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	18B12EC420	**Semester Odd (specify Odd/Even)**	**Semester** 7 **Session** 2018 -2019 **Month from July** to Dec
Course Name	Smart and Sustainable Systems		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Vinay Anand Tikkiwal
	Teacher(s) (Alphabetically)	Vinay Anand Tikkiwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the motivation for sustainable systems; implementation challenges and policy initiatives. Understand the basics of smart systems including sensors, sensor network integration, Internet of Things (IOT). Illustrate the role of smart technologies in implementing sustainable systems.	Understanding (Level II)
CO2	Understand the basics of renewable sources of energy and fundamentals of smart grids. Analyzing the role of renewable energy in sustainable systems.	Analysis (Level IV)
CO3	Illustrate the concept of sustainable urban infrastructures. Application of electronic and digital technologies to urbanization issues, smart urban transportation: electric vehicles (EVs).	Analysis (Level IV)
CO4	Understand the role of ICTs in reducing GHG emissions, green data centers, and energy efficient wireless and wired communications.	Understanding (Level II)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Motivation for sustainable systems, requirements, implementation challenges. Introduction to smart systems and their role in implementing sustainable systems.	3
2.	Smart Systems	Basics of Sensors, Actuators and Controllers, Sensor network integration, IOT, Smart Integrated systems.	6
3.	Green Energy	Fundamentals of renewable energy. Hybrid Energy Systems: configurations, design and optimization techniques.	8
4.	Smart Grids	Communication in power systems, smart grid technologies, grid integration, issues in grid integration, smart grid policy and regulation.	7
5.	e-Mobility	Basics of Electric Vehicles, Vehicle Types, EV infrastructure: Hardware; Specifications, Policies, Feasibility analysis, Infrastructural Issues, Economics of EV, Prospects in India.	7
6.	Smart Cities	Green Construction, Zero-Energy buildings, Smart urban transportation and Smart urban energy systems, Electronic and Digital Technologies, Instrumentation intelligence,	6

		Transition issues, Policies, Smart Cities Mission, India.	
7.	Green ICT	ICTs for sustainable development, Introduction to Green ICT Strategies, Green data centers, Energy efficient wireless and wired communications, recycling of ICT equipment, energy harvesting and CO_2 capturing methods.	5
		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.	Lin, Y.-L., Kyung, C.-M., Yasuura, H., Liu, Y (Eds.), *Smart Sensors and Systems*, Springer, 2015.
2.	Kamal, R., *Internet of Things Architecture and Design Principles*, 1st. Ed., Chennai, McGraw Hill Education (India), 2017.
3.	Kothari, D.P., Singal, K.C. and Ranjan, R., *Renewable Energy Sources and Emerging Technologies*, 2nd ed., Delhi: Prentice Hall of India, 2016.
4.	Momoh, J., *Smart Grid: Fundamentals of Design and Analysis*, Wiley-IEEE Press, 2012.
5.	Sharma, P., and Rajput, S. (Eds.), *Sustainable Smart Cities in India: Challenges and Future Perspectives*, Springer Nature, 2017.
6.	McClellan, S., Jimenez, J.A., Koutitas, A. (Eds.), *Smart Cities: Applications, Technologies, Standards, and Driving Factors*, Springer Nature, 2018.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NEC742	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from** July to December
Course Name	Introduction to data analysis with R		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Kapil Dev Tyagi
	Teacher(s) (Alphabetically)	Dr. Kapil Dev Tyagi

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Identify continuous/discrete probabilistic models for a given random variable distribution	Applying (C3)
CO2	Test for hypothesis using statistical tests like z-test, t-test ANOVA etc.	Analyzing (C4)
CO3	Explain unsupervised and supervised machine learning algorithms	Understanding (C2)
CO4	Utilize software in Matalb/R languages for implementation of ANOVA, Regression, and Machine learning techniques	Applying (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Software	Introduction to R and MATLAB programming for data analysis.	4
2.	Probabilistic models	Probabilistic models: Events and their probabilities, Rules of probability, Conditional probability and independence, Distribution of a random variable, Expectation and variance, Families of discrete distributions, Families of continuous distributions.	10
3.	Statistics	Descriptive statistics, Inferential statistics, Hypothesis testing and estimation (z-test, t-test, proportional z-test) ANOVA, Regression.	12
4.	Machine Learning	Introduction to Unsupervised and Supervised machine learning algorithms like ordinary least squares method, k-NN technique, Logistic regression etc.	8
5.	Simulations of data analysis techniques	Detailed simulation of ANOVA, Regression, and Machine learning techniques in Matalb/R languages.	5
6.	Data smoothing	Introduction to smoothing functions. Nonparametric smoothing, functional linear models, dimensional reduction functional principle components analysis.	3
		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.	A. Maheshwari, Business Intelligence and Data Mining Made Accessible, Createspace Independent Pub, 2014.
2.	E. Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Revised and Updated, John Wiley & Sons, 2016.
3.	Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4.	https://www.datacamp.com/courses/free-introduction-to-r
5.	https://onlinecourses.science.psu.edu/statprogram/r
6.	http://www.iiserpune.ac.in/~ayan/MTH201/Sahoo_textbook.pdf

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	16 B19EC691	**Semester Odd (specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from July**
Course Name	Renewable Energy		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Vinay A. Tikkiwal
	Teacher(s) (Alphabetically)	Mandeep Narula, Vinay A. Tikkiwal

