Detailed Syllabus
Lecture-wise Breakup

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

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

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

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

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

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

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

Detailed Syllabus

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

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

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

Evaluation Criteria

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

Detailed Syllabus
Lecture-wise Breakup

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

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C332-3.1	Explain the concepts of microwave circuits and scattering parameters.	Understanding (C2)
C332-3.2	Evaluate the performance of several waveguide components and determine their responses and applications.	Evaluating (C5)
C332-3.3	Analyze the behaviour of microwave sources based on solid state devices and tubes at microwave frequencies.	Analyzing (C4)
C332-3.4	Determine mearurent parameters of microwave components and understand the ISM applications of Microwave Energy.	Applying (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to RF and Microwave Engineering	History of Microwaves, applications of Microwaves, Maxwell's Equations.	2
2.	Microwave Transmission Lines	Review of Transmission lines, Line Equations. Microwave Integrated Lines: Microstrip line, Strip line, CPW line.	3
3.	Impedance matching	λ/4 Transformer, Tapered Lines :Exponential	3
4.	Scattering Parameters	S-parameters: definition, properties, 2-port, 3-port and 4-port.	4
5.	Microwave Components	H-plane, E-plane and Magic Tee, Isolator, Circulator, Directional Coupler, Cavity Resonators, Q of Cavity Resonator, Rectangular waveguide cavities.	10
6.	Microwave Devices and Sources	Microwave semiconductor devices, Schottky diode, Gunn diode, Microwave Tubes.	7
7.	Microwave Measurements	Impedance and Power Measurement Vector Network Analyzer, Spectrum analyzer.	4
8.	RF Filters	Classification of filters, Filter Design by Insertion loss method	3

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

Evaluation Criteria

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

Project Based Learning:

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

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

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

Detailed Syllabus

Lecture-wise Breakup

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

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

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

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

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

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

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	M.L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, 1st Edition, Springer, 2013, **[TEXTBOOK]**
2.	Alexander Miczo, Digital Logic Testing and Simulation, 2nd Edition, John Wiley & Sons, 2003
3.	Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, VLSI Test Principles and Architectures, 1st Edition, Morgan Kaufmann, 2006.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NEC742**	**Semester: Odd (specify Odd/Even)**	**Semester** 7th **Session** 2020-2021 **Month** from Aug.20 to Dec. 20
Subject Name	Introduction to data analysis with R		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Kapil Dev Tyagi
	Teacher(s)	Kapil Dev Tyagi

S. NO.	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C430-2.1	Identify continuous/discrete probabilistic models for a given random variable distribution	Applying Level (C3)
C430-2.2	Test for hypothesis using statistical tests like z-test, t-test ANOVA etc.	Analyzing Level (C4)
C430-2.3	Explain unsupervised and supervised machine learning algorithms	Understanding Level (C2)
C430-2.4	Utilize software in Matlab/R languages for implementation of ANOVA, Regression, and Machine learning techniques	Applying Level (C3)

Module No.	Subtitle 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 Implementation of these algorithms in R language	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 Matlab/R languages.	5
6.	Data smoothing (optional)	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**	

Practicalimplementation of theory based learning: Each one of the student is assigned to write the codes for implementation of the algorithms covered in theory in various languages like R, MATLAB etc.This method of learning will help students to better understand the theory and its practical implementation. Practical knowledge acquired by the students in this course will boost their confidence and clarity on various topics and this ultimately help them in placement interviews and further motivate to start their own startup company.

