Detailed Syllabus
Lecture-wise Breakup

Course Code	**15B1NEC731**	**Semester** Even **(specify Odd/Even)**	**Semester** VII **S**ession 2022-23 **Month from** August to December
Course Name	Soft Computing in Electronics		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr.Vijay khare
	Teacher(s) (Alphabetically)	Dr.Vijay khare

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain soft computing techniques and their roles in building Artificial intelligent system	Understanding Level (C2)
CO2	Apply neural networks to pattern classification and regression problems	Applying Level (C3)
CO3	Apply fuzzy logic and genetic algorithms to handle uncertainty and optimization problems	Applying Level (C3)
CO4	Evaluate and compare solutions by various soft computing approaches for a real time problem use existing software tools.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to Artificial Intelligence, Introduction of soft computing evolution of computing, Principle of Soft Computing, hard computing and soft computing, soft computing methods.	2
2.	Introduction to Neural Network architecture	Neuron, Nerve structure, Synapse, Definition of neural network, Neuron models and n/w architecture Learning in Artificial Neural Networks, activation functions, Single Layer feed forward network, Multi layer feed forward network and recurrent network, Learning methods (Supervised, unsupervised and reinforced), Learning Rules (Hebbian, Gradient Descent, Competitive and Stochastic)	10
3.	Feed forward and back Propagation Neural Network, Perceptron model and it applications	Perceptron neural network: Adaline and Madaline, Multi-layer feed forward neural network, back propagation algorithms and radial basis neural network, Non linear activations operator, effect of learning rule coefficient. Application of neural network	10

4.	Associated Memory	Auto associative memory, Hetro associated memory bidirectional associated memory, Autocorrelators and Heterocorrelators, Applications	6
5.	Fuzzy logic Introduction	Introduction, classical and Fuzzy sets &operations crisp relation and fuzzy relation, Fuzzy rules based system	6
6	Fuzzy Logic Membership Functions	Membership Functions, Fuzzy if-else rules, Fuzzy algorithms, Fuzzyfications and defuzzifications, , Fuzzy Controller Design and its industrial applications	6
7	Genetic Algorithms	Introduction of Genetic Algorithms, working principle, Genetic Operators, Crossover and mutation properties, Generation cycle, Genetic Algorithms in Problem Solving	7
		Total number of Lectures	**47**

Evaluation Criteria

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

Project based learning: To make subject application based,. Each student in a group of 2-3 will analysis different type data in the area of electronics like Defense , Biomedical data, Images, Robotics and Fuzzy logic based controller, Students will understand different type of algorithm which are used for feature extraction, classification and optimization, It helps in developing skill development, employability and entrepreneurship potential.

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.	Jacek M. Zurada, *Introduction to Artificial Neural Systems, Jaico Publishing House, 1994*
2.	Martin T. Hagan, Howard B. Demuth, Mark Beale, *Neural Network Design-Martin Hagan,2014*
3.	Simon Hykins, *Neural Networks-**A Comprehensive Foundation,** Prentice Hall, 1999*
4.	S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007
5.	M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998
6.	Rajasekharan and Rai, *Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications, PHI-2003*
7.	S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications" Prentice Hall of India.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NEC733	**Semester** ODD	**Semester** VII **Session** 2022 -2023 **Month from** Aug to Dec
Course Name	Fundamentals of Embedded Systems		
Credits	3	**Contact Hours**	3L

Faculty (Names)	**Coordinator(s)**	Dr Rachna Singh
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-4.1	Understanding of the fundamental concepts for embedded systems design and complete architecture of the ATMEGA16/32 microcontroller.	Understanding (C2)
C431-4.2	Identify various on chip peripherals of the ATMEGA16/32 microcontroller and make use of them for designing embedded applications.	Applying (C3)
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 (C4)
C431-4.4	Understanding of the basic concept of RTOS, detailed study of ARM7 architecture (32 bit) and study of wireless protocols.	Understanding (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	12