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the need of renewable sources of energy, impact of renewable energy on environment, challenges in the electric grid, Smart Grid.	Understanding (Level II)
CO2	Analyze basics of Solar radiation and Solar photovoltaics, Balance of PV systems	Analysis (Level IV)
CO3	Analyze wind energy resource and designing of Wind Energy Generators	Analysis (Level IV)
CO4	Illustrate different biomass energy resources, and extraction of biomass energy	Understanding (Level II)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Overview of energy use and related issues, major energy options, issues of supply and demand, energy conversions, global climate change issues, effects on ecology and biodiversity, status of renewable energy in India.	4
2.	**Solar Energy**	Fundamentals of Solar radiation, Solar Resource Assessment, Solar Photovoltaics, Balance of PV Systems, and Solar Thermal.	10
3.	**Wind Energy**	Wind resource, Basics of aerodynamics, Maximum power extraction from wind resource fundamental power equations, Basic design concepts of Wind Energy Generators	8
4.	**Biomass Energy**	Biomass resource, extracting biomass energy, landfill gas, waste to energy, energy balances and economics.	6
5.	**Electric Grid**	Basic operations, performance related issues, new developments and challenges in the electric grid.	2

		Total number of Lectures	**30**

Evaluation Criteria

Components	**Maximum Marks**
Mid-Term	30
End Semester Examination	40
TA	30
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.	Solanki, C.S., *Solar Photovoltaics: Fundamental, technologies and applications*, 3rd ed., Delhi: Prentice Hall of India, 2015
2.	Momoh, J., *Smart Grid: Fundamentals of Design and Analysis*, Wiley-IEEE Press, 2012.
3.	Ahmed S., *Wind Energy: Theory and Practice*, 3rd ed., Delhi: Prentice Hall of India, 2016
4.	Earnest J., *Wind Power Technology*, 2nd ed., Delhi: Prentice Hall of India, 2015
5.	Kothari, D.P., Singal, K.C. and Ranjan, R., *Renewable Energy Sources and Emerging Technologies*, 2nd ed., Delhi: Prentice Hall of India, 2016.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC421	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month from** July to December
Course Name	Image Analysis and Feature Extraction		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Abhishek Kashyap
	Teacher(s) (Alphabetically)	Dr. Abhishek Kashyap

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understanding the facts and ideas of Image Processing and demonstrate the review of Signal processing, Matrix algebra and Probability.	Understanding (Level II)
CO2	Develop the basic understanding of Sampling and Quantization of the processed Image and its Transforms.	Applying (Level III)
CO3	Examine the result in the processed image by applying Edge detection, Segmentation, Registration, Tracking and Reconstruction.	Analyzing (Level IV)
CO4	Determine the object recognition, Image compression and its optimization using Nature inspired algorithm.	Evaluating (Level V)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	What is Image Processing? Review of Signal processing, Matrix algebra, Probability/Statistics	7
2.	Image Processing	Sampling and Quantization, Image Transforms, Stochastic Models for Images, Image Enhancement, Image Filtering, Image Restoration	10
3.	Image Analysis/Computer Vision	Edge detection, Boundary Extraction, Segmentation, Level Set Method (brief introduction), Registration, Tracking, Reconstruction from Projections (Radon-transform, Fourier-transform, recent methods)	10
4.	Estimation topics	In the context of restoration, registration, segmentation, tracking, Bayesian cost functions, Least squares estimation, EM algorithm, alternating minimization, Monte Carlo methods, Kalman filter	10
5.	Nature inspired algorithm	Object Recognition, Image compression and optimization using Nature inspired algorithm	8

Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance: 10 Marks, Assignment: 5 Marks, Presentation: 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.	Milan Sonka et al: Image Processing, Analysis and Computer Vision
2.	Gonzalez and Woods: Digital Image Processing
3.	Rafael C.G. and Woods R.E.(1992) Digital Image Processing.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**15B1NEC732**	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2018 -2019 **Month from : July to Dec**
Course Name	Speech Signal Processing		
Credits	4	**Contact Hours**	3L+1P

Faculty (Names)	**Coordinator(s)**	B .Suresh
	Teacher(s) (Alphabetically)	B.Suresh

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Students will demonstrate knowledge of speech signal processing technologies.	Applying (Level III)
CO2	Students will demonstrate the ability to think critically in making decisions based on estimated parameters of speech.	Analyzing (Level IV)
CO3	Students will demonstrate effective communication skills that facilitate the effective presentation of analysis results obtained from analysis and develop a system which can perform desired task.	Understanding (Level II)
CO4	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support various decision-making situations	Applying (Level III)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Fundamentals of Human Speech Production	Introduction, The Process of Speech Production, Short-Time Fourier Representation of Speech, Acoustic Phonetics , Distinctive Features of the Phonemes of American English	5
2.	Time-Domain Methods for Speech Processing	Short-Time Analysis of Speech, Short-Time Energy and Short-Time Magnitude Short-Time Zero-Crossing Rate, The Short-Time Autocorrelation Function ,The Modified Short-Time Autocorrelation Function, The Short-Time Average Magnitude Difference Function	8
3.	Frequency-Domain Representations	Discrete-Time Fourier Analysis,Short-Time Fourier Analysis , Spectrographic Displays, Overlap Addition Method of Synthesis, Filter Bank Summation Method of Synthesis,	8

