Detailed Syllabus
Lecture-wise Breakup

Course Code	17M11EC118	**Semester Odd (specify Odd/Even**	**Semester 1st Session 2020-2021 Month from July to December**
Course Name	ADVANCED DIGITAL SIGNAL PROCESSING(CO code : C110)		
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 (C3)
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 Level(C4)
CO3	Analyze Multirate signal processing and examine its application.	Analyzing Level(C4)
CO4	Comprehend different methods for designing adaptive filters and examine its application	Analyzing Level(C4)

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	6
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;	12

		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.	
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.	14
4.	**Adaptive Filters**	Introduction, Application of adaptive filters, correlation structure, FIR Weiner Filter, Adaptive Direct-form FIR filters Adaptive Lattice-Ladder filters, Introduction to linear prediction, linear prediction and autoregressive modeling.	10
		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", 4th Edition, PHI, 2012
2.	Aurelio Uncini, "Fundamentals of Adaptive Signal Processing", Springr Nature, Jan 2015.
3.	Tulay Adah and Simon Haykins, "Adaptive Signal Processing: Next Generation Solutions", Wiley India, 2012.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT733	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2020 -2021 **Month from** July-December
Course Name	Stress: Biology, Behaviour and Management		
Credits	3 (3-0-0)	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Vibha Gupta
	Teacher(s) (Alphabetically)	Vibha Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-16.1	Explain the biological basis of stress.	**Understand Level (C2)**
C401-16.2	Relate cognitive processes and stress management.	**Understand level (C2)**
C401-16.3	Apply acquired knowledge in understanding and adjusting to different people and situations.	**Apply level (C3)**
C401-16.4	Improve quality of life by reducing stress.	**Create level (C6)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	The concept of Stress - Major stressors vs. routine hassles ; Major types of Stressors - Occupational Stressors; Organization Stress; Environmental Stressors; Happy Interactive Class (HIC)	3
2.	Scientific Foundations of Stress	HIC 1, The Nature of Stress; Human Physiology; Stress and Relaxation Responses; Stress and Disease	5
3.	Body Systems activated by stressors	HIC2, Nervous System, Endocrine System, immune system, Cardiovascular system, Gastrointestinal System, Muscles	9
4.	Cognitive Psychology	HIC3, Theoretical models: psychodynamic, behavioral, and cognitive; Thoughts, Beliefs and Emotions: Behavioral Patterns; Self-concept and Self-esteem; Stress emotions - Anger and Fear; Personality Traits – Stress prone and Stress resistant	11
5.	Social Psychology	HIC4, Family and Culture; Demands and Responsibilities; Relationships; Verbal and Non-verbal Communication; Human Spirituality	3
6.	Stress and the Human Environmental Interactions	HIC4, Time; Body Rhythms; Weather and Climate; Nutrition; Exercise; Drugs and Addictions; Violence and Post Traumatic Stress	3
7.	Happy Interactive Class (HIC) related to Stress management techniques and	HIC1 - DIY Strategies- Exercise and Health; HIC2 - Journal Writing/Music and Art Therapy; HIC3- Humor and Comic Relief; HIC4- Meditation/Mindfulness/Belly Breathing/Visual Imagery/Progressive Muscle Relaxation Psychological interventions; Developing Cognitive	HICs to be delivered in the modules 1-6

	therapeutic strategies	Coping Skills; Creative Problem Solving (case studies);	4
8.	The adaptive brain	Neuroplasticity – positive adaptation to stress	2
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Quiz and class discussions)
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.	George Fink "Stress: Concepts, Cognition, Emotion, and Behavior: Handbook in Stress Series; Volume 1; Academic Press; 2016
2.	Jeanne Ricks "The Biology of Beating Stress"Kindle Edition; 2014
3.	Jerrold S. Greenberg "Comprehensive Stress Management" Tata McGraw-Hill Edition; Tenth Ed., 2009
4.	Brian Luke Seaward "Managing Stress: Principles and Strategies for Health and Well-Being" Sixth Ed., Jones and Bartlett Publishers, 2009
5.	Saundra E. Ciccarelli, and Glenn E. Meyer "Psychology" South Asian Edition; Published by Pearson Education (2008); ISBN 10:8131713873 / ISBN 13: 9788131713877

