and applications. CO-2 Students will be equipped with the principles of various sensors, actuators and their applications in robots. CO-3- Be able to analyze any physical system using mathematical model. CO-4- Be able to do the path planning on robotic systems using various control strategies. CO-5- Students will be equipped with the simulation and hands on robotic kits.
	18B1WEC738	Time Frequency Analysis and Applications	CO-1 -Understand the concept of the spectral analysis. CO-2 Familiar with the basics concept of the short time Fourier transform/continuous wavelet transform. CO-3 Understand the basic concept of the distribution

			based Time-Frequency Analysis tools. AssessmentCO-4 Develop the TFA based algorithms for various applications.
10.		Industrial Training	

Semester: VII

SNo	Course Codes	Course Name	Course Outcomes
1.	18B19EC791	Project Part-I	CO-1 - Review and evaluate the available literature on the chosen problem. CO-2 - Formulate methodology to solve the identified problem CO-3 - Plan/Design Software/Hardware for the proposed system. CO-4 - Apply the principles,tools and techniques to solve the problem. CO-5 - To act as catalyst in transfering the Electronics & Communication Engineering Knowledge to the benefit of the society. CO-6 - Prepare the project report and present the results.
2.		Indian Constitution	From HSS Dept.
3.	**Open Elective-II / MOOCs**		
	18B1WEC635	Principles of Communication Systems	CO-1- To be familiar with the need of modulation and various types of modulation. CO-2- Assess and evaluate different analog and angle modulation and demodulation techniques. CO-3 - Develop an ability to compare and contrast the strengths and weaknesses of various communication systems. CO-4 To understand the need of sampling and sampling theorem. C CO-5- To understand the basics of various digitization techniques like PCM, DPCM, DM, ADM.
	18B1WEC672	Principles of Communication Systems Lab	CO-1- To understand the fundamentals of designing of a filter. CO-2- To design a laboratory set up for the understanding of Amplitude modulation and Angle modulation. CO-3- To design and understand the importance of Sampling. CO-4- To understand the practical implementation of PAM, PWM, PPM. CO-5- To understand transmission line encoding. CO-6- To practically design digitization techniques like PCM, DM.
	18B1WEC636	Fundamentals of Digital Signal Processing and Applications	CO-1-Analyze the interpretation of discrete/digital signals. CO-2- Study the frequency domain behavior of discrete / digital signals. CO-3- Analysis and design of DSP filters.

			CO-4- Study of application domains.
	18B1WEC673	Fundamentals of Digital Signal Processing Lab	CO-1- Understand the basics of Lab VIEW Programming and code compressor studio. CO-2- Generate the discrete time signals using sampling and conversion of analog signals in to digital signals. CO-3- Analyze the FFT Algorithm based frequency domain representation. CO-4- Design the FIR and IIR filter for specified parameters. CO-5- Apply the adaptive filtering for systems identification. CO-6-Perform the linear and circular convolution using DSP kit to get the LTI system response.
	20B1WEC731	Automation and Robotics	CO-1- Learn about brief history, types, requirement and architecture of automation, and their applications. CO-2- Learn about PLC, DCS and SCADA, and their applications. CO-3-Learn basic principles of robotics, its configurations, kinematics, dynamics, motion planning and control. CO-4-Acquire knowledge about the principles of various sensors, actuators and their applications in robots. CO-5-Understand the concept of dynamics and control for a typical pick and place robot.
	20B1WEC732	Machine Learning for Wireless Communications	CO-1-Able to understand the basics of machine learning. CO-2-Analyze the behavior of wireless channel. CO-3- Able to understand various technology of wireless communication. CO-4- Design and develop various machine learning algorithm in the field of wireless communication.
	20B1WEC733	Signal Processing for Machine Learning	CO-1-Student will be familiar with the different type signal processing. CO-2-Student will able to understand the pre-processing and de-noising techniques Assessment. CO-3- Student will able to understand the feature extraction techniques. CO-4 Student will able to understand the machine learning techniques. CO-5- Student will able to apply the signal processing and machine learning techniques for different applications.
4.	**Open Elective-III / MOOCs**		
	18B1WEC637	Principles of Wireless Communication	CO-1-Understand the basic blocks of wireless communication system design. CO-2- Understand the concept of cellular communication. CO-3- Analyze the effect of various parameters on the performance of communication system. CO-4- Demonstrate recent wireless communication