		Time-Decimated Filter Banks, Two-Channel Filter Banks, Implementation of the FBS, Method Using the FFT, OLA Revisited ,Modifications of the STFT.	
4.	The Cepstrum and Homomorphic Speech Processing	Homomorphic Systems for Convolution, Homomorphic Analysis of the Speech Model , Computing the Short-Time, Cepstrum and Complex Cepstrum of Speech, Homomorphic Filtering of Natural Speech, Cepstrum Analysis of All-Pole Models Cepstrum Distance Measures	8
5.	Linear Predictive Analysis of Speech Signals	Computation of the Gain for the Model ,Frequency Domain Interpretations of Linear Predictive Analysis, Solution of the LPC Equations The Prediction Error Signal	8
6.	Digital Coding of Speech Signals	Sampling Speech Signals A Statistical Model for Speech Instantaneous Quantization Adaptive Quantization Quantizing of Speech Model Parameters General Theory of Differential Quantization Delta Modulation Differential PCM (DPCM) Enhancements for ADPCM Coders ,Analysis-by-Synthesis Speech Coders Open-Loop Speech Coders Applications of Speech Coders	5
Total number of Lectures			**42**

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.	L. Rabiner, R. Schafer, Theory and Applications of Digital Speech Processing, Pearson, 2011
2.	J. R. Deller, J. H. L. Hansen, J. G. Proakis. Discrete-Time Processing of Speech Signals. IEEE Press, 2000
3.	Speech and Language Processing, 2nd Edition By Daniel Jurafsky, James H. Martin Published by PearsonCopyright © 2009 Published Date: May 16, 2008

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12EC422**	**Semester** Odd **(specify Odd/Even)**	**Semester 7th Session 2018 -2019 Month from: July to Dec. 2018**
Course Name	Wireless Sensor Networks		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Anuradha Phugat
	Teacher(s) (Alphabetically)	Dr. Anuradha Phugat

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Understanding the issues, applications and challenges related to implications of Wireless Sensor Networks (WSN).	Applying (C 3)
CO2	Understanding and demonstrating the hardware and software requirements for a given WSN application and to build a cost effective solution.	Applying (C 3)
CO3	Analyzing and designing various MAC and routing protocols for a given application scenario of WSN.	Creating (C 6)
CO4	Analysis of different data collection, protocol, hardware and OS selection methods to develop a real time wireless sensor network.	Creating (C 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Characteristic requirements for wireless sensor networks, Challenges for WSNs, Comparison of sensor network with ad hoc network, Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor Networks	9
2.	Physical Layer	Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication, packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management.	9
3.	Data Link Layer	MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols –fundamentals task and requirements, error control techniques, framing schemes, link management-Link-quality characteristics, Link-quality estimation	9
4.	Network Layer	Forwarding and routing, Gossiping and agent-based unicast forwarding: Randomized forwarding, Random walks,	9

		Energy-efficient unicast, Broadcast and multicast, geographic routing: position-based routing, Geocasting, mobile nodes: Mobile sinks, Mobile data collectors, Mobile regions, Data –centric and content-based networking –Data-centric routing, Data aggregation, Data-centric storage, Cross layer design issues	
5.	Case Study	Target detection tracking, Contour/edge detection, Field sampling, Habitat monitoring, Environmental disaster monitoring, Practical implementation issues, IEEE 802.15.4 low rate WPAN (LR-WPAN) Standards, Sensor Network Platforms and tools-Sensor node hardware, Node-level software platforms, node –level simulators.	9
		Total number of Lectures	45

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.	Holger Karl and Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Ltd, 2005.
2.	Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology, Protocols, and Applications“, John Wiley & Sons, 2007.
3.	K. Akkaya and M. Younis, “A survey of routing protocols in wireless sensor networks”, Elsevier Ad Hoc Network Journal, 2005, Vol. 3, no. 3, pp. 325—349.
4.	David Gay and Philip A. Levis, “ TinyOS Programming”, Cambridge University Press, New York, 2009
5.	Anna Ha´c, “Wireless Sensor Network Designs”, John Wiley & Sons Ltd, New York, 2003.
6.	Edgar H. Callaway, Jr., “Wireless Sensor Networks : Architecture and protocols”, Auerbach Publications, (CRC press), 2003.

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	**17B1NHS732**	**Semester :** Odd	**Semester** VII **Session** 2018 -2019 **Month from** July 2018 to Dec 2018
Course Name	Indian Financial System		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Mukta Mani(Sec62), Dr. Sakshi Varshney(Sec128)	
	Teacher(s) (Alphabetically)	Dr. Mukta Mani(Sec62), Dr. Sakshi Varshney(Sec128)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C401-1.1	Understand the inter-linkage of components of financial system and financial instruments of Money market and Capital market.	Understanding Level (C2)
C401-1.2	Analyze ways of fund raising in domestic and international markets	Analyzing Level (C4)
C401-1.3	Understand functioning of Stock market and evaluate securities for investment.	Evaluating Level (C5)
C401-1.4	Apply the knowledge of Mutual Funds and Insurance in personal investment decisions	Applying Level (C3)
C401-1.5	Apply knowledge of Income tax for calculation of tax liability of individual.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Meaning, Importance, and functions of Financial system. Informal and Formal financial system, Financial markets, Financial Institutions, Financial services and Financial instrument	4
2.	Money Market	Features of money market Instruments: Treasury bills, commercial bills, commercial papers, certificates of deposit, call and notice money, Functions of money market, Linking of	5