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.	Anil Maheshwari, Business Intelligence and Data Mining Made Accessible, Createspace Independent Pub, 2014.
2.	Eric 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

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

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

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

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Overview of Optical fiber Communications	Electromagnetic Spectrum, Historical development and advantages of optical fiber communication, Elements of optical fiber transmission link, Optical laws and definitions, optical fiber modes and configurations.	3
2.	Optical fibers Structures	Optical fiber wave guides, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers Modes, V Number, Mode Coupling, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index.	4
3.	Signal Degradation in	Signal distortion in optical fibers-	7

	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.	
4.	Optical Sources	Light emitting diode (LEDs)-structures, materials, Figure of merits, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes - Modes & threshold conditions, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, temperature effects, external quantum efficiency, and laser diode rate equations. Reliability of LED & ILD.	6
5.	Power Launching and Coupling	Source to fiber power launching: - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, LED coupling to single mode fiber. Fiber Splicing- Splicing techniques, splicing single mode fibers. Multimode fiber joints and single mode fiber joints. Fibre alignment and joint loss.	6
6.	Photo detectors& Receivers	Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation:- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers.	7
7.	Optical System Design	Considerations, component choice, multiplexing.Point-to- point links, System considerations, Link considerations. Overall fiber dispersion in multi mode and single mode fibers.	7

		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.	
		Total number of Lectures	40

Evaluation Criteria

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

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

Recommended Reading(Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	Gerd Keiser, Optical Fiber Communications, 3rd Edition, McGraw-Hill International edition, 2000.
2.	John M. Senior, Optical Fiber Communications, 2nd Edition, PHI, 2002.
3.	D.K. Mynbaev,S.C. Gupta and Lowell L. Scheiner,Fiber Optic Communications,Pearson Education, 2005.
4.	Govind P. Agarwal, Fiber Optic Communication Systems, 3rd Edition, John Wiley, 2004.
5.	Joseph C. Palais,Fiber Optic Communications, 4th Edition, Pearson Education, 2004

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC412	**Semester**Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** July to Dec
Course Name	Multimedia Communications		
Credits	4	**Contact Hours**	3-1-0

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

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

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

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

Evaluation Criteria

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

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

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC420	**Semester Odd (specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** July to Dec
Course Name	**Smart and Sustainable Systems**		
Credits	4	**Contact Hours**	3-1-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-6.1	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 (C2)
C431-6.2	Understand the basics of renewable sources of energy and fundamentals of smart grids. Analyzing the role of renewable energy in sustainable systems.	Analyzing (C4)
C431-6.3	Illustrate the concept of sustainable urban infrastructures. Application of electronic and digital technologies to urbanization issues, smart urban transportation: electric vehicles (EVs).	Analyzing (C4)
C431-6.4	Understand the role of ICTs in reducing GHG emissions, green data centers, and energy efficient wireless and wired communications.	Understanding (C2)

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	6

		transportation and Smart urban energy systems, Electronic and Digital Technologies, Instrumentation intelligence, 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	18B12EC421	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2020-2021 **Month from** August to December
Course Name	Image Analysis and Feature Extraction		
Credits	4	**Contact Hours**	3-0-2

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-1.1	Understanding the facts and ideas of Image Processing and demonstrate the review of Signal processing, Matrix algebra and Probability.	Understanding Level (C2)
C431-1.2	Develop the basic understanding of Sampling and Quantization of the processed Image and its Transforms.	Applying Level (C3)
C431-1.3	Examine the result in the processed image by applying Edge detection, Segmentation, Registration, Tracking and Reconstruction.	Analyzing Level (C4)
C431-1.4	Determine the object recognition, Image compression and its optimization using Nature inspired algorithm.	Evaluating Level (C5)

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 i.e. Genetic algorithm and	8

		Particle swarm optimization.	
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance: 5 Marks, Assignment: 15 Marks, Quiz: 5 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	19B12EC413	**Semester**	Odd	**Semester 7** **Session** 2020 -2021 **Month from** August to December	
Course Name	Convergence and Next Generation Networks				
Credits	4	**Contact Hours**		3-1-0	