		DAC Modules, Interfacing of ADC0804, Interfacing with DAC0808, Different wave generation through DAC0808, Stepper Motor & DC Motor, Interfacing with stepper & DC motor, Different Sensor Interfacing, (IR Sensor, DTMF, Temperature Sensor)	
5.	Concept of RTOS and Advanced Microprocessor	Real Time Operating System (RTOS), Types of real time tasks, Task Periodicity, Process state diagram, Kernel and Scheduler, Scheduling algorithms, Shared data (Resource) and Mutual Exclusion, Semaphore, Introduction to ARM, Features, ARM Pipeline, Instruction Set Architecture (ISA), Thumb Instructions, Exceptions in ARM, Embedded Wireless Protocols (Infrared Data Association (IrDA), Bluetooth, IEEE 802.11).	10
		Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning: Students will learn about the Architecture of ATmega16/32 microcontroller, in addition they will also learn how to interface various peripherals with microcontroller. They will also learn about the basic concepts of embedded C programming. Students in group of 2 or 3 can implement these concepts in designing microcontroller based projects.

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

Subject Code	17B11EC733	**Semester:** Odd **(specify Odd/Even)**	**Semester:** VII **Session:** 2022-23 **Month :** from August to December
Subject Name	Optical Communication		
Credits	3	**Contact Hours**	3(L)

Faculty (Names)	**Coordinator(s)**	Dr. Kaushal Nigam (JIIT-128) and Dr. Rahul Kaishik (JIIT-62)
	Teacher(s) (Alphabetically)	

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 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, 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
		Signal distortion in optical fibers- Attenuation, Absorption,	

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

Evaluation Criteria

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

Project Based Learning: Students will learn about fundamental concepts, working and applications of an optical communication system. Understanding of various losses 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.	Govind P. Agarwal, Fiber Optic Communication Systems, 5th Edition, John Wiley, 2021.
2.	Gerd Keiser, Optical Fiber Communications, 5th Edition, Mc Graw-Hill International Edition, 2017.
3.	John M. Senior, Optical Fiber Communications, 5th Edition, PHI, 2014.
4.	D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005.
5.	Joseph C. Palais, Fiber Optic Communications, 5th Edition, Pearson Education, 2005

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC413	**Semester** Odd	**Semester VII Session** 2022-2023 **Month from** Aug- Dec
Course Name	Digital Control Systems		
Credits	3	**Contact Hours**	3L

Faculty (Names)	**Coordinator(s)**	Ritesh Kumar Sharma
	Teacher(s) (Alphabetically)	Ritesh Kumar Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-2.1	To represent the systems in the Z domain and in state space representation.	Remembering Level(C1)
C433-2.2	To analyze transient and steady state behaviors of linear discrete time control systems with modified transfer function.	Analyzing Level (C4)
C433-2.3	To understand and gain knowledge in stability analysis of digital control systems.	Understanding Level (C2)
C433-2.4	To Design Digital Control Systems	Designing Level (C6)

Module No.	**Subtitle of the Module**	**Topics**	**No. of Lectures**
1.	Review of Z transform	z transform and inverse z transform .Relationship between s- plane and z- plane- Difference equation .Solution by recursion and z-transform.	3
2.	Review of state space techniques	Review of state space techniques to continuous data systems, state space representation of discrete time systems- Transfer function from state space model-various canonical forms- conversion of transfer function model to state space model-characteristics equation- solution to discrete state equations.	5
3.	Introduction to Digital Control System	Basic Elements of discrete data control systems, advantages of discrete data control systems, examples. Signal conversion & processing: Digital signals & coding, data conversion & quantization, sample and hold devices, Mathematical modeling of the sampling process; Data reconstruction and filtering of sampled signals: Zero order hold, first order Hold.	8
4.	Analysis of Digital Control Systems	Digital control systems- Pulse transfer function . z transform analysis of closed loop and open loop systems- Modified z- transfer function- Stability of linear digital control systems and Jury's stability test	8
5.	Stability tests	Stability tests- Steady state error analysis- Root loci - Frequency domain analysis- Bode plots- Gain margin and phase margin.	8
6.	State feedback concept	Controllability and Observability - Response between sampling instants using state variable approach-Pole placement using state feedback .	5
7.	Digital System Design	Observer Design for digital control, Pole placement design based on input-output models.	5

Total number of Lectures	**42**

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 analysis and Design of Digital controllers with the help of assignments/simulations based projects. The project work will consist of the system design requirements, simulation work using sci-lab or MATLAB, and analysis of the simulation output.