		money market with Monetary policy in India	
3.	Capital Market	Features of Capital market instrument: Equity shares, Bonds. Fund raising through Initial Public Offering, Rights issue, Preferential allotment and Private Placement. Process of IPO-Intermediaries in IPO, Book building process and allotment of shares	6
4.	Foreign investments in India	Fund raising from foreign market through: Foreign direct investment and foreign institutional investment, ADR, GDR, ECB, and Private equity.	5
5.	Stock Market	Trading in secondary market- Stock exchanges, regulations, demutualisation, broker, listing of securities, dematerialisation, trading, short selling, circuit breaker, stock market indices-methods of calculation of indices.	5
7.	Stock Valuation and Analysis	Investing basics: Consideration of Risk and Return, Stock Valuation and Analysis-Fundamental analysis: Economy, industry and company analysis; Technical Analysis of stocks using technical charts	6
8.	Investing in Mutual Funds and Insurance	Mutual Funds: Basics, Types of funds, risk and return considerations in selection of funds; Insurance: Basics, Life insurance and health insurance, types of policies	4
9.	Overview of Income Tax	Basics of Income tax- Concept of previous year, assessment year, person, income. Calculation of Income tax liability for individuals: Income from salaries- basic, DA, HRA, leave salary pension and other allowances; Income from House Property- self occupied house, rented house; Income from Capital Gain, Deductions under section 80C to 80U.	7
Total number of Lectures			**42**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, class test)
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.	Pathak Bharti V, *Indian Financial System,* 3rd Ed.,Pearson Education, 2013
2.	Madura Jeff, *Personal Finance*, 5th Ed, Pearson Education, 2013.
3.	Machiraju H R, *Indian Financial System*, 4th Ed, Vikas Publication, 2010
4.	Bhole L M, *Financial Institutions and Markets*, 4th ed. Tata McGraw Hill Publication, 2006.
5.	Singhania & Singhania, Students Guide to Income Tax, Taxmann Publication, 2013.

Detailed Syllabus

Lecture-wise Breakup

Course Code	18B12MA411	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month from** July 2018 to December 2018
Course Name	Ecological Mathematical Modelling		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Lakhveer Kaur	
	Teacher(s) (Alphabetically)	Dr. Lakhveer Kaur	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C401-10.1	Explain the concept of Mathematical Modelling with its classifications and limitations.	Understanding Level (C2)
C401-10.2	Explain continuous and discrete time model formulations with ecological interactions.	Understanding Level (C2)
C401-10.3	Demonstrate exponential growth, self-limited growth, period-doubling bifurcations and chaos.	Applying Level (C3)
C401-10.4	Analyze stability of ecological systems using ordinary differential equations.	Analyzing Level (C4)
C401-10.5	Analyze and interpret results of various ecological systems.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction of mathematical modelling	Introduction to modelling, Definition and examples, Classification of mathematical modelling, Dimensional Analysis, Traffic flow modelling, Techniques of mathematical modelling.	8
2	Characteristics of mathematical modelling	Characteristics of mathematical modelling, Steps in mathematical modelling, Limitations of mathematical modelling.	7
3	Single species population models	Continuous and discrete time model formulations and analysis, Exponential growth, self-limited growth, Period-doubling bifurcations, chaos.	7
4	Stability Analysis	Nondimensionalisation, linear stability analysis Graphical stability analysis and cobweb diagrams, Harvesting problems, insect population dynamics, Insect outbreak models.	7
5	Multi species population models	Models for interacting species, symbiotic, competitive, predator-prey host-parasite ecological interactions; Age-structured models.	7

6	Development and Analysis of mathematical models	Developing mathematical models from descriptive information of ecological systems, Model analysis and biological interpretation of results.	6
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.	**Giordano, F. R., Weir, M. D. and Fox, W. P.,** A First Course in Mathematical Modeling, Brooks/Cole Publishing, Pacific Grove, CA, 1997.
2.	**Gibbons, M. M.**, A Concrete Approach to Mathematical Modeling, John Wiley and Sons, 2007.
3.	**Kapur, J. N**., Mathematical Modeling, New Age International (P) Ltd. Publishers, New Delhi, 2015.
4.	**Britton, N. F.** , Essential Mathematical Biology, Springer International Edition, 2003.
5.	**Murray, J. D**., Mathematical Biology, Springer International Edition, 2002.

Detailed Syllabus

Course Code	18B12CS424	**Semester Odd**	**Semester** VII **Session** 2018 -2019 Month from July to December
Course Name	Algorithm Analysis and Artificial Intelligence		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Varsha Garg
	Teacher(s) (Alphabetically)	Varsha Garg

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Analyse algorithm's time complexities (Master's method, Recursion tree and substitution method- Sorting and Searching algorithms)	Analyse Level (Level 4)
CO2	Propose solutions for real life computing problems using greedy, divide & conquer, and dynamic programming techniques.	Create Level (Level 6)
CO3	Apply informed and uninformed searching algorithms(A*, Hill Climbing and Simulated Annealing) in AI related problems.	Apply Level (Level 3)
CO4	Solve constraint satisfaction problems and adversarial search algorithms	Create Level (Level 6)
CO5	Apply inference mechanisms(propositional logic , first order predicate logic, and probabilistic reasoning)	Apply Level (Level 3)
CO6	Design and simulate Genetic Algorithms for Optimization.	Create Level (Level 6)