Faculty (Names)	**Coordinator(s)**	Prakash Chandra Gupta
	Teacher(s)	Prakash Chandra Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-3.1	At the completion of the course, students will be able understand principles of multimedia, quality of service (QoS), network security and various signaling systems.	Understanding (C2)
C430-3.2	At the completion of the course, students will be able apply above concepts for developing understanding of the frameworks/protocols required for secure transport of multimedia with required quality of service.	Applying (C3)
C430-3.3	At the completion of the course, students will be able analyze NGN architecture with application of frameworks of QOS, security and signaling systems.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Convergence & NGN	a) Overview of telecom & broadcasting networks. b) Convergence & its key economic drivers. c) Architectural outline of NGN.	2
2.	Voice/ multimedia over IP Network	a) Quality of service parameters, Bandwidth & traffic control. b) Queuing & scheduling mechanisms, Queue buffer management using RED and ECN. c) Quality of service frameworks, RSVP, Differentiated service, Policy based quality of service implementation. d) Audio & video digitization & compression, Codec standards. e) Requirements for multimedia transport over IP network, Protocols for real-time & stored multimedia transport (RTP, RTCP, RTSP). f) Multicasting principles, group addressing. And protocols (PIM/IGMP).	11
3.	Network Security	a) Security requirements, security services, and security mechanisms. b) Encryption principles, Block ciphers & modes of operation. c) Message integrity verification and source authentication. d) Security at IP layer, IPSec (AH, ESP, transport and tunnel modes), IPsec framework components.	7
4.	Signaling Protocols for Converged Networks	a) Session Initiation Protocol (SIP), ITU-T H.323, SS7 Signaling protocol and its transport over IP (SCTP). b) Interworking between networks based on SIP, H.323 and SS7.	7
5.	Media Gateway Control &	a) Separation of media and call control functions, softswitch architecture, media gateway control, MEGACO/H.248.	2

	Softswitch		
6.	Next Generation Network	a) NGN architecture (ITU-T Y.2012). b) IP Multimedia subsystem (IMS) and its functional architecture. c) CSCF, HSS, SLF, BGCF, MGCF, MRFC, MRFP, PDP, PEP functions. d) IMS addressing, Private/public user identities. Globally routable user agent e) Discovery and session control. f) IMS services. Emergency service. g) Operations support system (OSS).	10
7.	Trends	a) Overview of fixed mobile convergence (FMC), generic access network (GAN).	1
		Total number of Lectures	**40**

Evaluation Criteria

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

Project Based Learning: Assignment component of the evaluation is project-based. Groups of 3 students will be assigned on projects that will be application oriented and will be extension of the concepts learn in the classroom.

Recommended Reading material:

1.	Hu Hanrahan, *Network Convergence*, John Wiley &Sons, 2007
2.	Lingfen Sun , Is-HakaMkwawa, Emmanuel Jammeh, Emmanuel Ifeachor, *Guide to Voice and Video over IP For Fixed and Mobile Networks*, Springer, 2013
3.	Daniels Collins, *Carrier Grade Voice Over IP*, MaGraw-Hill, 2013
4.	William Stallings, *Data & Computer Communication*, Pearson, 2014
5.	Prakash C Gupta, *Cryptography and Network Security*, PHI, 2014
6.	A. Ahson Syed, Ilyas Mohammad, *Fixed Mobile Convergence Handbook*, CRC Press. 2018

Detailed Syllabus

Lecture-wise Breakup

Subject Code	19B12EC417	**Semester: Odd (specify: Odd/Even)**	**Semester** 7th **Session** 2020-2021 **Month from** August to December
Subject Name	**Machine Learning and Statistical Pattern Recognition**		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	B.Suresh	
	Teacher(s) (Alphabetically)	B.Suresh ,Dr.Parul Arora	

S.NO	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C430-6.1	Identify supervised learning generative/discriminative learning, parametric/non-parametric learning,	Applying Level (C3)
C430-6.2	Test for their Knowledge in Clustering, dimensionality reduction, kernel methods.	Analyzing Level (C4)
C430-6.3	Explain Bias/variance tradeoffs; VC theory; large margins	Understanding Level (C2)
C430-6.4	Utilize software Python to design and implement text and web data processing applications.	Applying Level (C3)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1	Basic Familiarity	Familiarity with the basic probability theory, Familiarity with the basic linear algebra	6
2.	supervised learning	Generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines Implementation of these module topics using Python	10
3.	unsupervised learning	clustering, dimensionality reduction, kernel methods Implementation of these module topics using Python	9
4.	learning theory	bias/variance tradeoffs; VC theory; large margins Implementation of these module topics using	9