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.	B. C. Kuo , "Digital control systems" (Second Edition) , Oxford University Press,2007.
2.	K. Ogatta, "Discrete Time control systems ", 2nd ed. PHI),1995
3.	M. Gopal, "Digital Control and State Variable Methods", 3rd Edition, TMH, Sep-2008.
4.	G. F. Franklin, J. D. Powell, M. Workman, Digital Control of Dynamic Systems, 3rd Edition, Longman, 1998.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC421	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022-2023 **Month from** August to December
Course Name	Image Analysis and Feature Extraction		
Credits	4	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-5.1	Understanding the facts and ideas of Image Processing and demonstrate the review of Signal processing, Matrix algebra and Probability.	Understanding Level (C2)
C432-5.2	Develop the basic understanding of Sampling and Quantization of the processed Image and its Transforms.	Applying Level (C3)
C432-5.3	Examine the result in the processed image by applying Edge detection, Segmentation, Registration, Tracking and Reconstruction.	Analyzing Level (C4)
C432-5.4	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**

Project Based Learning: Students will learn about the image processing operations which are most important for the understanding of computer vision applications. Students can perform real time applications like object detection, optimization.

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

Text Books

1.	Digital image processing R. Gonzalez, and R. Woods. Prentice Hall, Upper Saddle River, N.J., (2008)

Reference Book

1.	Image Processing, Analysis, and Machine Vision Fourth Edition Milan Sonka The University of Iowa, Iowa City Vaclav Hlavac Czech Technical University, Prague Roger Boyle Prifysgol Aberystwyth, Aberystwyth, Cengage Learning 200 First Stamford Place, 4th Floor Stamford, CT 06902 USA, 2015

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester Odd**	**Semester VII Session 2022 -2023** **Month from August - December**
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 Email id: kanupriya.misra@jiit.ac.in

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, Using Tableau.	10
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 Analytics. Data Visualization and Storytelling using	12

		Tableau.	
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	**44**

Evaluation Criteria

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

Project Based Learning:

Students, in groups of 5-6, are required to select a contemporary topic of HR. Further students are required to select a sector from where they will collect the data. Data should be collected from at least 50 respondents from the chosen sector. The information can be collected with the help of an interview or some kind of questionnaire pertaining to the HR topic chosen. Analysis of the collected data should be done using SPSS software. Findings should be discussed and recommendations should be suggested.

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	19B12EC416	**Semester** odd	**Semester** VII **Session** 2022 -2023 **Month from** August 22 to December 22
Course Name	Deep Learning for Multimedia		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr Juhi Gupta
	Teacher(s) (Alphabetically)	Dr Juhi Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C430-2.1	Compare various loss functions and optimization methods for deep learning approaches	Understanding Level (C2)
C430-2.2	Experiment with various CNN architectures for related applications	Applying Level (C3)
C430-2.3	Apply and analyze sequence models for natural language processing	Analyzing Level (C4)
C430-2.4	Utilize and compare various deep learning techniques in real life problems	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Neural Networks, Loss Functions and Optimization	Neuron Model and Network Architectures: Perceptron and Hamming networks. Perceptron learning rule and proof of convergence. Performance surfaces and optimum points: Performance Optimization, Steepest Descent, Stable Learning Rates and Widrow-Hoff Learning.	13
2.	Backpropagation and Generalization	Backpropagation: Multilayer Perceptrons, Function Approximation, Performance Index, Chain Rule, Backpropagating the Sensitivities, Convergence, Generalization., Methods for Improving Generalization: Early Stopping, Regularization, Relationship Between Early Stopping and Regularization	8
3.	Convolutional Neural Network (CNN) Architectures	Review: Feed forward neural net, Layers for Conv Nets, Feature Maps and Pooling, FC layer to Conv layer conversion, CNN to Classify Text and Images: LeNet5, AlexNet, VGG, ResNet.	10
4.	Sequential Networks	Recurrent Neural Networks, Adding Feedback Loops and Unfolding a Neural Network, Long Short-Term Memory, Recurrent Neural Network for word predictions, Autoencoders, Different Autoencoder Architectures, Neural Language Models: Word Embeddings and Word Analogies, Word2vec.	10

Total number of Lectures	41

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [Assignments and Quiz]
Total	**100**

