Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B11EC731**	**Semester ODD**	**Semester** 7th **Session** 2018 -2019 Month from **July 2018**
Subject Name	Mobile Communications		
Credits	**4**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Dr. Alok Joshi and Dr. Juhi
	Teacher(s) (Alphabetically)	Dr. Alok Joshi , Dr. Juhi and Prof. Prakash Kumar Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the evolution of mobile communication and basics of all the wireless standards currently being employed.	Understanding (C2)
CO2	Perform mathematical analysis of cellular systems and cellular capacity improvement designs.	Analyzing (C4)
CO3	Analyze large and small scale propagation models and their design both mathematically and conceptually. Analysis of various fading models.	Analyzing (C4)
CO4	Analyze architecture of 2G, 3G and 4G systems and issues associated with them. Formulate research problems based on the issues associated with 4G systems.	Analyzing (C4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Mobile communication system evolution	Evolution of mobile communication systems. 2G, 3G, and 4G systems. Block diagram of mobile communication system. Problems of mobile communication: spectrum, propagation. Near far problem.	3
2.	The cellular Concept – System Design Fundamentals	Introduction, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage & capacity in cellular system	8
3.	Mobile Radio Propagation	Free Space Propagation Model, Ground Reflection Model, Small scale Propagation, Impulse Response model of a multipath channel, Parameters of mobile multipath channels, Types of small scale fading, Rayleigh and Ricean distributions, Level crossing rates and Average fade duration.	12
4.	Multiple Access Techniques	FDMA, TDMA, CDMA and OFDMA techniques and their performance. Number of channels.	5

5.	Mobile communication network architectures	GSM**:** GSM standards and architecture, GSM Radio aspects, typical call flow sequences in GSM, security aspects. GPRS, UMTS.	8
6	Introduction to 4G systems	Long Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMax).	4
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance, Performance. Assignment/Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**T. S. Rappaport, Wireless Communications (principle and practice), PHI/Pearson, 2002.**
2.	William C.Y. Lee, Mobile Cellular Telecommunications- Analog & Digital Systems, Mc.Graw Hill, 1995
3.	Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005
4.	V.K.Garg, Principles and Applications of GSM, Pearson Education, 1999
5.	V.K.Garg, IS-95 CDMA and CDMA 2000, Pearson Education, 2000

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NEC734	**Semester** Odd	**Semester** VII **Session** 2018 -2019 **Month from** July to December
Course Name	RF and Microwave Engineering		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Shweta Srivastava
	Teacher(s) (Alphabetically)	Dr. Jasmine Saini

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the concepts of microwave circuits and scattering parameters.	Understanding (C2)
CO2	Evaluate the performance of several waveguide components and determine their responses and applications.	Evaluating (C5)
CO3	Analyze the behaviour of microwave sources based on solid state devices and tubes at microwave frequencies.	Analyzing (C4)
CO4	Determine mearurent parameters of microwave components and understand the ISM applications of Microwave Energy.	Applying (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Microwave Transmission Lines	Microwave Integrated Lines: Microstrip line, Strip line, CPW line. S-parameters: definition, 2-port, 3-port and 4-port.	4
2.	Impedance matching	λ/4 Transformer, Binomial multisection matching Transformers, Tapered Lines	4
3.	Microwave Components	H-plane, E-plane and Magic Tee, Isolator, Circulator, Directional Coupler, Cavity Resonators, Q of Cavity Resonator	10
4.	Microwave Devices and Sources	Microwave semiconductor devices, Schottky diode, Gunn diode, IMPATT diode, HEMT, Microwave Tubes.	10
5.	Microwave Measurements	Impedance and Power Measurement Vector Network Analyzer, Spectrum analyzer, RF Filters.	6
6.	Microwave Propagation and Applications	Industrial, Scientific and Medical applications of Microwave Energy, Biological effects of microwave energy.	4
7.	Microwave Transcievers, RF MEMS	Block diagram of a microwave transceiver, Basics and applications of RF MEMS	2
		Total number of Lectures	40

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	D.M. Pozar, Microwave Engineering (2nd Ed.), John Wiley, 1998.
2.	S.Y. Liao, Microwave Devices and Circuits (3rd Ed.), Pearson, 2003.
3.	Peter A. Rizzi, Microwave Engineering, Pearson, 1998.
4.	B. R. Vishvakarma , R. U. Khan and M.K. Meshram , Microwave Circuit Theory and Applications, Axioe Books, 2012.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NEC736	**Semester: Odd**	**Semester** 7th **Session** 2018 -2019 **Month from July-Dec**
Course Name	Essentials of VLSI Testing		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Shamim Akhter
	Teacher(s) (Alphabetically)	Dr. Shamim Akhter