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	**Semester: ODD**	**Semester: 7th Session:** 2020 -2021 **Month from July to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Navendu Goswami
	Teacher(s) (Alphabetically)	Navendu Goswami

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
Lecture-wise Breakup

Course Code	20B12PH411	**Semester** ODD	**Semester 7th Session** 2020 -2021 **Month from July to December**
Course Name	SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES		
Credits	3	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Dr. Dinesh Tripathi
	Teacher(s) (Alphabetically)	NA

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Define unusual properties exhibited by superconducting materials and how these properties are important in the development of superconducting Devices.	Remember Level (Level 1)
CO2	Explain the theories of superconductivity, the basic and operating parameters of superconductors, their classifications and design limitations for superconductor's applications-devices.	Understand Level (Level 2)
CO3	Solve the various issues related to fabrication of superconducting wires, tapes, design of superconducting magnets and devices.	Apply Level (Level 3)
CO4	Examine the potential use of low Tc and high Tc superconductors for designing both small and large scale applications.	Analyze Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic properties of Superconducting materials	Historical review, the state of zero resistance, Perfect Diamagnetism, Meissner effect, London's theory, Penetration depth, Concept of coherence length and origin of surface energy, Intermediate and mixed states, Critical currents and critical fields, Outlines of B-C-S theory, concept of energy gap, Levitation force of superconductors, Tunneling in superconductors: Gaiever tunneling and Josephson tunneling	10
2.	Classifications & synthesis of Superconducting materials	Type I and Type II superconductors, Classification of superconducting materials, Conventional superconductor: metals (Pb, Nb, Ti etc.), metal alloys (NbTi, Nb3Sn etc.) and Inter-metallic superconductors (MgB2); Non-conventional Superconductors: Oxide based superconductors (BSCCO, YBCO), iron pnictides superconductors, Fabrication of superconducting wires & tapes.	10
3.	Design of Superconducting magnet	Flux flow, Flux pinning, Pinning force, Magneto-thermal Instabilities in Type II superconductors, Flux Jumps, Stabilization Criterion: Cryostatic and dynamic stabilization, Manufacture of long length superconducting multifilamentary wires, Design and fabrication of superconducting magnets, Magnetic field calculations, current leads, Persistent switches, and superconducting magnet energization.	12

4.	Superconducting devices	Josephson junction in magnetic field, Superconducting Quantum Interference Devices (SQUIDS) and its applications, Superconductive Switches, Infrared detectors Superconducting energy storage system (SMES), Fault current limiters (SFCL), Maglev trains	8
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment (5), Quiz (5), Attend. (10) and Class performance (5))
Total	**100**

Recommended Reading material:

1.	Roseins & Rhodrih, Introduction to Superconductivity, 2nd Edition, Pergamon Press plc
2.	Vladimir Z. Kresin & Stuart A. Wolf, Fundamentals of Superconductivity, Springer Science & Business Media
3.	Williams, Applied Superconductivity , Academic press New York.
4.	M. N. Wilson, Superconducting Magnet Design (Monographs on Cryogenics), Clarendon Press, Oxford Science Publications