Project based learning: Each student in a group of 3-4 select a topic related to latest development in the technology and write done Algorithms and their corresponding code, This method of learning will help students to understand latest development in the industry once they land in to entry it will be a simple task to design and implement any given task. Knowledge acquired during this course will boost their confidence and clarity while attending any Interview related to placement activities and establishment of their own application based startup company related 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.	Introduction to Deep Learning, S. Kansi, Springer 2018
2.	Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
3.	Deep Learning, I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
4.	The Elements of Statistical Learning , T. Hastie, R. Tibshirani, J. Friedman., 2nd Edition, 2008
5.	Machine Learning Yearning , A. Ng, 2018

Detailed Syllabus

Lecture-wise Breakup

Subject Code	19B12EC417	**Semester: Odd (specify: Odd/Even)**	**Semester** VII **Session** 2022-2023 **Month from** August to December
Subject Name	**Machine Learning and Statistical Pattern Recognition**		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Parul Arora
	Teacher(s) (Alphabetically)	Parul Arora

S.NO	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY
C432-6.1	Identify supervised learning generative/discriminative learning, parametric/non-parametric learning,	Applying Level (C3)
C432-6.2	Test for their Knowledge in Clustering, dimensionality reduction, kernel methods.	Analyzing Level (C4)
C432-6.3	Explain Bias/variance tradeoffs; VC theory; large margins	Understanding Level (C2)
C432-6.4	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	10
3.	unsupervised learning	clustering, dimensionality reduction, kernel methods	9
4.	learning theory	bias/variance tradeoffs; VC theory; large margins	9
5.	Recent applications of machine learning	Robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing	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 technology and write down Algorithms and their corresponding code, This method of learning will help students to understand latest development in the industry once they land in industry. It will be a simple task to design and implement any given task. Knowledge acquired during this course will boost their confidence and clarity while attending any Interview related to placement activities and establishment of their own application based startup company related 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

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**20B12EC413**	**Semester (Odd)**	**Semester VII Session 2022 -2023 Month from August – December**
Subject Name	**Basics of Antenna and Wave Propagation**		
Credits	3	**Contact Hours**	3 (3 - 0 – 0)

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

S. No.	**Course Outcomes**	**Cognitive Levels/ Blooms Taxonomy**
C431-1.1	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)
C431-1.2	Compare Broadband Antennas, Frequency Independent antennas and Aperture antennas. Explain Dipole antenna and their characteristic, loop antenna	Applying (Level III)
C431-1.3	Design Array Antennas and identify the E and H fields for the antennas. Design Reconfigurable antenna, Active antenna, Dielectric antennas and measure radiation pattern, polarization and VSWR.	Creating (Level VI)
C431-1.4	Define terminology relevant to mode of propagation and examine the propagation of radio waves in different atmospheres.	Analyzing (Level IV)

Module No.	**Subtitle of the Module**	**Topics**	**No. of Lectures**
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	Linear antennas, current distribution Total	7

	Antennas	power, radiation resistance, Short-dipole, center-fed dipole, Half-wave dipole, dipole characteristics, folded dipole, Small loop antenna, Loop characteristics	
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
Total	**100**

Project based learning: Each student in a group of 4-5 will do project based on antenna designing and measurement. Each group will assign designing problems on different types of antenna with its real time applications. Apart from course different research paper will provide to the students then based on the research data students will solve different design problem and do discussion in class.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)

1.	John D. Kraus & RJ Marhefka, Antennas for all applications, The McGraw-Hill Companies, 5th edition, 2017
2.	C.A. Balanis, Antenna Theory, Analysis and Design. NY: John Wiley and Sons, 4th edition, 2016.
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, 2015

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**21B12EC412**	**Semester Odd**	**Semester: VII Session: 2022 -2023** **Month from August to December**
Subject Name	Modelling and Simulation of Semiconductor Devices		
Credits	3	**Contact Hours**	3

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

S. No.	**Course Outcomes**	**Cognitive Levels/ Blooms Taxonomy**
CO1	Develop an understanding of semiconductor physics, different modeling techniques and models.	Understanding (Level II)
CO2	Perform mathematical modeling for different transport equations and given boundary conditions.	Applying (Level III)
CO3	Analyze the electrical performances of Semiconductor devices.	Analyzing (Level IV)
CO4	Analyze the electrical performances of Optical and Photonic devices.	Analyzing (Level IV)