Sr.	**Module**	**Chapters**	**Lectures**
1.	Introduction	Time Complexity analysis: Master's Method. Divide and Conquer methods: Insertion Sort, Merge Sort, Quick Sort	04
2.	Greedy Algorithms	Knapsack Problem; Coin change Problem; Huffman Coding; Activity Selection; Minimum Spanning tree	05
3.	Dynamic Programming Algorithms	Knapsack Problem; Coin change Problem; Matrix chain Multiplication, Longest common subsequence	05
4.	Artificial Intelligence : Problem Solving- I	State Spaces, Uninformed search strategies (BFS, DFS, DLS, IDS, Bidirectional search),	05
5.	Problem solving-II	Informed Search & Explorartion (A*,Heuristic, 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 vs First order inference, Unification amd lifting, f/w and b/w chaining) ,	05
8.	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	04
9.	Genetic Algorithms	Travelling Salesman Problem, Knapsack Problem, Linear Programming	04
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+Test)
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.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein , Introduction to Algorithms, MIT Press, 3rd Edition, 2009
2.	Steven Skiena ,The Algorithm Design Manual, Springer; 2nd edition , 2008
3.	Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3 edition,1997
4.	Horowitz and Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978
5.	Artificial Intelligence – A modern approach by Stuart Russel and Peter Norvig, PHI, 2008.
6.	Artificial Intelligence Review: An International Science and Engineering Journal, Springer
7.	Nunes de Castro, Leandro, " Nature-Inspired Computing Design, Development, and Applications" IGI Global, 31-May-2012 - 435 pages

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12HS412	**Semester Odd**	**Semester VII Session** 2018 -2019 **Month from July 2018 - December 2018**
Course Name	HUMAN RESOURCE ANALYTICS		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr Kanupriya Misra Bakhru
	Teacher(s) (Alphabetically)	Dr Kanupriya Misra Bakhru

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-20.1	Understand different analytical techniques used for solving HR related problems**.**	Understand Level (C 2)
C401-20.2	Apply descriptive and predictive analysis techniques to understand trends and indicators in human resource data.	Applying Level (C 3)
C401-20.3	Analyze key issues related to human resource management using analytical techniques.	Analyze Level (C 4)
C401-20.4	Critically asses and evaluate the outputs obtained from analytical tools and recommend HR related decisions.	Evaluate Level (C 5)
C401-20.5	Create hypotheses, propose solutions and validate using appropriate analytical tehcniques	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Human Resource (HR) Analytics	Understanding the need for mastering and utilizing HR analytic techniques, Human capital data storage and 'big (HR) data' manipulation, Predictors, prediction and predictive modeling, Current state of HR analytic professional and academic training, HR's Contribution to Business Value, the Changing Nature of HR.	8
2.	Human Resource information systems and data	Understanding HR metrics and data, Data collection, tracking, entry, Data availability in the entire Employment Lifecycle, Approaches and costs of collecting HR related data, Analysis software options, Using SPSS, Preparing the data.	8
3.	Analysis Strategies	From descriptive reports to predictive analytics, Statistical significance, Data integrity, Types of data, Categorical variable types, Continuous variable types, Using group/team-level or individual-level data, Dependent variables and independent variables, Introduction of tools for HR data analysis: Correlation, Regression, Factor Analysis, Cluster Analysis, Structural equation modeling.	10
4.	Application of Human Resource Analytics	Workforce Planning Analytics, Diversity Analytics, Talent Sourcing Analytics, Talent Acquisition Analytics, Talent Engagement Analytics, Training and Intervention Analytics, Analytical Performance Management, Retention	10

		Analytics.	
5.	Future of Human Resource Analytics	Rise of Employee Behavioral Data, Automated Big Data Analytics, Big Data Empowering Employee Development, Quantification of HR, Artificial Intelligence in HR.	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, 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.	Bhattacharyya, HR Analytics: Understanding Theories and Applications, Sage, 2017
2.	Pease, Byerly and Jac Fitz-enz, Human Capital Analytics: How to Harness the Potential of Your Organization's Greatest Asset, Wiley, 2012
3.	Isson, Harriott and Jac Fitz-enz, People Analytics in the Era of Big Data: Changing the Way You Attract, Acquire, Develop, and Retain Talent, Wiley, 2016
4.	Guenole, Ferrar and Feinzig, The Power of People: How Successful Organizations Use Workforce Analytics To Improve Business Performance, First Edition, Pearson, 2017
5.	Sesil, Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing, Incentive and Improving Collaboration, Pearson, 2014

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NHS731	**Semester** ODD	**Semester 7th Session** 2018 -2019 **Month from** July 2018 to December 2018
Course Name	DISASTER MANAGEMENT		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr Nilu Choudhary
	Teacher(s) (Alphabetically)	Dr Nilu Choudhary

COURSE OUTCOMES		**COGNITIVE LEVELS**
C4O1-2.1	Understand disasters, their hazards and natural and social phenomena related to them.	Understanding level(C2)
C4O1-2.2	Analyse information on risks and relief	Analyzing level(C4)
C4O1-2.3	Make use of disaster management principles and community involvement methods in Disaster Risk Reduction.	Apply level(C3)
C4O1-2.4	Evaluate the role of different approaches and Humanitarian Assistance needed to manage pre and post- disaster periods	Evaluate level(C5)
C4O1-2.5	Formulate strategies for mitigation in future scenarios by applying technological innovations and learning lessons from past.	Creating level(C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Disasters**	Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks	4
2.	**Disasters: Types Of Disaster**	Natural and manmade disasters, their Impacts, Hazards.	4
3.	**Disaster :Caste, Class and Gender**	Caste and disaster, Disaster discrimination, Social class, Differential impacts of disaster - in terms of caste, class, gender, age location, Role of Women's in Disaster.	5
4.	**Approaches to Disaster Risk reduction**	Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, Structural - nonstructural measures roles and responsibilities of community	5
5.	**Inter-relationship between Disasters and Development:**	Factors affecting Vulnerabilities, differential impacts, impact of appropriate technology and local resources.	5
6.	**Disaster Risk Management in India**:	Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health	5