Course Description

Course Code	17B1NMA732	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2020-21 **Month from** Aug 2020- Dec 2020
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C401-8.1	solve a single and a system of non-linear equations and analyze the convergence of the methods.	Applying Level (C2)
C401-8.2	explain finite and divided difference formulae for numerical interpolation.	Understanding Level (C3)
C401-8.3	apply numerical differentiation and integration in engineering applications.	Applying Level (C3)
C401-8.4	solve a system of linear equations using direct and iterative methods with their applications in various engineering problems	Applying Level (C3)
C401-8.5	solve eigen-value and corresponding eigen- vector problem for a square matrix	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.	Roots of Non-linear Equations	Concept of round-off and truncation errors. Iterative methods to find roots for one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equi-spaced points, Divided differences,Spline interpolation, Least square approximation	7
3.	Numerical Differentiation and Integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods. Iterative methods: Jacobi and Gauss Seidel Methods and their convergence. Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of parabolic and elliptic partial differential equations by Finite Difference Methods	12
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20

T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, PBL)
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, 7th Ed., Pearson Education, 2004.
2.	**Conte, S.D. and deBoor, C.**, Elementary Numerical Analysis, 3rd Ed., McGraw-Hill, 1980.
3.	**Gupta, R.S.**, Elements of Numerical Analysis, 2nd Ed., Cambridge University Press, 2015.
4.	**Jain, M.K., Iyengar, S.R.K. and Jain, R.K.**, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age International, New Delhi, 2014.
5.	**Smith, G.D.**, Numerical Solution of Partial Differential Equations, 2nd Ed., Oxford, 1978.

Detailed Syllabus
Lab-wise Breakup

Course Code	15B19EC791	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** August to December
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 (C2)
CO2	Analyze/ Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time	Analyzing (C4)
CO3	Evaluate /Validate sound conclusions based on evidence and analysis	Evaluating (C5)
CO4	Develop the skill in student so that they can communicate effectively in both verbal and written form.	Create Level (C6)

Evaluation Criteria

Components	**Maximum Marks**
Mid Sem Viva	20
Final Viva	30
Day to Day	30
Project Report	20
Total	**100**

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NEC733	**Semester** ODD **(specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** July 20 to Dec 20
Course Name	Fundamentals of Embedded Systems		
Credits	4	**Contact Hours**	3L+ 3T

Faculty (Names)	**Coordinator(s)**	Mr. Ritesh kumar Sharma (62)
	Teacher(s) (Alphabetically)	Dr. Gaurav Verma, Mr. Ritesh kr Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-4.1	**Understanding of the fundamental concepts for embedded systems design and complete architecture of the ATMEGA16/32 microcontroller.**	Understand [Level 2]
C431-4.2	**Identify various on chip peripherals of the ATMEGA16/32 microcontroller and make use of them for designing embedded applications.**	Apply [Level 3]
C431-4.3	**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 4]
C431-4.4	**Understanding of the basic concept of RTOS, detailed study of ARM7 architecture (32 bit) and study of wireless protocols.**	Understand [Level 2]

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	12

		of Matrix Keyboard to control 7-segment display, ADC and DAC Modules, Interfacing of ADC0804, Interfacing with 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**

Project Based Learning Component: This course teaches embedded system design using a building block approach, which allows one to visualize the requirement of an embedded system and then to design it efficiently. Learning out Embedded Systems will give the skills to design and manufacture embedded system products of the future which will help participants towards better employability. The course will teach embedded system design using a microcontroller, namely ATMEL Corporation ATmega16/32 microcontroller and also introduced the concept of advanced microprocessor of ARM family. The course will introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols. It will also teach effective embedded programming techniques in C and RTOS. It will have a significant practical component, which will be achieved by distributing different minor projects to group of students.