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the fundamental of Digital System testing	Analysing (Level IV)
CO2	Analyze Stuck-at faults model and Fault Simulation algorithms	Analysing (Level IV)
CO3	Perform Combinational and Sequential ATPG	Evaluating (Level V)
CO4	Analyze Controllability and Observability of Combinational and Sequential circuits	Analysing (Level IV)
CO5	Understand Design for Testability (DFT), Built-In-Self-Test(BIST), and Test Vector Compression	Analysing (Level IV)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to VLSI Testing	Types of tests, Test Process and Equipments, Automatic Test Equipment, Fault coverage, Defect level	5
2.	Fault Modeling	Stuck-at faults, Fault equivalence & dominance, Logic and Fault Simulation algorithms,	8
3.	Testability measures	Controllability & Observability for Combinational and Sequential circuits, SCOPE algorithm	7
4.	Testing algorithms for Combinational & sequential circuits	Combinational ATPG, D-algorithm, PODEM, FAN, Sequential ATPG	12
5.	Design For Testability	Introduction to Design for Testability (DFT), Scan Test, Boundary Scan Test, Built-In-Self-Test, Test Compression Techniques	11
		Total number of Lectures	**43**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance : 5 Marks, Quiz:10 Marks, Assignment: 10 Marks)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	M.L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, 1st Edition, Springer, 2005, [TEXTBOOK]
2.	Alexander Miczo, Digital Logic Testing and Simulation, 2nd Edition,John Wiley & Sons, 2003
3.	Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures, 1st Edition,Morgan Kaufmann, 2006,

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B11EC732	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from** July to December
Course Name	Cognitive Communication Systems		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Bajrang Bansal, Dr. Vivek Dwivedi
	Teacher(s) (Alphabetically)	Dr. Bajrang Bansal, Dr. Vivek Dwivedi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the concepts of various generation of wireless communication and spectrum scarcity.	Understanding (C2)
CO2	Understand the concepts of radio (CR) architecture, functions of cognitive radio.	Understanding (C2)
CO3	Analyzing the Spectrum sharing and management and Spectrum sensing methods.	Analyzing (C4)
CO4	Evaluating the performance of optimization of dynamic spectrum access and management.	Evaluating (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction of various generation of wireless communication, Spectrum scarcity, cognitive radio (CR) architecture, functions of cognitive radio, Fundamental challenges and issues in designing cognitive radio.	8
2.	Spectrum sharing and management	Spectrum access models,dynamic spectrum access (DSA), underlay, overlay and hybrid cognitive radio, Potential applications of cognitive radio.	8
3.	Spectrum sensing	Interference temperature/channel estimation , Detection of spectrum holes, Practical spectrum sensing approaches, Collaborative sensing, External Sensing.	12
4.	Techniques for optimization of dynamic spectrum access and management	Optimization techniques, Constrained optimization, Lagrangian method, Optimality, Primal-dual algorithm, Linear programming and the simplex algorithm, Non-linear programming , applications of cognitive radio.	14
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	E. Hossain, D. Niyato, and Z. Han, Dynamic Spectrum Access and Management in Cognitive Radio Networks, Cambridge University Press, 2009 (ISBN: 978-0-521-89847-8).
2.	Cognitive radio networks, Kwang-Cheng Chen, Ramjee Prasad, John Wiley & Sons Ltd.
3.	Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, HuseyinArslan, Springer.
4.	Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NEC735**	**Semester Even**	**Semester 8th year 2019** **Month from: Jan 2019**
Subject Name	Information Theory and Applications		
Credits	**4**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Dr. Alok Joshi, Dr. Neetu Singh
	Teacher(s) (Alphabetically)	Dr. Alok Joshi, Dr. Neetu Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the concept of probability, its relation with information, entropy, and their application in communication systems.	Understanding (C2)
CO2	Identify theoretical and practical requirements for implementing and designing compression algorithms.	Analyzing (C4)
CO3	Analyze the relationship between bandwidth and capacity of communication channels and its importance in real life communication systems.	Analyzing (C4)
CO4	Analyze the need for channel coding in digital communication systems.	Analyzing (C4)
CO5	Generate error correcting codes for error detection and correction.	Analyzing (C4)

Module No.	**title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Review of Basic Probability	Probability spaces. Random variables. Distributions and densities. Functions of random variables. Statistical Averages. Inequalities of Markov and Chebyshev. Weak law of large numbers.	3
2.	Information Measure	Discrete entropy. Joint and conditional entropies. Entropy in the continuous case. Maximization of continuous entropy. Entropy of a bandlimited white Gaussian process.	5
3.	Data Compression	Uniquely decipherable and instantaneous codes. Kraft- McMillan inequality. Noiseless coding theorem. Construction of optimal codes.	4
4.	Data Transmission	Discrete memoryless channel. Mutual information and channel capacity. Shannon's fundamental theorem and its weak converse. Capacity of a bandlimited AWGN channel. Limits to communication – Shannon limit.	5

5.	Error Control Coding	Coding for reliable digital transmission and storage. Types of codes. Modulation and coding. ML decoding. Performance measures.	3
6.	Linear Block Codes	Algebra Background, Groups, Fields, Binary field arithmetic. Vector Spaces over GF(2). Generator and parity check matrices. Syndrome and error detection. Standard array and syndrome decoding. Hamming codes.	8
7.	Cyclic Codes	Polynomial representation, Systematic encoding. Cyclic encoding, Syndrome decoding.	6
8.	Convolutional Codes	Generator Sequences. Structural properties. Convolutional encoders. Optimal decoding of convolutional codes- the Viterbi algorithm.	8
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance, Performance. Assignment/Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	R.B. ASH: Information Theory, Dover, 1990
2.	RANJAN BOSE: Information theory, coding and cryptography, Macgraw Hill 2008
3.	R.W. YEUNG: Information Theory and Network Coding, Springer, 2008
4.	SHU LIN & D.J. COSTELLO: Error Control Coding, 2nd Edn, Pearson, 2004.
5.	T.K. MOON: Error Correction Coding, Wiley, 2006.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NEC733**	**Semester Even**	**Semester VIIIth Session** 2018 -2019 **Month from** Jan
Course Name	Antenna Theory and Wave Propagation		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Vishal Narain Saxena
	Teacher(s) (Alphabetically)	Vishal Narain Saxena