7.	**Risk Society**	Risk Society in 1992,Ulrick Beck, Processes of Modernization, The new paradigm of risk society	4
8	**Disaster Management Act(2005)**	DM Act and Policy, Other related policies, plans, programmes and Legislation).	2
9	**Global trends in disasters, Urban Disaster, Pandemics, Climatic Change and Complex Emergencies**	MDG and Disaster, Agenda 21: For Local actions, Global trends in disasters, urban disasters, pandemics, Epidemics, complex emergencies, Climate change.	4
10	**Disaster, Environment and Development**	Environment Management, Importance of Waste Management, Types of Disaster Waste, Sources of Waste	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Oral Questions)
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.	National Disaster Management Policy. Government of India, 2009.
2.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi. 2011
3.	Indian Journal of Social Work. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April. 2002
4.	Alexander David, Introduction in "Confronting Catastrophe", Oxford University Press, 2000
5	Coppola P Damon, Introduction to International Disaster Management, Elsevier. 2007

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS734	**Semester** Odd		**Semester** VII **Session** 2018 -2019 **Month from** July 2018 to Dec 2018	
Course Name	Managerial and Communication Skills				
Credits	3		**Contact Hours**	3-0-0	
Faculty (Names)	**Coordinator(s)**	Dr. Anshu Banwari			
	Teacher(s) (Alphabetically)	Dr. Anshu Banwari			

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-3.1	Demonstrate understanding of basic aspects of business communication and realize the importance of it	Understand Level (C2)
C401-3.2	Assess one's and other's communication skills and adapt oneself in order to meet challenges at the competitive workplace	Evaluate Level (C5)
C401-3.3	Apply the appropriate conflict handling style for effective conflict management	Apply Level (C3)
C401-3.4	Demonstrate understanding about the opportunities and challenges of intercultural communication and recognizing cultural variations	Understand Level (C2)
C401-3.5	Apply the appropriate steps for better decision making by interpreting information	Apply Level (C3)
C401-3.6	Develop an understanding of professional ethics	Apply Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Communication Skill Assessment (CSA) & Development Plan	Build an overall understanding and expectations of the professional environment, Introspection and SWOT analysis of self, Gap Analysis, Guidelines for developing necessary skills and required knowledge to help students in their professional life, Strategies in the Job- Search process, Work on their personality profile and communication skills to make them ready to face the professional world	5
2.	Fundamentals and Functions of Business Communication	Definition and Importance of Business Communication, Communication requirements and characteristics of Managerial Communication, Interpersonal & Intrapersonal Business Communication	5
3.	Building Active Communication Skills	Writing for effect in business messages, Listening, Formal Speaking, Defensive and Non-Defensive Communication, Corporate Body language, Audio and Visual communication, Business Etiquettes and Mannerism	5

4.	Conflict Resolution and Negotiation skills	Origins of Conflict, Guidelines for Effective conflict management, Effective Negotiation in professional environment, Gaining leverage through Persuasion, Impasse and Alternative Dispute Resolution (ADR)	5
5.	Corporate communication	Meeting Management: Need and Importance of Meetings, Conduct of Meeting, Public Relations : Meaning, Functions of PR Department, Roles and responsibilities of an Internal and External PR team, Corporate Social Responsibility	5
6.	Group Discussion and Interview Preparation and, Psychometric Tests	Introduction to the Job recruitment process, Criteria and methods of selection, Interview and GD concepts. Types of Interviews – Selection, Appraisal, Grievance, Exit, Preparing for an Interview, mock group discussion sessions, Psychometric Tests: Importance, Pattern & Practice sessions	5
7.	Data Interpretation and Decision making	Importance of Data Interpretation, Decision Making Techniques, Case Study: Approaches to solve , Reasoning: Interpretation Techniques	5
8.	Communicating Interculturally	Understanding the opportunities and challenges of Intercultural communication, Enhancing Intercultural sensitivity, Improving intercultural communication skills	5
9.	Ethics of Business Communication	Ethics, Fairness & Trust in Business Communication	2
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Discussion Questions)
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.V. Lesikar, & M.E. Flatley,** Basic Business Communication Skills for Empowering the Internet Generation, 10th Ed,Tata McGraw Hill Publishing Company, 2005
2.	**S. Sengupta,** Business and Managerial Communication, Prentice Hall of India, 2011.
3.	**A.C. Krizan, P. Merrier, J. Logan, & K. Williams**, Business Communication, 7th Ed, Thomson South-Western, 2008.
4.	**C.L.Bovee, J.V.Thill** , Business Communication Today,8th Ed, Pearson Education, 2008

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
Lecture-wise Breakup

Subject Code	17B1NPH731	**Semester : Odd**	**Semester: I**, **Session :** 2018 -2019 Month from: July to December
Subject Name	Introduction to Quantum Information Processing		
Credits	**03**	**Contact Hours**	**03**