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

Course Code	15B19EC792	**Semester -:** Odd (specify Odd/Even)	**Semester-: 7th Session** 2020 -21 **Month- :** August - December
Course Name	**Term Paper**		
Credits	3	**Contact Hours**	40

Faculty (Names)	**Coordinator(s)**	**Bhagirath Sahu, Mandeep Narula**
	Teacher(s)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C460.1	**Summarize the contemporary scholarly literature, activities and techniques for various domain of Electronics Engineering.**	**Understand Level (C2)**
C460.2	**Analyze the recent technology and research trends in Electronics and Communication.**	**Analyzing Level (C3)**
C460.3	**Develop the skill so that they can communicate effectively in both verbal and written form.**	**Applying Level (C4)**

Evaluation Criteria

Components	**Maximum Marks**
Mid-Term Seminar & Viva	20
D2D upto Mid-Term	20
End Term Seminar & Viva	20
D2D upto End-Term	20
End-Report	20
Total	**100**

Detailed Syllabus

Course Code	15B19EC793	**Semester -:** Odd (specify Odd/Even)	**Semester-:** 7th **Session** 2020-21 **Month- :** July - December
Course Name	Summer Training Viva		
Credits	2	**Contact Hours**	Six weeks

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C455.1	Extend theoretical knowledge to real time Industry	Understanding Level (C2)
C455.2	Demonstrate the capacity for critical reasoning and independent learning	Understanding Level (C2)
C455.3	Make use of Industrial Training experience to prepare a scientific report	Applying Level (C3)
C455.4	Develop greater clarity about career goals in present condition	Applying Level (C3)

Evaluation Criteria

Components	**Maximum Marks**
Viva	25
Real world idea and knowledge of Industry	25
Report	25
Diary	25
Total	**100**

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NEC734	**Semester** Odd	**Semester** VII **Session** 2020 -2021 **Month from** August to December
Course Name	RF and Microwave Engineering		
Credits	3	**Contact Hours**	3L+1T

Faculty (Names)	**Coordinator(s)**	Monika
	Teacher(s) (Alphabetically)	Abhay Kumar, Monika, Prof. Shweta Srivastava

COURSE OUTCOMES		**COGNITIVE LEVELS**
C332-3.1	Explain the concepts of microwave circuits and scattering parameters.	Understanding (C2)
C332-3.2	Evaluate the performance of several waveguide components and determine their responses and applications.	Evaluating (C5)
C332-3.3	Analyze the behaviour of microwave sources based on solid state devices and tubes at microwave frequencies.	Analyzing (C4)
C332-3.4	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.	Introduction to RF and Microwave Engineering	History of Microwaves, applications of Microwaves, Maxwell's Equations.	2
2.	Microwave Transmission Lines	Review of Transmission lines, Line Equations. Microwave Integrated Lines: Microstrip line, Strip line, CPW line.	3
3.	Impedance matching	λ/4 Transformer, Tapered Lines :Exponential	3
4.	Scattering Parameters	S-parameters: definition, properties, 2-port, 3-port and 4-port.	4
5.	Microwave Components	H-plane, E-plane and Magic Tee, Isolator, Circulator, Directional Coupler, Cavity Resonators, Q of Cavity Resonator, Rectangular waveguide cavities.	10
6.	Microwave Devices and Sources	Microwave semiconductor devices, Schottky diode, Gunn diode, Microwave Tubes.	7
7.	Microwave Measurements	Impedance and Power Measurement Vector Network Analyzer, Spectrum analyzer.	4
8.	RF Filters	Classification of filters, Filter Design by Insertion loss method	3

9.	Microwave Propagation and Applications	Industrial, Scientific and Medical applications of Microwave Energy, Biological effects of microwave energy.	4
		Total number of Lectures	40

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	20
PBL	05
Total	**100**

Project Based Learning:

Microwave Engineering is a fundamental course in Electronics and Communication Engineering. In this course, a brief introduction about basics of RF and Microwave Engineering is presented, which can be utilized to impart knowledge to design various microwave circuits at high frequencies. The project based exercises using RF basics can be used for filter designing.