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Recall the concepts of Electromagnetic field theory, classify different types of antennas, illustrate antenna parameters and demonstrate the effect on antenna parameters due to changes in the physical dimensions.	Understanding (Level II)
CO2	Compare Broadband Antennas, Frequency Independent antennas and Aperture antennas. Explain Array Antennas and identify the E and H fields for the antennas.	Applying (Level III)
CO3	Design Reconfigurable antenna, Active antenna, Dielectric antennas and measure radiation pattern, polarization and VSWR.	Creating (Level VI)
CO4	Define terminology relevant to mode of propagation and examine the propagation of radio waves in different atmospheres.	Analyzing (Level IV)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Radiation Fundamentals & Antenna Parameters	Antenna types, radiation, use of potential functions, radiated fields, far fields, Radiation from current element, Infinitesimal dipole, antenna parameters, radiation pattern, Directivity, numerical evaluation of directivity, Gain, efficiency, impedance, Loss resistance, Polarization, equivalent area, effective area and its relation to gain	8
2.	Linear Antennas Loop Antennas	Linear antennas, current distribution Total power, radiation resistance, Short-dipole, center-fed dipole, Half-wave dipole, dipole characteristics, folded dipole, Small loop antenna, Loop characteristics	7
3.	Antenna Arrays	Antenna arrays, Broadside and end-fire arrays, Hansen-Woodyard array, binomial arrays, Array theory Scan blindness in array theory ,Aperiodic arrays	7
4.	Broadband Antennas, Frequency Independent antennas & Aperture antennas	Yagi-Uda arrays, helical antennas Log-periodic antenna Fields as sources of radiation; Horn antennas, Reflector antennas	7
5.	Modern antennas-	Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR	6

6.	Propagation of Radio Waves	Modes of propagation , Structure of atmosphere , Ground wave propagation , Free Space Wave Propagation, Ground Reflection, Surface Waves, Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept, Ionospheric propagation, Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation, Electrical Properties of Ionosphere	8
		Total number of Lectures	**43**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Tutorial, assignment and presentation)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	John D. Kraus & RJ Marhefka, Antennas for all applications, The McGraw-Hill Companies, 2nd/3rd edition, 2006
2.	C.A. Balanis, Antenna Theory, Analysis and Design. NY: John Wiley and Sons, 2nd edition, 2002
3.	WL Stutzman& GA Thiele, Antenna Theory and Design , John Wiley and Sons, 2nd edition,1997
4.	Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NEC833**	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month from July to December**
Course Name	Low Power Analog CMOS Design		
Credits	**4**	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Kirmender Singh
	Teacher(s) (Alphabetically)	Kirmender Singh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understand the various MOS device models applicable for deep submicron process.	Remembering (Level I)
CO2	Analyse in detail the various categories of single stage amplifiers and understand the analog design octagon in design of high performance low power amplifiers.	Analyzing (Level IV)
CO3	Analyse the differential amplifier, current mirror and different biasing technique in CMOS process	Analyzing (Level IV)
CO4	Analyse the frequency response of single stage, differential amplifier with active and passive loads	Analyzing (Level IV)
CO5	Analyse and improve the stability of one stage, two stage and gain boosted operational amplifier using frequency compensation	Analyzing (Level IV)
CO6	Design a low power operational amplifier for desired specification and improve its performance using proper compensation technique.	Creating (Level VI)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of MOS transistor and Models	Review of MOS current voltage characteristics, second order effects, MOS device models, challenges in low power analog circuits	4
2.	Single stage amplifier	Common source stage with resistive current-source load, CS stage with source degeneration, source follower, common gate, cascode stage and folded cascode	8
3.	Active loaded Differential amplifier	Single ended and differential operation, basic differential amplifier, common mode response, differential pair with MOS load, Gilbert cell, frequency response of differential amplifier	8
4.	Current Mirror and Biasing Techniques	Basic current mirror, cascode current mirror, Active current mirror: Large-signal, small-signal, common-mode properties, , Biasing Techniques: CS, CG and differential amplifier.	7
5.	Frequency response of amplifiers	Review of Miller effect, Common source, source followers, common gate. Cascode and differential pairs.	7
6.	Low voltage Operational	Performance parameters, one-stage Op Amps, two stage Op-Amps, Miller compensation of two stage, Indirect	11

	Amplifiers	feedback compensation, design of compensated two stage amplifier, slew rate, power supply rejection	
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance-5+ assignment/quiz-10+ Class Response-10)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Education(India) Private Limited, 2015
2.	P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, Oxford University Press, 3rd Edition, 2010
3.	A.S .Sedra & K.C.Smith, Microelectronic Circuits Theory and Application, 6th Edition, Oxford University Press, 2011
4.	Paul R. Gray, Paul J. Hurst, Stephen H Lewis, Robert G. Meyer, 5th Edition, Wiley Publication, 2009