			standards.
	18B1WEC674	Principles of Wireless Communication Lab	CO-1-Understand the basics of LabView, MATLab and WiCOMM-T kit. CO-2- Understand basics of various analog and digital modulation techniques. CO-3- Gain practical experience of the functioning of wireless systems. CO-4- Analyze the performance of practical wireless communication systems.
	18B1WEC639	Software Defined Radio and Applications	CO-1-Understand the terminology of software defined radio. CO-2- Understand the need of software defined radio system in next generation communication system. CO-3- Analyze the design considerations for software defined radio system. CO-4- Demonstrate application areas of software defined radio technology.
	18B1WEC676	Software Defined Radio Lab	CO-1- Understand the basics of MATLab and WiCOMM-T kit. CO-2- Attain flexibility in design and implementation of communication system. CO-3- Gain practical experience of the functioning of next generation communication systems through SDR technology. CO-4-Analyze the performance of reconfigurable software controlled digital communication systems.
	20B1WEC734	Digital Systems	CO-1-To review the basic concepts of digital systems. CO-2- Understand the working of sequential circuits. CO-3- Usage of different techniques for digital systems. CO-4 Study of different hazards and races countered by digital system.
	20B1WEC735	Artificial Intelligence Techniques for Genomic Signal Processing	CO-1-Student will be familiar with the genomics signal processing. CO-2-Student will able to understand the pre-processing and de-noising techniques Assessment. CO-3-Student will able to understand the artificial neural network along with its training and testing. CO-4-Student will able to understand the deep learning techniques along with its implementation. CO-5-Student will able to apply the artificial intelligence techniques in genomics signal processing.
	20B1WEC736	Image Sensing and Reconstruction	CO-1- Analyze the need and foundation of digital image sensing and reconstruction. CO-2 Study of the mathematical algorithms for filtering the image data. CO-3 Analysis of problems and approaches in real time image processing. CO-4 Study of application domains.
5.	**Professional Elective-V**		
	18B1WEC852	Design of Modern Antennas	CO-1- To define overall needs and constraints of RF systems and antennas.

			CO-2- To understand the mechanism of antenna radiation. CO-3 -To design and analyze various antennas for specific application. CO-4 -Size reduction techniques, Broad banding and multi band operation techniques in antenna design. CO-5 -Evaluate the opportunities involving technology, a product or a service required for developing a startup idea.
	18B1WEC851	Soft Computing Techniques	CO-1- Comprehend the fuzzy logic and the concept of fuzziness and concepts of neural networks. CO-2 -Demonstrate knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic. CO-3 Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications. CO-4 Apply fuzzy rules and neural network learning rules and design paradigms to solve engineering and other Problems.
	18B1WEC850	Fault Tolerant Communication Systems	CO-1 -Historical background and basic approaches of fault-tolerance in communication system. CO-2- Integration of integrity, survivability, availability, protection & restoration. CO-3- Routing schemes used for fault-tolerance. CO-4 -Planning and testing of fault-tolerant architectures. CO-5- Fault-tolerant planning for the development of mission-critical communication and systems.
	18B1WEC849	Cognitive Radio Networks	CO-1- Understand the fundamental issues regarding dynamic spectrum access and radio resource management. CO-2-Analyze the emerging issues in cognitive radio network. CO-3- Apply different spectrum sharing models in the Cognitive Radio Network. CO-4 -Apply efficient sharing of the unutilized spectrum among cognitive and licensed users while avoiding interference to the licensed user due to cognitive user's transmission.
6.	**Professional Elective-VI**		
	18B1WEC848	RF Engineering	CO-1- To have a thorough knowledge of RF and microwave components. CO-2 -To have a thorough knowledge about different parameters involved in microwave receiver and their significance. CO-3 -To have a thorough knowledge about different parameters involved in microwave receiver and their significance. CO-4 -To design different RF filters according to certain specifications. CO-5 -To understand active microwave components

			and their use in different applications.
	18B1WEC847	Medical Image Processing	CO-1 -Able to understand different types of medical imaging modalities and would be able to differentiate them with respect to their advantages and limitations. CO-2- Acquire an ability to analyze and process medical images. CO-3- Understand different feature extraction techniques and classifiers used for image classification. CO-4- Understand the role of computer aided diagnosis for medical images.
	18B1WEC846	Design of Dependable Systems	CO-1- Introduction to dependability attributes such as availability, reliability, safety, QoS, SLA in systems. CO-2 -Familiarization with dependability analysis approaches. CO-3- Application of methodologies used dependability modeling. CO-4- Design of dependability schemes on practical systems. CO-5- Evaluation of survivability of networks, dependability evaluation of networks.
	18B1WEC838	Artificial Intelligence Techniques	CO-1- Analyze the need and foundation of Artificial Intelligence. CO-2 -Study the Intelligent agents that receive percepts from the environment and perform actions CO-3- Analysis of problem solving, knowledge and reasoning. CO-4 Study of application domains.