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

Subject Code	17B1NEC735	**Semester Odd (Specify Odd/Even)**	**Semester** 7th **Session** 2020-21 **Month from** Aug 2020 to Dec 2020
Subject Name	Information Theory and Applications		
Credits	4	**Contact Hours**	3-1-0

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

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
C430-5.1	Understand the concept of probability, its relation with information, entropy, and their application in communication systems.	Understanding Level (C2)
C430-5.2	Identify theoretical and practical requirements for implementing and designing compression algorithms.	Analyzing Level (C4)
C430-5.3	Analyze the relationship between bandwidth and capacity of communication channels and its importance in real life communication systems.	Analyzing Level (C4)
C430-5.4	Analyze the need for channel coding in digital communication systems.	Analyzing Level (C4)
C430-5.5	Generate error correcting codes for error detection and correction.	Analyzing Level (C4)

Module No.	**Subtitle 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.	6
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	2

		and storage. Types of codes. Modulation and coding. ML decoding. Performance measures.	
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**
Test-1 Examination	20
Test-2 Examination	20
End Semester Examination	35
TA	25 (Attendance, Performance. Assignment/Quiz)
Total	**100**

Project Based Learning: Students will learn about the design and implementation of compression algorithms as well as error-correcting codes with the help of assignments.

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.	R.W. YEUNG: Information Theory and Network Coding, Springer, 2010.
3.	SHU LIN & D.J. COSTELLO: Error Control Coding, 2nd ed., Pearson, 2011.
4.	T.K. MOON: Error Correction Coding, Wiley, 2006.
5.	A. POPOULIS: Probability, Random Variables and Stochastic Processes, Tata McGraw-Hill Edition, 2002**.**
6.	R. BOSE: Information Theory, Coding and Cryptography, Tata McGraw-Hill Education, 2016.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17B1NEC736	**Semester:** ODD	**Semester**: 7th **Session** 2020 -21 **Month:** Aug 2020 **to** December 2020
Subject Name	Essentials of VLSI Testing		
Credits	4	**Contact Hours**	3-1-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-4.1	Understand the fundamental of Digital System testing	Analyzing Level (C4)
C430-4.2	Analyze Stuck-at faults model and Fault Simulation algorithms	Analyzing Level (C4)
C430-4.3	Perform Combinational and Sequential ATPG	Evaluating Level (C5)
C430-4.4	Analyze Controllability and Observability of Combinational and Sequential circuits	Analyzing Level (C4)
C430-4.5	Understand Design for Testability (DFT), Built-In-Self-Test(BIST), and Test Vector Compression	Analyzing Level (C4)

Module No.	**Subtitle 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	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 algorithms	12
5.	Design For Testability and BIST Architecture	Introduction to Design for Testability (DFT), 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 **Total** **100**		

Project Based Learning: Students will learn about implementation of different ATPG algorithms for combinational and sequential circuit with the help of assignments.

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, 2013, **[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

Subject Code	17B11EC733	**Semester: ODD**	**Semester: 7th Session : 2020-21 Month : from July to December**
Subject Name	OPTICAL COMMUNICATION		
Credits	4	**Contact Hours**	3(L)+1(T)

Faculty (Names)	**Coordinator(s)**	Dr. Rahul Kaushik
	Teacher(s) (Alphabetically)	Dr. Rahul Kaushik

S. No.	Course Outcomes	Cognitive Levels
C412.1	Develop an understanding of optical fiber, its structure, types, and propagation and transmission properties.	Remembering (C1)
C412.2	Identify and examine the different kinds of losses and signal distortion in optical Fibers.	Analyzing (C4)
C412.3	Classify the Optical sources and detectors and their principle of operation.	Understanding (C2)
C412.4	Design a fiber optic link based on budget analysis.	Evaluating (C5)

Module No.	Subtitle of the Module	Topics	No. of Lectures
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, Total Internal Reflection, 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-	7

		Connector types, Single mode fiber connectors, Connector return loss.	
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, and laser diode rate equations. Reliability of LED & ILD.	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. Fibre alignment and joint loss.	6
6.	Photo detectors& 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**

Project Based Learning: Students will learn about the constituents of an optical link and their suitability/choice for any application. Understanding of various losses incur in an optical link provide requisite skills in design, analysis and evaluation of the performance of analog and digital optical fiber link. Students will be able to design an optical link with the given specifications. Designing based questions given in the assignments built-up the thought process of the students in the field applications.