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B11EC733	**Semester** ODD	**Semester** VII **Session** 2018 -2019 **Month from** July to December
Course Name	Optical Communication		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Amit Kumar Goyal
	Teacher(s) (Alphabetically)	Dr. Amit Kumar Goyal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Develop an understanding of optical fiber, its structure, types, propagation and transmission properties.	Remembering (C1)
CO2	Identify and examine the different kinds of losses and signal distortion in optical Fibers.	Analyzing (C4)
CO3	Classify the Optical sources and detectors and their principle of operation.	Understanding (C2)
CO4	Design a fiber optic link based on budget analysis.	Evaluating (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Overview of Optical fiber Communications	Electromagnetic Spectrum, Historical development and advantages of optical fiber communication, Elements of optical fiber transmission link, Optical laws and definitions, optical fiber modes and configurations.	3
2.	Optical fibers Structures	Optical fiber wave guides, Ray theory transmission, TIR, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers Modes, V Number, Mode Coupling, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index.	4
3.	Signal Degradation in Optical fibers	Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion, Pulse broadening. Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss.	7
4.	Optical Sources	Light emitting diode (LEDs)-structures, materials, Figure of merits, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes -Modes & threshold conditions, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, temperature effects, external quantum efficiency, laser diode rate equations. Reliability of LED & LD.	6

5.	Power Launching and Coupling	Source to fiber power launching: - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, LED coupling to single mode fiber. Fiber Splicing- Splicing techniques, splicing single mode fibers. Multimode fiber joints and single mode fiber joints. Fiber alignment and joint loss.	6
6.	Photodetectors& Receivers	Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation:- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers.	7
7.	Optical system design	Considerations, component choice, multiplexing. Point-to-point links, System considerations, Link considerations. Overall fiber dispersion in multi mode and single mode fibers. Rise time considerations. Distance consideration in optical transmission system. Line coding in Optical links, WDM Principles & Types of WDM, Measurement of Attenuation and Dispersion, Eye pattern.	7
		Total number of Lectures	40

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Gerd Keiser, Optical Fiber Communications, 3rd Edition, McGraw-Hill International edition, 2000.
2.	John M. Senior, Optical Fiber Communications, 2nd Edition, PHI, 2002.
3.	D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005.
4.	Govind P. Agarwal, Fiber Optic Communication Systems, 3rd Edition, John Wiley, 2004.
5.	Joseph C. Palais, Fiber Optic Communications, 4th Edition, Pearson Education, 2004

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NEC733	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2019 -2020 **Month from** July to December
Course Name	Fundamentals of Embedded Systems		
Credits	4	**Contact Hours**	3L+ 3T

Faculty (Names)	**Coordinator(s)**	Dr. Gaurav Verma (62)
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understanding of the fundamental concepts for embedded systems design and complete architecture of the ATMEGA16/32 microcontroller.	Understanding level (C2)
CO2	Identify various on chip peripherals of the ATMEGA16/32 microcontroller and make use of them for designing embedded applications.	Applying Level (C3)
CO3	Experiment the basic concepts of embedded 'C' programming and make use of them in designing embedded system applications around various sensors and actuators.	Analyzing Level (C4)
CO4	Understanding of the basic concept of RTOS, detailed study of ARM7 architecture (32 bit) and study of wireless protocols.	Understanding level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Fundamental for Embedded Developers.	Embedded System and its applications, Future Trends of Embedded System, Design Parameters of Embedded System and its significance, Microprocessor Versus Microcontrollers, Microcontrollers for Embedded Systems, Embedded Versus External Memory Devices, CISC Versus RISC Processors, and Harvard Versus Von-Neumann architecture.	4
2.	Detailed Study of AVR Microcontroller	ATmega16/32 Microcontroller (Basic architecture, Pin configuration, Memory organization (registers and i/o ports), Embedded C programming, Timers, on chip PWM, on chip ADC, Interrupts and Serial Communication.	10
3.	Concept of Embedded 'C' programming	Introduction to C, Difference between C and Embedded C, Data Types used in Embedded C, Arithmetic & Logical Operators, Control Flow, If & If – else, While & Do – while, For, Switch & Case, Continue & Break, Array & String, Functions and Header files, Pointers.	6
4.	Real World Interfacing with Microcontroller	Interfacing of single LED, Blinking of LED with timer and without timer, Interfacing of push-button and LED, Interfacing of 7-segment display, Interfacing of 8 push-buttons to control 7-segment display, Intelligent LCD Display, Interfacing of intelligent LCD display, Interfacing of Matrix Keyboard to control 7-segment display, ADC and DAC Modules, Interfacing of ADC0804, Interfacing with	12

		DAC0808, Different wave generation through DAC0808, Stepper Motor & DC Motor, Interfacing with stepper & DC motor, Different Sensor Interfacing, (IR Sensor, DTMF, Temperature Sensor)	
5.	Concept of RTOS and Advanced Microprocessor	Real Time Operating System (RTOS), Types of real time tasks, Task Periodicity, Process state diagram, Kernel and Scheduler, Scheduling algorithms, Shared data (Resource) and Mutual Exclusion, Semaphore, Introduction to ARM, Features, ARM Pipeline, Instruction Set Architecture (ISA), Thumb Instructions, Exceptions in ARM, Embedded Wireless Protocols (Infrared Data Association (IrDA), Bluetooth, IEEE 802.11).	10
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments & Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Muhammad Ali Mazidi, "The AVR microcontroller and Embedded Systems using Assembly and C", 2nd Edition, Pearson Education, 2008.
2.	Frank Vahid / Tony Givargis, "Embedded System Design", Willey India, 2002.
3.	Santanu Chattopadhyay, "Embedded System Design", 1st Edition, PHI Learning, 2010.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester VII Session** 2018 -2019 **Month from** July-December
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Indira P. Sarethy
	Teacher(s) (Alphabetically)	Dr. Indira P. Sarethy, Dr. Shweta Dang