		Python	
5.	Recent applications of machine learning	Robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing Implementation of these module topics using Python	8
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance: 5 Marks, Assignment: 15 Marks, Quiz: 5 Marks)
Total	**100**

Project based learning: Each student in a group of 3-4 select a topic related to latest development in the technolog and write done Algorithms and their corresponding code, This method of learning will help students to understar latest development in the industry once they land in to entry it will be a simple task to design and implement ar given task. Knowledge acquired during this course will boost their confidence and clarity while attending ar Interview related to placement activities and establishment of their own application based startup company relate with latest and cutting edge technologies

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.	Machine Learning A Probabilistic Perspective, Kevin P. Murphy.2012 MIT press.
2.	Computer Vision: Algorithms and Applications Richard Szeliski, 2019 Springer.
3.	The Elements of Statistical Learning Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani Jerome Friedman.Second Edition 2017,Springer

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Detailed Syllabus
Lecture-wise Breakup

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

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

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

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

Course Code	15B19EC791	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2020 -2021 **Month from** August to December
Course Name	Major Project Part-1		
Credits	4	**Contact Hours**	

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Summarize the contemporary scholarly literature, activities, and explored tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Electronics Engineering.	Understanding (C2)
CO2	Analyze/ Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time	Analyzing (C4)
CO3	Evaluate /Validate sound conclusions based on evidence and analysis	Evaluating (C5)
CO4	Develop the skill in student so that they can communicate effectively in both verbal and written form.	Create Level (C6)

Evaluation Criteria

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

Detailed Syllabus

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

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

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

Evaluation Criteria

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NHS831**	**Semester: Odd (specify Odd/Even)**	**Semester: VII Session** 2020 -2021 **Month: July 2020 -Dec 2020**
Course Name	Gender Studies		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Puneet Pannu
	Teacher(s) (Alphabetically)	Puneet Pannu

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-19.1	Demonstrate knowledge of the construct of gender and the way it intersects with other social and cultural identities of race, class, ethnicity and sexuality	Understand (C2)
C401 - 19.2	Apply feminist and gender theory in an analysis of gender including an examination of the social construct of femininity and masculinity	Apply (C3)
C401- 19.3	Analyze the ways in which societal institutions and power structures such as the family, workplace impact the material and social reality of women‟s lives	Analyze (C4)
C401-19.4	Assess the need for Gender Sensitization and Gender Inclusivity and its practice in contemporary settings	Evaluate (C5)
C401- 19.5	Evaluate and interpret information from a variety of sources including print and electronic media, film, video and other information technologies	Evaluate (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introducing Gender Issues**	• Sex and Gender • Types of Gender • Gender Roles • Gender Division of Labor • Gender Stereotyping and Gender Discrimination	9
2.	**Gender Perspectives of Body & Language**	• Biological, Phenomenological and Socio-Cultural Perspectives of body • Body as a Site and Articulation of Power Relations • Cultural Meaning of Female Body and Women‟s Lived Experiences • The Other and Objectification	6
3.	**Social Construction of Femininity** & **Feminism**	• Bio-Social Perspective of Gender • Gender as Attributional Fact • Feminine & Feminist • Major Theorists of Feminism Challenging Cultural Notions of Femininity • Feminism Today: Radical, Liberal, Socialist, Cultural, Eco feminism & Cyber feminism • Images of Women in Sports, Arts, Entertainment, Media and Fashion Industry ;Cultural Feminism &	9