Faculty (Names)	**Coordinator(s)**	Prof Anirban Pathak and Dr Amit Verma
	Teacher(s) (Alphabetically)	Prof Anirban Pathak and Dr Amit Verma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-5.1	Correlate Quantum Information Processing and their applications in quantum communication and computation.	Remembering (C1)
C401-5.2	Explain quantum information, Qubit, quantum gates, and quantum circuits. Their applications in quantum computing, quantum cryptography and communications.	Understanding (C2)
C401-5.3	Demonstrate the use of basic principles in solving various problems related to quantum circuits with the use of linear algebra and many algorithms and protocols.	Applying (C3)
C401-5.4	Prove and estimate solution of numerical problems using physical and mathematical concepts involved with various quantum circuits.	Evaluating (C5)
C401-5.5	Design of quantum circuits of desired output for quantum cryptography applications.	Creating (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	What is information? Why do wee need to know how to manage the information growth? Is the information independent of physical laws used to store and process it? What is the present status of the subject and how far can we go? Definitions of classical information, Quantum information and their differences.	**3**
2.	Thermodynamics and statistical mechanics	Introduction to thermodynamics; First and second law of thermodynamics; Microstates and Macro states; Entropy, Conditional entropy; Entropy as a measure of disorder (up to S = kln (omega)	**6**
3.	Classical theory of information	Basic ideas of classical information theory, Measures of information (information content and entropy); Maxwell's Demon; Data compression; The binary symmetric channel; error correcting codes; Classical theory of computation; Universal computer; Turing machine; Computational complexity; Uncomputable functions; Shortcomings of classical information theory and necessity of information theory.	**8**
4.	Introduction to quantum mechanics	Basic ideas of quantum mechanics; Probability	**8**

		interpretation; Measurement problem; Hilbert space; Schrodinger equation.	
5.	Quantum information	Quit; Quantum gates; No cloning theorem (Why quantum information can't be perfectly copied); Dense coding; Quantum teleportation; Quantum data compression; Quantum cryptography; The universal quantum computer; Universal gate; Church-Turing principle; Quantum algorithms; Simulation of Physical systems; Shor's factorization algorithm; Grovers's search algorithm; Experimental quantum information processors; Quantum error correction.	**9**
6	Computers and Intelligent machines	Basic ideas of quantum computers and intelligent machines.	**4**
7	Summary	Summary of entire course and a short of introduction to the present goals of quantum information technology.	**2**
		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.	Neil Gershenfeld, The Physics of information technology, Cambridge University Press.
2.	H Hirvensalo, Quantum computing, Springer Verlag.
3.	Lecture notes for Physics 229: Quantum Information and Computation, John Preskil http://www.theory.caltech.edu/people/preskill/ph229/#describe
4	Andew steane, Quantum computing, Rep. Prog. Phys. 61, 117-173 (1998) or quant-ph/9708022 http://xxx.lanl.gov
5	P A M Dirac, The principles of Quantum mechnaics, Oxford University Press.
6	David J.C. MacKay, Information Theory, Inference and Learning Algorithm.
7	A. Barenco, Quantum Physics and Computers, Contemporary Physics, **37**, 375-89 (1996).
8	C.H. Bennett, Quantum Information and Computattion, Physics Today, Oct., 1995, **24-30** (1995).
9	A. Ekert, P. Hayden, H Inamori, Basic concepts in quantum computation, quant-ph/ 0011013.
10	D. Gottesman and H K Lo, From quantum cheating to quantum security, Physics Today, Nov., 2000.
11	J Preskill, battling decoherence: the fault – tolerent quantum computer. Physics Today, 24-30, June 1999.
12	A. M. Steane and W. Van Dam, Physicists triumph at guess my number, Physics Today, 35-39, Feb. 2000.
13	V. Vedral and M. B. Plenio, Basics of quantum computation, Prog. Quant. Electron, 22 1-39 (1998)
14	A. Zeilinger, Fundamentals of quantum information, Physcs World, 11, March, 1998.

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NPH732	**Semester :ODD**	**Semester** VII **Session** 2018 -2019 **Month: July-December**
Course Name	Green Energy and Climate Modeling		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Prashant Chauhan
	Teacher(s)	Dr. Prashant Chauhan

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-6.1	Recall the basic information about different energy resources, reserves and define the problem with fossil fuel	Remembering (C1)
C401-6.2	Explain green house effect, modelling of temperature measurement and physics behind the global warming	Understanding (C2)
C401-6.3	Demonstrate the basic principles and designs of different solar collectors and concentrators, and identify the best design/material/location to absorb maximum solar energy	Applying (C3)
C401-6.4	Analyze the potential of different renewable energy sources like wind, ocean and bio mass energy	Analyzing (C4)
C401-6.5	Compare the output of renewable energy source using different design under different conditions/location	Evaluating (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Man and energy, world and Indian production /reserve of conventional energy sources, alternative energy sources.	02
2.	The greenhouse effect	Physics behind greenhouse effect, Blackbody radiation, layer model depending on energy flux and temperature at earth surface, radiation effect on Greenhouse gases, temperature structure of the atmosphere, Heat, pressure, wind, feedback mechanism. Carbon Cycle and Climate, Fossil Fuels, Effect of Conventional energy sources.	10
3.	Solar energy	Nature and availability of radiation, estimation of solar energy radiation. Effect of receiving surface, location and orientation, heat transfer consideration relevant to solar energy, Characteristics of materials and surface used in solar energy absorption. Device for thermal collection and storage	06
4.	Ocean Energy	Tidal energy, and its characteristics, tidal energy estimation, important component of tidal energy plant, single basin plant, double basin plant, turbine, tidal power plant development in India, wave energy, design parameters of wave energy plant, introduction and working of ocean thermal energy conversion,	06
5.	Wind Energy and Bio Mass energy	Introduction to wind energy, Nature, power, forces, conversion and estimation. Components of wind energy system types, safety and environment, Introduction to bio mass energy, conversion and utilization of biogas plants and gas fiers	10
6.	Fusion Energy	Basics of DT fusion, Magnetic confinement fusion, laser inertial fusion, present status of fusion reactors and future scope at international and national level	6
		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.	Global Warming : Understanding the forecast by David Archer, Wiley
2.	Kothari D.P. renewable energy resources and emerging technologies, Prentice of India
3.	G D, Non-conventional energy sources, Khanna Publishers
4.	Duffie J A & Beckmann W A, Solar engineering of thermal process, Wiley-International Publication