Module No.	**Subtitle of the Module**	**Topics**	**No. of Lectures**
1.	Introduction	Review of semiconductor electronics, band model for solids, Distinguish among activities of analysis, modeling, simulation and design, Transform the equivalent circuit form of a device model into a mathematical form, and vice-versa, Semi-classical Bulk Transport – Qualitative Model	8
2.	Fundamentals of Models	Fundamental equations for semiconductor devices: current equations, Poisson equation, study cases, continuity equations, Semi-classical Bulk Transport – EM field and Transport Equations. Drift-Diffusion Transport Model – Equations, Boundary Conditions, Mobility and Generation / Recombination	12

3.	Modeling and design strategy of MOSFET	MOSFET: basic theories and models, MOSFET parameters, Body effects, transconductance, speed of response, channel-length modulation, MOSFET design, control of the threshold voltage. MOSFET Model: Structure and Characteristics, Qualitative Model, Equations, Boundary Conditions and Approximations, Surface Potential based and Threshold based solutions, Parameter Extraction	10
4.	Modeling and design strategy of Photonic Devices	Introduction to optical and photonic devices, Electromagnetic waves in homogeneous material, Waves scattering on interfaces and thin slabs, light cone, dispersion relation, Modeling of one-dimensional photonic crystal: physical origin of gaps, lattice defects, bound states. Photonic crystal slabs and Bloch surface wave based design.	10
5.	Recent Trends	Introduction to recent trends in semiconductor devices	2
		Total number of Lectures	42

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 modeling & analysis of semiconductor devices with the help of assignments/simulations based projects. Some modeling and simulation based problems will be assigned to students.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)

1.	Sophocles J. Orfanidis, Electromagnetic Waves and Antennas, Rutgers University, 2016
2.	Sarkar C. K., Technology Computer Aided Design: Simulation for VLSI MOSFET, 2018.
3.	Sahay S., Mamidala M. J., Junctionless Field-Effect Transistors: Design, Modeling, and Simulation, 2018.
4.	IEEE, Elsevier, and IOPscience Journals

Detailed Syllabus
Lecture-wise Breakup

Course Code	22B12EC412	**Semester-** Odd **(specify Odd/Even)**	**Semester -VII Session 2022-23** **Month from** Aug to Dec
Course Name	Introduction to Power electronics		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Ruby Beniwal
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Acquire knowledge about fundamental concepts and techniques used in power electronics	Understanding Level (C2)
CO2	Ability to analyze various single phase and three phase power electronics circuit and understand their applications	Analyzing Level (C4)
CO3	Ability to identify basic requirements for power electronics application.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Overview of power electronics, Applications of Power Electronics, Types of Power Electronic Circuits, Peripheral Effects, Characteristics and Specifications of Switches.	4
2.	**Power electronic devices**	**Solid State Power Devices:** Principle of operation of SCR, dynamic characteristic of SCR during turn ON and turn OFF, parameters of SCR, dv/dt and di/dt protection, snubber circuit, commutation circuits; Heat sink design. **Modern Power Devices**: Principle of operation of MOSFET, IGBT, GTO, MCT, SIT, SITH, IGCT, their operating characteristics. **Power Transistors:** Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits.	12
3.	**Rectifiers**	**Controlled Rectifiers:** Introduction, Single-Phase Full Converters, Single-Phase Dual Converters, Three-Phase Full Converters, Three-Phase Dual Converters. **AC Voltage Controllers:** Introduction, Single-Phase Full-Wave Controllers with Resistive Loads, Single-Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers.	8

4.	**DC-DC Converters:**	Introduction, principle of step down and step up chopper with RL load, performance parameters, DC-DC converter classification.	9
5.	**DC-AC converters**	Introduction, principle of operation single phase bridge inverters, three phase bridge inverters, voltage control of single phase inverters, Harmonic reductions, Current source inverters.	9
		Total number of Lectures	42

Project Based Learning: Students will be asked to do the analysis and designing of the power electronics systems. Students can model and simulate the system using SPICE.