		Celebrating Womanhood • Analysis of role women have played across cultures	
4.	**Social Construction of Masculinity**	• Definition and Understanding of Masculinities • Sociology of Masculinity& its Types • Social Organization of Masculinity and Privileged Position of Masculinity • Politics of Masculinity and Power • Major Theorists of Masculinity • Masculine Identities in Literature, Cinema & Media.	9
5.	**Gender Sensitization Empowerment &Gender Inclusivity**	• Women & Women Rights In India • From Women's Studies to Gender Studies: A Paradigm Shift • Gender Sensitization & Gender Inclusivity • Gender Studies & Media: Creating New Paradigms in Gender & Culture	9
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project/ Assignment)
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	Davis K., et al, *"Handbook of Gender and Women's Studies*. London: Sage. (2006)
2	Helgeson, Vicki S., *"The Psychology of Gender"*, Pearson(2012)
3	Friedan B., "*The Feminine Mystique"*, Penguin. (1971/1992)
4	Debeauvoir S. , "*The Second Sex"*, Vintage (1953/1997)
5	Wharton Amy S., "*The Sociology of Gender: An Introduction to Theory & Research*", Wiley-Blackwell (2005)
6	Pachauri G.," *Gender, School & Society*", R.Lall Publishers(2013)
7	Connell R.W, "*Masculinities*", Cambridge: Polity. (1985)
8	MacInnes J., "The *End of Masculinity"*. Buckingham: Open University Press. (1998)
9	Kaul A.& Singh M., *"New Paradigms for Gender Inclusivity*", PHI Pvt Ltd (2012)

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester VII Session** 2020 -2021 **Month from** July-December
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

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

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

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

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

Evaluation Criteria

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

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

1.	Research papers and online resources

Detailed Syllabus
Lecture-wise Breakup

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

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

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

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

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

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Quiz and class discussions)
Total	**100**

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS731	**Semester: Odd**	**Semester** VII **Session** 2020 -2021 **Month from** July 2020 to Dec 2020
Course Name	Customer Relationship Management		
Credits	3	**Contact Hours**	3-0-0

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

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

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

		Importance of CRM in B2B Markets, Customer Emotion, Customer Knowledge, Reciprocity, Voice of the Customer, Participation. ***Dominos using different types of content to practice engagement	
5.	Components of e CRM solutions (Overview) and Role of Digital Technologies	Data warehousing, Datamining and CRM, Market Basket Analysis and Retail sector, Campaign Management, Sales Force Automation, Customer Service and Support, Corporate Blogs, Online communities, Twitter, Wikis. The Experience ecosystem. CEM, Consumer engagement, segmentation and differentiation. ** Exercise on online campaign management solutions	7
6.	Product offerings in the CRM Marketplace (Overview) and CRM Roadmap	Evaluating Technological solutions for CRM, Comparison of Siebel, Oracle, MySAP.com and People Soft Enterprise solutions, Comparison of Talisma, Sales logix, Microsoft and Sales notes for small and medium enterprises, Defining a CRM strategy, CRM Implementation Roadmap, Developing a relationship orientation, Customer centric marketing and processes, Building organizational capabilities through internal marketing, Issues in implementing a technology solution for CRM.	7
7.	Operational issues in implementing CRM, Social CRM	Process view of CRM, Budgeting for attraction vs. retention, Learning from customer defections, Customer Retention Plans, Evaluating Retention programs, Social Customer Relationship Management, Social Customer Insights, Social CRM Strategy, and Social Customer Analytics. * Excercise on Mckinsey's social media model	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.	Customer Relationship Management, Ed. Peelan Rob Beltman, 2nd Edition, Pearson, 2014.
2.	Ou, Y. C., Verhoef, P. C., & Wiesel, T. The effects of customer equity drivers on loyalty across services industries and firms. Journal of the Academy of Marketing Science, *45*(3), 336-356, 2017.
3.	Lin, Y. C., Lee, Y. C., & Lin, S. Y. The influence of the personality traits of webcasters on online games. International Journal of Electronic Customer Relationship Management, *11*(1), 94-103, 2017
4.	Menzel, C. M., & Reiners, T.Customer relationship management system a case study on small-medium-sized companies in north Germany. In *Information Systems for Small and Medium-sized Enterprises* pp. 169-197. Springer, Berlin, Heidelberg, 2014.
5.	Customer Relationship Management-A strategic perspective, G. Shainesh, Jagdish Sheth, Reprinted Macmillan Publishers India Limited, 2009.
6.	Mukerjee, K., Customer Relationship Management-A Strategic approach to Marketing, 3rd Edition Prentice Hall of India, 2007.