Recommended Reading(Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in 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	18B12EC412	**Semester**Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** July to Dec
Course Name	Multimedia Communications		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Richa Gupta
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES Upon completion of the course, the students will be able to		**COGNITIVE LEVELS**
C430-7.1	familiarize with basics of data compression used in the development of various construction algorithms for source codes.	C3
C430-7.2	identify theoretical and practical requirements for implementation and designing of Error Resilient Codes.	C3
C430-7.3	learn fundamentals of transform coding, digital image processing and its applications.	C3
C430-7.4	analyse the need of image compression & video compression and distinguish between different image CODECs.	C4
C430-7.5	familiarize with psychoacoustic principle used in the development of audio codec standards.	C4

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of Information Theory	Introduction, Information Measure, Discrete entropy. Joint and conditional entropies.	3
2.	Data Compression	Uniquely Decipherable Codes and Instantaneous Codes. Kraft - McMillan inequality. Noiseless coding Theorem. Data Compression: Lossless Compression and Lossy Compression. Optimal codes. Construction algorithms of source codes – Huffman Codes, Shannon - Fano codes, Arithmetic Codes, Lempel Ziv Welch Code and Run Length Coding.	8
3.	Error Resilient Codes	Reversible Variable Length Codes: Introduction, Types of RVLCs, Construction Algorithms of Symmetrical and Asymmetrical RVLCs. Applications of RVLCs in Multimedia Communications.	8
4.	Multimedia Information Representation and Transform Coding	Introduction, Digital Principles, Representations of text, image, audio and video data. Transform Coding, Discrete Cosine Transforms – 1 D and 2D. Energy compaction.	3

5.	Digital Image Processing	Basics of digital image processing, Structure of the Picture Information, luminance and chrominance components, RGB components. Image Enhancement, Image segmentation, Image Restoration and Morphological Image Processing.	12
6.	Image Compression	Basics of Image Compression, Joint Photographic Expert Group (JPEG) compression.	3
7.	Video Compression	Basic principle of video processing, I, P and B pictures in video content, Structure of video frame, Macroblock, Motion Estimation and Compensation, Compression on the block level, Video Coding Standards.	4
8.	Audio Compression	Basics of Audio Signal Processing, Principle of Psychoacoustic and its applications, Audio Compression and Standards for Audio codec.	4
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Research Assignment, Assignment, Quiz, Class Tests)
Total	**100**

Project Based Learning: Students are required to prepare a consolidated summary (including approach, limitations, pros and cons, applications, scope etc.) of any recent research paper published in reputed International Conference or International Journal related to Multimedia Communications. They will submit this research assignment towards the end of the semester.

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. Bosi and R. Goldberg, Introduction to Digital Audio Coding and Standards. Kluwer Academic, Boston, 2003.
2.	R. C. Gonzalez and R. E. Woods, Digital Image Processing Using MATLAB, Prentice Hall, 2009.
3.	K. Sayood, Introduction to data compression, Elsevier, 4th edition.
4.	A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B11EC731**	**Semester ODD**	**Semester** 7th **Session** 2020 -2021 **Month from** Aug **to** Dec
Subject Name	Mobile Communication		
Credits	**4**	**Contact Hours**	**3-1-0**

Faculty (Names)	**Coordinator(s)**	Kuldeep Baderia, Juhi Gupta
	Teacher(s) (Alphabetically)	Bajrang Bansal, Juhi Gupta, Kuldeep Baderia, Vivek Dwivedi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C410.1	Explain the evolution of mobile communication and basics of all the wireless standards currently being employed.	Understanding Level (C2)
C410.2	Perform mathematical analysis of cellular systems and cellular capacity improvement designs.	Analyzing Level (C4)
C410.3	Analyze large and small scale propagation models and their design both mathematically and conceptually. Analysis of various fading models.	Analyzing Level (C4)
C410.4	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 Level (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	8