Evaluation Criteria

Components	**MaximumMarks**
Mid-Term	30
EndSemesterExamination	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.	Bimbhra, P.S., *Power Electronics,* Khanna Publishers, 2021.
2.	Rashid, M. H., *Power Electronics: circuits, devices & applications,*Pearson Education, 2014.
3.	Luo F. L., Ye H., *Advanced DC/DC Converters,* CRC Press 2017
4.	Mohan, N., Undeland, T. M., & Robbins, W. P., *Power electronics: converters, applications, and design*. John wiley & sons 2003.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**22B12EC413**	**Semester ODD (specify Odd/Even)**	**Semester VII Session 2022-23 Month from August to December**
Subject Name	**Low Power CMOS VLSI Circuit Design**		
Credits	3	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)		

S. No.	**Course Outcomes**	**Cognitive Levels/ Blooms Taxonomy**
C431-2.1	Able to analyze the need for low power VLSI circuits and understand dynamic and static power dissipation and factors affecting them	Remembering Level (C1)
C431-2.2	Able to recognize role of simulation possible at various levels of design	Understanding Level (C2)
C431-2.3	Able to define Relationship of probability while calculating power dissipation of circuits and able to apply power reduction techniques possible at circuit and logic level	Applying Level (C3)
C431-2.4	Able to analyze clock as a major source of power dissipation and distinguish various methods to reduce power	Analyzing Level (C4)

Module No.	**Subtitle of the Module**	**Topics**	**No. of Lectures**
1.	Introduction	Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Physics of power dissipation in CMOS devices.	3
2.	Device & Technology Impact on Low Power	Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.	3
3.	Power estimation : Simulation Power analysis and Probabilistic power analysis	SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems. Monte Carlo simulation. Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.	8
4.	Low Power Design: Circuit level and Logic level	Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic	8

5.	Low power Architecture & Systems:	Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.	8
6.	Low power Clock Distribution :	Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network	6
7.	Algorithm & architectural level methodologies :	Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.	6
		Total number of Lectures	42

Evaluation Criteria

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

Project Based Learning: Student will design and synthesize low power combinational and sequential circuits CMOS based circuits.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)

Text:

1. Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2012

2. Rabaey, Pedram, “Low power design methodologies” Kluwer Academic, 2012

References:

1. Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2009

Detailed Syllabus
Lecture-wise Breakup

Course Code	22B12EC414	**Semester:** Odd 2022	**Semester: VII, Session:** 2022-2023 **Month from** August to December, 2022
Course Name	Reliability Engineering and Life Testing		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES (C431-3)		**COGNITIVE LEVELS**
C431-3.1	Understand the fundamentals of reliability engineering and its application in critical real time scenarios.	Understanding Level (C2)
C431-3.2	Analyse the role of RAMS in simple and complex systems.	Analyzing Level (C4)
C431-3.3	Develop a comprehensive understanding of various reliability evaluation and life testing techniques.	Understanding Level (C2)
C431-3.4	Apply reliability analysis methods on time independent and time dependent failure models.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction**	Background, causes of failures, need for reliability, availability, maintenance and safety (RAMS), quality, repairable and non-repairable systems, reliability characteristics, bathtub curve, component reliability and hazard models: parts count and parts stress, reliability improvement techniques.	8
2.	**Statistical Methods in Reliability**	Introduction to probability theory, random variables: PDF and CDF, Discrete and Continuous distributions – Binomial, Poisson, exponential, Weibull, Rayleigh, Gamma, Lognormal, rectangular.	6
3.	**Reliability Modelling and Evaluation of simple and complex systems**	Series, parallel, series-parallel, standby and k-out-of-m modelling. System reliability evaluation techniques including methods of bounds, decomposition, tie/cut sets, fault tree and transformation techniques. Sum-of-Disjoint Products technique for minimizing system reliability expression. Concept of conditional probability. Analysis of dependent failures. Reliability computations using similar and dissimilar stress-strength distributions (Exponential, Weibull, Normal and Gamma). Time-dependent stress-strength distributions, fatigue failures, Markov modelling.	12

4	**Testing Methods**	Reliability Testing, Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.	8
5.	**Reliability Economics and Management**	Reliability costs, effect of reliability on cost, reliability achievement and utility cost models, cost effective choice of subsystems, replacement policies, management objectives, management's role in reliability and quality control.	8
		Total number of Lectures	42

Evaluation Criteria

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

Project Based Learning: Part of the final grade of this course is assigned to research project(s). Students will read and comprehend different research papers, implement them and write short summaries of the work. At the end of the term, students will present projects (along with computer simulation) in class. This will enable the students to become well-versed with different reliability evaluation philosophies. It will also help them to understand the failure data and learn to use some well-known reliability assessment and life data analysis tools. Summarily, this course will prepare the students to secure a job as a reliability engineer in the reputed MNCs like EATON, Alstom, and Philips.