7.	Customer Relationship Management Concepts and Technologies-Francis Buttle, 3rd Edition Taylor and Francis, 2015.
8.	Berry, Michael, J. A, Linoff, Gordon S., Datamining Techniques for Sales, Marketing and CRM, 2nd Edition, Wiley Publications, 2007.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12CS424	**Semester Odd**	**Semester** VII **Session** 2020-21 **Month from July to December**
Course Name	Algorithm Analysis and Artificial Intelligence		
Credits	**3**	**Contact Hours**	**3-1-0**

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-12.1	Analyse algorithm's time complexities (Master's method, Recursion tree and substitution method- Sorting and Searching algorithms)	Analyse Level (Level 4)
C401-12.2	Propose solutions for real life computing problems using greedy, divide & conquer, and dynamic programming techniques.	Create Level (Level 6)
C401-12.3	Apply informed and uninformed searching algorithms (A*, Hill Climbing and Simulated Annealing) in AI related problems.	Apply Level (Level 3)
C401-12.4	Solve constraint satisfaction problems and adversarial search algorithms	Create Level (Level 6)
C401-12.5	Apply inference mechanisms(propositional logic , first order predicate logic, and probabilistic reasoning)	Apply Level (Level 3)
C401-12.6	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	06
2.	Divide and Conquer and Greedy Algorithms	Strassen's Matrix multiplication , Knapsack Problem; Coin change Problem; Huffman Coding; Activity Selection; Minimum Spanning tree etc.	09
3.	Dynamic Programming Algorithms	Knapsack Problem; Coin change Problem; Matrix chain Multiplication, Longest common subsequence etc.	05
4.	Artificial Intelligence : Problem Spaces and Problem Solving by search	State Spaces, Uninformed search strategies (BFS, DFS, DLS, IDS, Bidirectional search), Informed Search & exploration (A*,Heuristic, Local search algorithms, online search agents)	07
5.	Constraint satisfaction problems	Constraint satisfaction problems (backtracking, variable and value ordering, local search), Adversarial Search (games, alpha beta pruning, elements of chance, state of art games)	06
6.	Propositional Logic	Knowledge based agents, PL, FOPL, Syntax and semantics, use, knowledge engineering) , Inference in FOPL(Propositional vs First order inference	06
7.	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	03
8.	Genetic	Travelling Salesman Problem, Knapsack Problem	01

	Algorithms		
		Total number of Lectures	**43**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance-10 Quiz/Assignments/Presentations/Mini-Project- 15)
Total	**100**

Project based learning: Each student understood on the application of Artificial Intelligence for algorithmic optimization. They presented the application by a power-point presentation. It can help improve the efficiency of the real life projects in the real world IT organizations.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc.

TEXT BOOKS

1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein , Introduction to Algorithms, MIT Press, 3rd Edition, 2009
2.	Artificial Intelligence – A modern approach by Stuart Russel and Peter Norvig, PHI, 2008.
REFERENCE BOOKS Journals, Reports, Websites etc. in the IEEE format	
3.	Artificial Intelligence Review: An International Science and Engineering Journal, Springer
4.	Nunes de Castro, Leandro, " Nature-Inspired Computing Design, Development, and Applications" IGI Global, 31-May-2012 - 435 pages
5.	Steven Skiena ,The Algorithm Design Manual, Springer; 2nd edition , 2008
6.	Knuth, The art of Computer Programming Volume 1, Fundamental Algorithms, Addison-Wesley Professional; 3 edition,1997
7.	Horowitz and Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978