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-14.1	Explain healthcare market, drugs and devices, role of various stakeholders	Understand Level (C2)
C401-14.2	Apply related intellectual property laws and regulatory approvals for healthcare sector	Apply Level (C3)
C401-14.3	Analyze the various business models/ innovations in the healthcare industry	AnalyzeLevel (C4)
C401-14.4	Compare and examine economic aspects pertaining to the sector	AnalyzeLevel (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Healthcare markets**	About the various Regulatory bodies for approval of new medical innovations	**02**
2.	**Clinical Pharmacokinetics and Clinical trials for new Drugs**	Biologic sampling techniques, analytical methods for the measurement of drugs and metabolites, and procedures that facilitate data collection and manipulation. Clinical Trials: PhI, II, III and IV	**05**
3.	**Regulatory approval pathways**	Preclinical studies US and EU filings IND submissions, NDA and BLA Submissions, Non-patent exclusivities, data and market exclusivities cost analysis	**06**
4.	**Patents of drugs and devices, Entry for generics in health care markets**	Role of patents on new drugs and devices, Ever-greening of patents, Product and Process patents. Hatch Waxman act and Introduction of generics and resulting cost reduction, Orange book (FDA) and related case studies.	**08**
5.	**Economics of healthcare**	Stakeholders in healthcare- doctors, hospitals and insurers and theirroles, technology and human capital	**7**
6.	**Medical technology and insurance**	For medical devices, pharmaceuticals, genetic diagnostic tests and their regulations	**4**
7.	**Indian hospital sector**	Various players – government, private, PPP models, strategic perspectives, case studies	**4**
8	**Innovations in the marketplace**	Health to market innovations	**4**

9	**Healthcare informatics**	e-health, collection of health data, data processing, evaluation, health information systems, case studies	**2**
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments 1, 2, 3, Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Research papers and online resources

Detailed Syllabus

Lecture-wise Breakup

Course Code	17B1NCI742	**Semester: Odd**	**Semester: VII Session:** 2018 -2019 Month: **July-December**
Course Name	**ALGORITHMS AND ARTIFICIAL INTELLIGENCE**		
Credits	**3**	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Satish Chandra
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Implement and analyze the problem solving agents using various informed, uninformed and evolutionary search strategies.	Level-III (Apply)
CO2	Represent and illustrate constraint satisfaction problems and adversarial search algorithms for solving problems of game theory.	Level-II (Understanding)
CO3	Apply inference mechanisms using propositional logic (PL) and first order predicate logic (FOPL).	Level-III (apply)
CO4	Apply model of probabilistic reasoning in incomplete and uncertain environment	Level-III (Apply)
CO5	Evaluate and simulate learning based agent and empower the agents with natural language understanding.	Level-V (Evaluate)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Sorting and searching algorithms ($O(N^2)$ sorting, Heap, Quick and Merge sorting,	04
2.	Graph Algorithms	DFS, BFS, Shortest path algorithms;	05
3.	Algorithm Design Techniques: Greedy,	Greedy, Divide and Conquer and Dynamic Programming techniques.	05
4.	Artificial Intelligence approaches:	State Spaces, Uninformed search strategies (BFS, DFS, DLS, IDS, Bidirectinal search),	05

	Problem Solving-I		
5.	Problem solving-II	Informed Search and Explorartion (A*, Heuristic function, Local search algorithms, online search agents)	05
6.	Problem solving-III	Constraint satisfaction problems (backtracking, variable and value ordering, local search), Adversarial Search (games, alpha beta pruning, elements of chance, state of art games)	05
7.	Propositional Logic	Knowledge based agents, PL, FOPL, Syntax and semantics, use, knowledge engineering) , Inference in FOPL((Propositional vrs First order inference, Unification and lifting, f/w and b/w chaining) ,	5
8	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	4
9	Natural Language Processing	Parsers, Derivations and Syntax trees, Grammar Free Analyzers, Sentence generation and Translation	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Peter Norvig, Stuart Russel, Artificial Intelligence – A modern approach, PHI, 2009
2.	Sartaz Sahni and Horowitz, "Fundamentals of Computer Algorithms(second edition)– 2008