Detailed Syllabus

Lecture-wise Breakup

Course Code	17B1NMA731	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2018 -2019 **Month from** July 2018-Dec. 2018
Course Name	Applied Linear Algebra		
Credits	**3**	**Contact Hours**	**3-0-0**
Faculty (Names)	**Coordinator(s)**	Dr. R. C. Mittal	
	Teacher(s) (Alphabetically)	Dr. R. C. Mittal	

COURSE OUTCOMES : After pursuing the above mentioned course, the students will be able to:		**COGNITIVE LEVELS**
C401-7.1	explain field, vectors, vector spaces and their dimensions.	Understanding level (C2)
C401-7.2	apply linear transformations in solving practical engineering problems.	Applying Level (C3)
C401-7.3	develop the concept of rank, determinant, existence and uniqueness of solution of a system of linear equations.	Applying Level (C3)
C401-7.4	explain the concept of length, distance and inner-product.	Understanding level (C2)
C401-7.5	apply the concept of orthogonality and orthogonal matrices to orthogonalize a set of linearly independent vectors.	Applying Level (C3)
C401-7.5	analyze eigenvalues, eigenvectors and their properties to solve a system of ordinary differential equations.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Vector Space and Dimension	Field, Vector Space, Vector subspace, linear dependence and independence, Span of a set, Dimension of a vector space, Direct Sum and Complement	7
2.	Linear Transformation I	Linear Transformation and its algebra, and its matrix representation, homomorphism, isomorphism, rank and null subspace, rank-nullity theorem, Solution of a system of Linear Equations, Determinant	7
3.	Linear Transformation II	Change of basis, Inverse of a linear transformation, Linear functional, transpose	5
4.	Inner Product and Metric	Inner product space, Metric and normed spaces. Orthonormal basis, Orthogonal Subspaces, Gram-Schmidt orthogonalization.	8
5.	Eigen Values and Eigen Vectors	Eigen values and Eigenvectors, Modal matrix and diagonalization, Similarity Transformation, Eigen systems of real symmetric, orthogonal, Hermitian and unitary	9

		matrices	
6.	Applications of Linear Algebra	Bilinear and Quadratic forms, Positive definite matrices, Norm of a matrix, Condition number,Application to find solutions of ordinary differential equations	6
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignments, Quizzes)
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.	**Hoffman, K and Kunze, R.** , Linear Algebra, Fourth Edition, Prentice Hall of India, 2005
2.	**Strang, G**., Linear Algebra and its Applications, 3rd Ed., 1998
3.	**Noble, B. and Daniel, J.** , Applied Linear Algebra, Prentice Hall of India, 2000
4.	**Lipshutz, S. and Lipsom, M. ,** Linear Algebra, 3rd Edition, Schaum Series, 2001
5.	**Krishnamurthy, V., Mainra, V. P., and Arora, J. L.** , An Introduction to Linear Algebra, Affilated East-West, 1976

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	17B1NMA734	**Odd Semester**	**Semester** VII **Session** 2018 -2019 **Month from:** July 2018- December 2018
Course Name	Fuzzy Logic and Nature Inspired Optimization		
Credits	3	**Contact Hours**	**3-0-0**
Faculty (Names)	**Coordinator(s)**	Dr. Dinesh C. S. Bisht	
	Teacher(s) (Alphabetically)	Dr. Dinesh C. S. Bisht	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-9.1	Explain the basic concepts of fuzzy sets, fuzzy rules and fuzzy reasoning.	Understanding Level (C2)
C401-9.2	Apply fuzzy inference in the area of control and robotics.	Applying Level (C3)
C401-9.3	Compare the classical and nature inspired optimization techniques.	Understanding Level (C2)
C401-9.4	Apply various nature inspired techniques to solve optimization problems.	Applying Level (C3)
C401-9.5	Demonstrate MATLAB for aforementioned techniques.	Understanding Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basics	Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Membership Function Formulation, Fuzzy Rules and Fuzzy Reasoning.	6
2.	Fuzzy Logic and Applications	Crisp logic, Fuzzy Logic, Fuzzy Rule Based System, Defuzzification Methods, Fuzzy Inference Systems, Engineering Applications of fuzzy logic.	6
2.	Optimization	Introduction to Optimization, Finding the Best Solution, Minimum-Seeking Algorithms, Exhaustive Search, Analytical Optimization.	5
3.	Nature Inspired Optimization Techniques	Natural Optimization Methods, Biological Optimization, Binary Genetic Algorithm, Natural Selection on a Computer, Components of a Binary Genetic Algorithm, The Continuous Genetic Algorithm, Components of a Continuous Genetic Algorithm, Basic Applications, Introduction to Particle Swarm Optimization and Ant colony optimization.	17
4.	Practical	MATLAB Introduction, Files in MATLAB, Graphs,	8

	Application using MATLAB	Programming in MATLAB, Fuzzy logic toolbox, nature inspired optimization programming using MATLAB.	
Total number of Lectures			**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments)
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.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2.	Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
3.	Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989
4.	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
5.	S.N. Sivanandam & S.N. Deepa, Principles of Soft Computing, Wiley Publications, 2008.

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 VI)

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
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**

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**