Detailed syllabus
Lecture-wise Breakup

Subject Code	**18B12HS211**	**Semester: ODD**	**Semester VII Session 2020-2021** **Months: from Aug 2020 to Dec 2020**
Subject Name	**PSYCHOLOGY OF PERSONALITY**		
Credits	**3**	**Contact Hours**	**(3-0-0)**
Faculty (Names)	**Coordinator(s)**	Dr. Badri Bajaj	
	Teacher(s) (Alphabetically)	Dr. Badri Bajaj	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-9.1	Demonstrate a basic understanding of concepts of personality	Understanding (Level 2)
C401-9.2	Apply the concepts of personality in day to day life	Applying (Level 3)
C401-9.3	Examine the different theoretical perspectives and approaches of personality	Analyzing (Level 4)
C401-9.4	Develop solutions for handling problems and achieving goals using personality concepts, theories and approaches	Creating (Level 6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	**Introduction to the Psychology of Personality**	Definition and perspectives, Approaches, Research methods	**6**
2.	**Determinants of Psychology of Personality**	Motivation and Emotion, Interior selves and interior worlds, Mental abilities	**6**
3.	**Theories**	Psychoanalytical Theory of Personality: Freud, Neo Freudians: Jung, Horney, Erikson	**10**
4.	**Approaches**	Trait Approach: Allport, Cattell, Biological Approach, Social learning , Humanistic approach	**10**
5.	**Assessment of Personality**	Interviews, Projective tests, Behavioral assessment, Personality inventories	**10**
		Total:	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, 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.	Schultz, D. P., and Schultz, S. E., *Theories of personality*. Cengage Learning 11th Ed., 2016.
2.	Burger, Jerry M. *Personality: an introduction*. Cengage Learning, 10th Ed., Cengage Learning, 2019.
3.	Mayer, John D. *Personality: A systems approach*. Rowman & Littlefield, 2017.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester Odd**	**Semester VII Session 2020 -2021** **Month from Aug 2020 - Dec 2020**
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 techniques	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.	Edwards and Edwards, Predictive HR Analytics. Mastering the HR Metric, Kogan Page, Limited, 2019
2.	Banerjee, Pandey and Gupta, Practical Applications of HR Analytics, Sage, 2019
3.	Bhattacharyya, HR Analytics: Understanding Theories and Applications, Sage, 2017
4.	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
5.	Guenole, Ferrar and Feinzig, The Power of People: How Successful Organizations Use Workforce Analytics To Improve Business Performance, First Edition, Pearson, 2017
6.	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	17B1NPH732	**Semester: ODD**	**Semester: 7th Session:** 2020 -2021 **Month from July to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3+1

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

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

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

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

Evaluation Criteria

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

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

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

Detailed Syllabus
Lecture-wise Breakup

Subject Code	17B1NPH731	**Semester : Odd**	**Semester: VII**, **Session : 2020-2021** Month from: July to December
Subject Name	Introduction to Quantum Information Processing		
Credits	**03**	**Contact Hours**	**3+1**

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 we 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 interpretation; Measurement problem; Hilbert space; Schrodinger equation.	**8**
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 searchalgorithm; 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 Class 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: 7th Session:** 2020 -2021 **Month from July to December**
Course Name	Green Energy and Climate Modeling		
Credits	3	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Prashant Chauhan
	Teacher(s)	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	20B12PH411	**Semester** ODD	**Semester 7th Session** 2020 -2021 **Month from July to December**
Course Name	SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES		
Credits	3	**Contact Hours**	3+1

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

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

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

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

Evaluation Criteria

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

Recommended Reading material:

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

Applied Numerical Methods (17B1NMA732)

Course Description

Course Code	17B1NMA732	**Semester** - Odd	**Semester** VII **Session** 2020-21 **Month from** Aug 2020- Dec 2020
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr Yogesh Gupta and Dr Neha Ahlawat	
	Teacher(s) (Alphabetically)	Dr Yogesh Gupta, Dr Neha Ahlawat, Dr. Pankaj Srivastava	