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS731	**Semester: Odd**	**Semester** VII **Session** 2018 -2019 **Month from** July 2018 to Dec **2**018
Course Name	Customer Relationship Management		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Shirin Alavi
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-17.1	Apply the financial, social and electronic aspects of the Customer Relationship in business situations.	Apply Level (C3)
C401-17.2	Appraise the role of customer share and customer centricity in organizations.	Apply Level (C3)
C401-17.3	Develop the skills to understand customization, innovation and co-creation in organizations and apply them in business contexts.	Analyze Level (C4)
C401-17.4	Analyze the role of interactive technology for customer engagement, customer retention and customer experience management in organizations.	Analyze Level (C4)
C401-17.5	Evaluate the technological solutions and their applications for effective Customer Relationship Management across different functions in organizations.	Evaluate Level (C5)
C401-17.6	Develop specific models for response modelling and consumer profiling in organizations.	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	CRM-The Strategic Imperatives	Introduction, CRM in Marketing and IT, CRM for Business Leadership, Criticality of customer relationships, Why businesses should adopt CRM, Implementing CRM.	3
2.	Conceptual Foundations of CRM, Building Customer Relationships	Evolution of CRM, Benefits, Schools of thought on CRM, Defining CRM. Customer Retention and Customer Acquisition, Customer Profitability is Skewed, Service Benefits of CRM, Transaction Marketing vs. Relationship Marketing, Relationship Building as a process, Bonding for Customer Relationships-Financial, Social, customization and Structural bonds, Ladder of Loyalty Zero Customer Defection, CRM Framework.	7
3.	Relationship Marketing and Economics of CRM	Internal and external relationships, Electronic Relationships, Operational, Analytical and Collaborative CRM, Market Share vs. Share of Customer, Customer Lifetime Value, and Activity based costing for CRM	6
4.	CRM in B2C ,B2B Markets , Customer Experience Management	CRM in Product and Service Markets, Case Studies, Characteristics of Business Markets, Participants in the business buying process, Key Account Management, Using KAM for Customer Segmentation, Customer Retention Strategy, KAM as a growth and Development Strategy, Customer Value Management in Business Markets,	7

		Importance of CRM in B2B Markets, Customer Emotion, Customer Knowledge, Reciprocity, Voice of the Customer, Participation.	
6.	Components of e CRM solutions (Overview) and Role of Digital Technologies	Data warehousing, Datamining and CRM, Market Basket Analysis and Retail sector, Campaign Management, Sales Force Automation, Customer Service and Support, Corporate Blogs, Online communities, Twitter, Wikis. The Experience ecosystem. CEM, Consumer engagement, segmentation and differentiation.	7
7.	Product offerings in the CRM Marketplace(Overview) and CRM Roadmap	Evaluating Technological solutions for CRM, Comparison of Siebel, Oracle, MySAP.com and People Soft Enterprise solutions, Comparison of Talisma, Sales logix, Microsoft and Sales notes for small and medium enterprises, Defining a CRM strategy, CRM Implementation Roadmap, Developing a relationship orientation, Customer centric marketing and processes, Building organizational capabilities through internal marketing, Issues in implementing a technology solution for CRM.	7
8.	Operational issues in implementing CRM,Social CRM	Process view of CRM, Budgeting for attraction vs. retention, Learning from customer defections, Customer Retention Plans, Evaluating Retention programs, Social Customer Relationship Management, Social Customer Insights, Social CRM Strategy, and Social Customer Analytics.	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project: Report and Viva)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Customer Relationship Management-A strategic perspective, G. Shainesh, Jagdish Sheth, Reprinted Macmillan Publishers India Limited, 2009.
2.	Mukerjee, K., Customer Relationship Management-A Strategic approach to Marketing,Third Edition Prentice Hall of India, 2007.
3.	Customer Relationship Management Concepts and Technologies-Francis Buttle ,Third Edition Taylor and Francis,2015.
4.	Berry, Michael, J. A, Linoff, Gordon S., Datamining Techniques for Sales, Marketing and CRM, Second Edition, Wiley Publications, 2007.

Detailed Syllabus

Lecture-wise Breakup

Course Code	17B1NMA732	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2017 -2018 **Month from** July 2018 – Dec 2018
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Prof. Sanjeev Sharma and Dr. Neha Ahlawat	
	Teacher(s) (Alphabetically)	Dr. Neha Ahlawat and Prof. Sanjeev Sharma	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C401-8.1	solve system of linear equations using direct and iterative methods with their applications in various engineering problems.	Applying Level (C3)
C401-8.2	explain finite and divided difference formulae for numerical interpolation.	Understanding Level (C2)
C401-8.3	apply the methods of least squares to best fit the given data.	Applying Level (C3)
C401-8.4	apply numerical differentiation and integration in engineering applications.	Applying Level (C3)
C401-8.5	solve system of non-linear equations and analyze the convergence of the methods.	Analyzing Level (C4)
C401-8.6	evaluate the solutions of initial and boundary value problems using various numerical methods.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition, Iterative methods: Gauss Seidel. Power method for largest eigenvalues, Jacobi method for real symmetric matrices	10
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equispaced points, Divided differences, Hermite interpolation, Least square approximation	8
3.	Numerical Differentiation and quadrature	Approximation of derivatives, Newton-Cote formulae, Gauss-Legendre quadrature formulae, Double integration	8
4.	Non-linear Algebraic Equations	Iterative methods for one or more nonlinear equations with convergence	4
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods,	12

		Numerical solutions of parabolic and elliptic partial differential equations	
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**Gerald, C.F. and Wheatley P.O.**, Applied Numerical Analysis, 6th Ed., Pearson Education, 1999.
2.	**Conte, S.D. and DeBoor, C.**, Elementary Numerical Analysis, 3rd Ed., McGraw-Hill, 1980.
3.	**Gupta, R.S.**, Elements of Numerical Analysis, 1st Ed., Macmillan 2009.
4.	**Jain, M.K., Iyengar, S.R.K. and Jain, R.K.**, Numerical Methods for Scientific and Engineering Computation 5th Ed., New Age International, New Delhi, 2007.
5.	**Smith, G.D.**, Numerical Solution of Partial Differential Equations, 2nd Ed., Oxford, 1978.