		GSM, security aspects. GPRS, UMTS.	
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	**20M41EC117**	**Semester:** ODD **(specify Odd/Even)**	**Semester: 1 Session: 2020-21 Month from Aug to Dec**
Course Name	**ADVANCED DIGITAL COMMUNICATION SYSTEMS**		
Credits	3	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Dr. Ashish Goel	
	Teacher(s) (Alphabetically)	Dr. Ashish Goel	

COURSE OUTCOMES- At the completion of the course, students will be able to		**COGNITIVE LEVELS**
C112.1	Understanding of line coding schemes and study of various issues related to ISI	Understanding Level (C2)
C112.2	Understand and analyse the Optimum filter realization for digital signals	Analyzing Level (C4)
C112.3	Understand the concepts of digital modulation techniques and evaluate their probability of error and bandwidth efficiency.	Evaluating Level (C5)
C112.4	Understanding of symbol and carrier synchronization and various equalization schemes.	Understanding Level (C2)
C112.5	Analyse different types of spread spectrum techniques.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	**Waveform Coding and Baseband Shaping for Data Transmission**	Overview of wave form coding scheme, Companding scheme for PCM system, Signal to Quantization Noise Ratio of Companded PCM system. Line codes and Power Spectral Density of line coding schemes, Intersymbol Interference: Ideal solution, Practical Solution and Correlative Coding. Eye pattern.	10
2.	**Optimal Reception of Digital Signals**	Baseband Signal Receiver, Peak signal to RMS Noise output Voltage Ratio, Probability of error, Optimum Threshold: Maximum Likelihood Detector and Bayes' Receiver, Optimal receiver design: calculation of the optimum filter transfer function, Optimum filter realization using Match filter, Probability of error of Matched filter, Optimum filter realization using Correlator	8
3.	**Digital Modulation Techniques**	Digital modulation formats, M-ray modulation techniques: Modulation, Demodulation, Power spectra, Bandwidth efficiency, symbol error probabilities. Channel capacity theorem for M-ary modulation formats. Minimum Shift keying: Effect of side lobes, MSK as FSK, Signal Space representation of MSK, Phase continuity in MSK, generation and reception of MSK, GMSK.	10
4.	**Synchronization and Equalization**	Synchronization: Phase Jitter in Symbol Synchronization, Carrier synchronization. Equalization: Maximum–Likelihood Sequence	7

		Estimation (MLSE), Linear equalization, Decision -feedback equalization, Reduced complexity ML detectors	
5.	**Spread Spectrum Signals for Digital Communication**	Model of spread spectrum digital communication system, Spreading code sequences; generation and properties: PN Sequence, Gold Code, Walsh Hadamard Code. Direct sequence spread spectrum signals; Frequency hopped spread spectrum signals, FDMA, TDMA, CDMA, Time hopping SS, Synchronization of SS systems.	7
		Total number of Lectures	**42**

Project based learning: Here, students will learn the advanced concept digital communication starting from the basics process of modulation, demodulation and its impairment. These schemes are of utmost importance to understand the concepts of any current or future generations of communication system and to design the same . Student will be able to design the physical layer of digital communication and to analyze the effect of ISI, effect of noise and fading issues. Students can perform the some simulation on Matlab to analyze the same. Understating of these techniques will further help to work in any core communication industry.

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.	John G. Proakis, "Digital Communication", McGraw Hill, 5th edition, 2013.
2.	H. Taub, D. L. Schilling and Gautam Saha, Principles of Communication Systems, 4th/ed, TMH, 2017
3.	S.Haykin, Digital Communication Systems ,John Wiley & Sons, 2013
4.	Don Torrieri, " Principles of Spread-Spectrum Communication Systems ", Springer, 2015.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester VII Session** 2020 -2021 **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