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

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Roots of Non-linear Equations	Concept of round-off and truncation errors. Iterative methods to find roots for one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equi-spaced points, Divided differences, Spline interpolation, Least square approximation	7
3.	Numerical Differentiation and Integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods. Iterative methods: Jacobi and Gauss Seidel Methods and their convergence. Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of	12

		parabolic and elliptic partial differential equations by Finite Difference Methods	
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	**Gerald, C.F. and Wheatley P.O.**, Applied Numerical Analysis, 7th Ed., Pearson Education, 2004.
2.	**Conte, S.D. and deBoor, C.**, Elementary Numerical Analysis, 3rd Ed., McGraw-Hill, 1980.
3.	**Gupta, R.S.**, Elements of Numerical Analysis, 2nd Ed., Cambridge University Press, 2015.
4.	**Jain, M.K., Iyengar, S.R.K. and Jain, R.K.**, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New Age International, New Delhi, 2014.
5.	**Smith, G.D.**, Numerical Solution of Partial Differential Equations, 2nd Ed., Oxford, 1978.

Generalized Fuzzy Set Theory with Applications (19B12MA412)

Course Description

Course Code	19B12MA412	**Semester** Odd	**Semester** VII **Session** 2020-21 **Month from** Aug 2020- Dec 2020
Course Name	Generalized Fuzzy Set Theory with Applications		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Mohd. Sarfaraz	
	Teacher(s) (Alphabetically)	Dr. Mohd. Sarfaraz, Dr. Amit Srivastava	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-21.1	Apply the concept of Intuitionistic fuzzy sets in defining new information measures and in medical diagnosis and pattern recognition problems.	C5
C401-21.2	Explain various hesitant fuzzy and generalized fuzzy operations.	C2
C401-21.3	Describe various aggregation and generalized aggregation operators.	C2
C401-21.4	Apply the concept of Pythagorean fuzzy sets in defining new information measures and in multiple attribute decision making (MADM) problems.	C5
C401-21.5	Illustrate Fuzzy and possibility measures with evidence theory.	C3

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Intuitionistic fuzzy sets	Intuitionistic fuzzy sets (*IFS*s) – Basic definitions and operations. Measures of entropy, similarity and discrimination between Intuitionistic fuzzy sets (*IFS*s). Applications of *IFS*s in medical diagnosis and pattern recognition.	10
2.	Hesitant fuzzy sets	Hesitant fuzzy sets – concepts, basic operations and basic properties. Extensions of hesitant fuzzy sets – Dual Hesitant fuzzy sets, Interval valued Hesitant fuzzy sets, Triangular Fuzzy Hesitant Fuzzy Sets, Hesitant Fuzzy Linguistic Term Sets.	10
3.	Aggregation Operators	Aggregation Operators – concepts, basic operations and basic properties, weighted aggregation operators, Ordered weighted averaging operator, Induced ordered weighted averaging operator.	8

4.	Pythagorean fuzzy sets	Pythagorean fuzzy sets - concepts, basic operations and basic properties, Hesitant Pythagorean fuzzy sets and their aggregation operators in multiple attribute decision making.	8
5.	Dempster-Shafer Theory	Dempster-Shafer Theory as an alternative to Bayesian networks. Frame of discernment, Belief function, Plausibility and basic probability assignments.	6
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	**Atanassov, Krassimir T.,** Intuitionistic Fuzzy Sets -Theory & Applications, Springer, 1999.
2.	**Xu, Zeshui,** Hesitant Fuzzy Sets Theory, Springer Verlag, 2014.
3.	**Bhargava, A. K.,** Fuzzy Set Theory, Fuzzy Logic and Their Applications, S. Chand & Company Pvt. Ltd., 2013.
4.	**Cengiz Kahraman, Uzay Kaymak, Adnan Yazici, (**Editors), Fuzzy Logic in Its 50th Yea New Developments, Directions and Challenges, Studies in Fuzziness and Soft Computing, Springer Verlag, Vol. 341, 2016.
5.	**Huchang Liao, Zeshui Xu,** Hesitant Fuzzy Decision Making Methodologies and Applications, Uncertainty and Operations Research, Springer Verlag, 2017.