Detailed Syllabus
Lecture-wise Breakup

Course Code	10B1NPH732	**Semester :** Odd	**Semester:** VII **Session:** 2018 -2019 **Month:** from July to December
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Navendu Goswami and Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Dr. Navendu Goswami and Dr. Sandeep Chhoker

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-4.1	Define the Nanoscience and Technology and to know about various other terminologies and developments involved with Nanoscience and Technology	Remembering (C1)
C401-4.2	Classify the nanomaterials depending on the nature of dimensionalities, type of materials classes and explain the basic concepts of nanomaterials	Understanding (C2)
C401-4.3	Apply the concepts of Nanoscience for solving the theoretical and numerical problems	Applying (C3)
C401-4.4	Determine the properties of nanomaterials through suitable characterization tools	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Development of nanoscience and nanotechnology, naturally occurring nanomaterials, Crystallinity of nanomaterials, Metallic nanostructures, Semiconductor nanostructures Magnetic nanomaterials, Chemically assisted nanostructures, Growth in 2-D nanostructures, Carbon nanomaterials	10
2.	Properties of Nanomaterials	Surface to volume ratio, Surface states and energy, Nanoscale oscillators, Confinement in nanostructures, Density of States and number of states of 0-, 1-, 2-, 3-dimensional systems, Change in Band structure and gap, Energy levels, confinement energy and emission in nano, Fluorescence by QDs, Concept of Single electron transistor	5
3.	Nanomaterials Synthesis	Introduction to synthesis techniques, Top down and bottom up approach, Biological methods, Sol-gel method, Nucleation and growth, Ball Milling technique, Chemical vapor deposition, Physical Vapor deposition: Concept of Epitaxy and sputtering, Basics of Photolithography and its limitations, Soft Lithography and Nanolithography	10
4.	Characterization of Nanomaterials	Resolving power (Rayleigh and other criteria) of microscopes and their limitations for nanostructure measurements, Concept of Far and Near field and modification by NSOM, Basic principle, Design of setup, Theory and working, Characterization procedure, result analysis, Merits/demerits of SEM, TEM, STM, AFM	5
5.	Application of	Nanoelectronics, Nanobiotechnology, Catalysis by	10

	Nanomaterials	nanoparticles, Quantum dot devices, Quantum well devices, High T_c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS	
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	*Nanostructures and nanomaterials: synthesis properties and application*, Guozhong Cao, Imperial college press, London.
2.	*Introduction to nanotechnology,* Charles Poole *et al* J John Wiley & Sons, Singapore.
3.	*The Handbook of Nanotechnology: Nanometer Structures, Theory, Modeling, and Simulation,* A. Lakhtakia, Spie Press USA.
4.	*Springer Handbook of Nanotechnology,* Edited by B. Bhushan, Springer Verlag.

Detailed Syllabus
Lab-wise Breakup

Course Code	15B19EC791	**Semester Even (specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from** July to DEc
Course Name	Major Project Part-1		
Credits	4	**Contact Hours**	

Faculty (Names)	**Coordinator(s)**	Dr. Sajai Vir Singh
	Teacher(s) (Alphabetically)	Mr. Varun Goel

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Summarize the contemporary scholarly literature, activities, and explored tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Electronics Engineering.	Understanding (Level II)
CO2	Analyze/ Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time	Analyzing (Level IV)
CO3	Evaluate /Validate sound conclusions based on evidence and analysis	Evaluating (Level V)
CO4	Develop the skill in student so that they can communicate effectively in both verbal and written form.	Create (Level 6)

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Viva (V1)	20
End Term Viva (V2)	30
Day to Day	30
Project Report	20
Total	**100**

Detailed Syllabus
Summer Training Viva

Course Code	15B19EC793	**Semester Odd (specify Odd/Even)**	**Semester** 7th **Session** 2019 -2020 **Month from** July to December
Course Name	Summer Training Viva		
Credits	2	**Contact Hours**	-

Faculty (Names)	**Coordinator(s)**	Dr. Bajrang Bansal, Mrs. Smriti Bhatnagar
	Teacher(s) (Alphabetically)	Dr. Bajrang Bansal, Mrs. Smriti Bhatnagar

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Extend theoretical knowledge to real time Industry.	Understanding (Level II)
CO2	Demonstrate the capacity for critical reasoning and independent learning.	Understanding (Level II)
CO3	Make use of Industrial Training experience to prepare a scientific report.	Applying (Level III)
CO4	Develop greater clarity about career goals in present condition.	Applying (Level III)

Evaluation Criteria

Components	**Maximum Marks**
Timely submission of diary, Certificate and duration of Training	20
Diary entry and Report Quality	30
Knowledge earned through Training/Viva	50
Total	**100**

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M11EC118	**Semester Odd 2018 (specify Odd/Even)**	**Semester I &III** **Session** July 2019 –December 2019
Course Name	ADVANCED DIGITAL SIGNAL PROCESSING		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Vineet Khandelwal
	Teacher(s) (Alphabetically)	NIL