Semester: VIII

SNo	Course Codes	Course Name	Course Outcomes
1.	**Open Elective-IV/ MOOCs**		
	18B1WEC739	Optimization Techniques in Engineering	CO-1- Cast engineering minima/maxima problems into optimization framework. CO-2- Learn efficient computational procedures to solve optimization problems. CO-3- To design algorithms, the repetitive use of which will lead reliably to finding an approximate solution. CO-4- Analyze and appreciate variety of performance measures for various optimization problems. CO-5-Understand importance of optimization of industrial process management.
	18B1WEC740	Electrical Machines	CO-1-The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions. CO-2-The skill to analyze the response of any electrical machine. CO-3 -The ability to troubleshoot the operation of an

			electrical machine. CO-4- The ability to select a suitable measuring instrument for a given application. CO-5- The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.
	18B1WEC741	Biomedical Signal Processing	CO-1- Understand the origin of different biomedical signals. CO-2- Able to filter out the noise and artifacts from the medical signals. CO-3- Able to extract different events from the signals. CO-4 -Understand different waveform analyzing methods for medical signals.
	20B1WEC731	Automation and Robotics	CO-1- Learn about brief history, types, requirement and architecture of automation, and their applications. CO-2- Learn about PLC, DCS and SCADA, and their applications. CO-3-Learn basic principles of robotics, its configurations, kinematics, dynamics, motion planning and control. CO-4-Acquire knowledge about the principles of various sensors, actuators and their applications in robots. CO-5-Understand the concept of dynamics and control for a typical pick and place robot.
2.	**Open Elective V/ MOOCs**		
	18B1WEC839	Industrial Internet of Things	CO-1- To Understand the Characteristics of IoT. CO-2- To provide the basic knowledge of Network & Communication Aspects of IoT. CO-3- To Design IoT applications in different domain and be able to analyze their performance. CO-4 -To Implement basic IoT applications on embedded platform.
	18B1WEC841	Satellite Communication	CO-1- To obtain basic knowledge of satellite communication principles. CO-2 -To have a thorough understanding of orbital mechanics and launches for the satellite communication. CO-3 -To understand the basic knowledge of link design of a satellite system. CO-4- To provide better understanding of multiple access systems and earth station technology. CO-5 -To prepare students with knowledge in satellite navigation and GPS and satellite packet communications.
3.	**Professional Elective-VII**		
	18B1WEC839	Radar Principles and Applications	CO-1- To know the basic building blocks of a radar system. CO-2- To have an in-depth knowledge on different types of signals that are used in radar systems. CO-3 -To know about the ambiguity function and its

			significance in radar signal processing. CO-4- To know the principle of operation of sonar and sound propagation in water. CO-5- To apply the knowledge acquired in this course in real time applications.
	18B1WEC840	Industrial Automation and Control	CO-1- Students will be able to handle any kind of process by framing it in block diagram, mathematical model and different process variables. CO-2- Students will be able to handle different types of controller like electronic, pneumatic and hydraulic. CO-3- Understand principle of working of various signal conditioners used with Temperature, Displacement, Optical and various miscellaneous other sensors. CO-4- Students will be able to implement different control schemes to various processes. CO-5- Students will be able to design relay logic for various processes.
	18B1WEC841	Bio Electronic Sensors	CO-1- Gain knowledge on sensors, actuators and transducers. CO-2- Learn to design circuits of bio-sensor for electrical and nonelectrical signals. CO-3 -Acquaint with different types of amplifiers used for biosensors. CO-4- Learn about bio-potential and bio-potential amplifiers.
	18B1WEC842	Optical Networks	CO-1- Recognize and classify the structures of Optical fiber and types. CO-2 -Discuss single hop and multihop fibers. CO-3- Analyze various coupling losses. CO-4 -Get acquainted with optical switching. CO-5 -Get familiar with the recent optical networks used for practical purposes.
4.	18B19EC891	Project Part-II	CO-1 - Review and evaluate the available literature on the chosen problem. CO-2 - Formulate methodology to solve the identified problem CO-3 - Plan/Design Software/Hardware for the proposed system. CO-4 - Apply the principles, tools and techniques to solve the problem. CO-5 - To act as catalyst in transferring the Electronics & Communication Engineering Knowledge to the benefit of the society. CO-6 - Prepare the project report and present the results.