COURSE OUTCOMES At the end of the semester, students will be able to		**COGNITIVE LEVELS**
CO1	Recall the principles of various transform techniques like Z, Chirp Z, Hilbert, Discrete Fourier transform and Fast Fourier Transform.	Applying (Level III)
CO2	Demonstrate the ability to apply different methods to design and analyze digital FIR (Finite Impulse Response) and IIR (Infinite Impulse Response) filters with its structural realization.	Analyzing (IV)
CO3	Analyze Multirate signal processing and examine its application.	Analyzing (Level IV)
CO4	Comprehend different methods for designing adaptive filters and examine its application	Analyzing (Level IV)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Review of Digital Signal Processing**	Review of discrete–time sequences and systems, Linear Shift Invariant (LSI) systems. Causality and Stability Criterion, FIR & IIR representations, Z-Transform, Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) algorithms using decimation in time and decimation in frequency techniques, Chirp Z- Transform, Hilbert Transform and applications	9
2.	**Design of IIR and FIR Filters**	Digital filter specifications, selection of filter type, and filter order, FIR filter design; using windowing Techniques, Fourier Series and frequency sampling method, Design of IIR Filters Using Butterworth, Chebyshev and Elliptic Approximations, Frequency Transformation Techniques; approximation of derivatives, Impulse invariant method, Bilinear transformation, Structures for IIR Systems – Direct Form I & II, Cascade, Parallel, Lattice & Lattice-Ladder Structures, Structures For FIR Systems – Direct , Cascade, Parallel, Lattice & Lattice ladder Structures.	11

3.	**Multirate Digital Signal Processing**	Decimation & Interpolation, Sampling rate conversion, Identities, polyphase decomposition, General polyphase framework for Decimator and Interpolator, Multistage decimator and Interpolator, Efficient transversal structure for Decimator and Interpolator, FIR and IIR structure for Decimator, Filter design for FIR decimator and Interpolator, Application of Multirate Signal processing.	16
4.	**Adaptive Filters**	Introduction. Application of adaptive filters, Adaptive Direct-form FIR filters Adaptive Lattice-Ladder filters.	6
		Total number of Lectures	42

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	J.G. Proakis & D.G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", PHI ,3rd Edition
2.	John G. Proakis, Charles M. Rader, Fuyun Ling, Chrysostomos L. Nikias, Mark Moonen and Ian K. Proudler, Algorithms for Statistical Signal Processing, Pearson Education Inc., 2002
3.	P.P. Vaidyanathan, "Multirate Systems and Filter Banks", PHI, 2010

Detailed Syllabus
Lecture-wise Breakup

Course Code	17M21EC112	**Semester**	**Semester** Odd **Session** 2018 -2019 **Month from** July to December
Course Name	Digital Integrated Circuit Design		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Archana Pandey
	Teacher(s) (Alphabetically)	Dr. Archana Pandey

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Develop an understanding of exiting challenges in digital IC design, and analysis of CMOS inverter performance.	Understanding (Level II)
CO2	Identify and estimate the delay and power consumption in CMOS based gates and choosing best design configuration via logical effort.	Analyzing (Level IV)
CO3	Design and analyze combinational and sequential logic circuits effectively.	Applying (Level III)
CO4	Design different types of semiconductor memories and test integrated circuits for fault tolerance.	Evaluating (Level V)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Introduction to CMOS digital integrated circuits	CMOS devices and manufacturing technology, CMOS inverters and gates, Propagation delay calculation of CMOS inverter, noise margins, power dissipation, and regenerative logic circuits	6
2.	Delay Estimation and Power consumption in CMOS gates	Delay Definitions, Switch-level RC Delay Models, Effective Resistance and Capacitance calculations, Elmore Delay Model, Linear Delay Model, Switching Activity of logic gates	7
3.	Logical Effort	Delay in a Logic gate, Multistage Logic Networks, Gate sizing, Choosing the best No. of stages, Limitation of logical effort	5
4.	Designing Arithmetic Building Blocks	Adders, Multipliers and Shifters	6
5.	Sequential Circuit Analysis	Timing Metrics for Sequential Circuits, Bi-stability principle, Static latches and Registers, Flip flops, Dynamic Sequential Circuit, Schmitt Trigger	6
6.	Designing Memory	Semiconductor Memories, Memory peripheral Circuitry	4

	and Array Architecture		
7.	Testing	Introduction to testing and various concepts	7
		Total number of Lectures	**41**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	J. M. Rabaey, A. Chandrakasan, B. Nikolic: Digital Integrated Circuit: A design perspective, 2nd Edition Pearson Education, Delhi-2005
2.	Weste, Neil HE, and David Money Harris. *CMOS VLSI Design*. Pearson/Addison Wesley, 2005.
3.	Geiger, Randall L., Phillip E. Allen, and Noel R. Strader. *VLSI design techniques for analog and digital circuits*. Vol. 90. New York: McGraw-Hill, 1990.
4.	*www.ieeexplore.ieee.org*

Detailed Syllabus
Lab-wise Breakup

Course Code	15B19EC792	**Semester Odd (specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from** July to December
Course Name	Term Paper		
Credits	**3**	**Contact Hours**	

Faculty (Names)	**Coordinator(s)**	Dr. Gopal Rawat
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Summarize the contemporary scholarly literature, activities and techniques for various domain of Electronics Engineering.	Understanding (Level II)
CO2	Analyze the recent technology and research trends in Electronics and Communication.	Analyzing (Level IV)
CO3	Evaluate /Validate sound conclusions based on evidence and analysis.	Evaluating (Level V)
CO4	Develop the skill so that they can communicate effectively in both verbal and written form.	Applying (Level III)

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Seminar	20
End Term Seminar	20
Day to Day work prior to Mid Term	20
Day to Day work after Mid Term and upto End Term	20
Term Paper Report	20
Total	**100**