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.	V. A. Naikan, "Reliability engineering and life testing," PHI Learning Pvt. Ltd.; 2008 Dec 12.
2.	C. E. Ebeling, "An introduction to reliability and maintainability engineering", Tata McGraw-Hill Education; 2017.
3.	K. K. Aggarwal, "Reliability engineering", Springer Science & Business Media; 1993 Oct 31.
4.	S. K. Chaturvedi, "Network reliability: measures and evaluation", John Wiley & Sons; 2016 May 31.
5.	K. B. Misra, "Reliability analysis and prediction: A methodology oriented treatment", Elsevier; 2012 Dec 2.
6.	E. A. Elsayed, "Reliability Engineering", Wiley, 3rd Edition, November 2020.

Detailed Syllabus
Lecture-wise Breakup

Course Code	22B12EC415	**Semester:** Odd 2022	**Semester: VII Session:** 2022-23 **Month from** August to December
Course Name	5G Wireless Communication Systems		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Samriti Kalia
	Teacher(s) (Alphabetically)	Dr. Samriti Kalia

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO 1	Understand basics, features and requirements of 5G wireless systems and its application in real time scenarios.	Understanding [Level II]
CO 2	Develop a comprehensive understanding of different types of 5G architectures, RAN and massive centralized RAN.	Analyzing [Level IV]
CO 3	Understand and Analyze various types of 5G enabling technologies including IOT for 5G and cognitive radio	Understanding [Level II]
CO 4	Understanding the role of mmwave communication in 5G wireless systems	Applying [Level III]

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to 5G wireless systems**	Introduction and motivation for 5G, Evolving LTE to 5G Capability, Spectrum for 5G, features and requirements of 5G, 5G standardization	8
2.	**5G RAN architecture**	Different architecture of 5G, Basics of RAN architecture, Functional architecture and 5G flexibility, Integration of LTE and new air interface to fulfill 5G requirements, Physical architecture and 5G deployment, Massive centralized RAN,	8
3.	**5G Radio Access Technologies**	Machine-Type Communication (MTC), Massive MTC, Device-to-device (D2D) communications, Multi-carrier with filtering-Filter-bank based multi-carrier, Universal filtered OFDM, Non-orthogonal multiple access (NOMA), Sparse code multiple access (SCMA), beam division multiple access	10
4	**5G Enabling technologies**	Ultra dense networks for 5G, massive MIMO, self cancellation techniques, concept of cognitive radio and spectrum sharing techniques for 5G, IOT for 5G	8

5.	**mmWave Communication**	Spectrum and regulations, Channel propagation, Hardware technologies for mmW systems, Beamforming architecture, Physical layer techniques.	8
		Total number of Lectures	42

Evaluation Criteria

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

Project Based Learning: Students will learn about the basic features, requirements and spectrum of 5G. Further, they shall be able to learn the overall architecture of 5G in detail. Additionally, they will have deep knowledge about the enabling technologies used in 5G including spectrum sharing and IOT for 5G. Apart from that, they will also get to know the concept of mmwave communication for 5G.

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.	Afif Osseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016
2.	Erik Dahlman, Stefan Parkvall, Johan Sko¨ld, "5G NR: The Next Generation Wireless Access Technology", Academic, Elsevier, 2018
3.	Hrishikesh Venkatarman and Ramona Trestian, "5G Radio Access Networks: Centralized RAN, Cloud-RAN, and Virtualization of Small Cells", Taylor and Francis, 2017
4.	Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", CRC Press, Taylor and Francis, 2019

Detailed Syllabus
Lab-wise Breakup

Course Code	16B1NEC832	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** August - December
Course Name	MIMO-OFDM APPLICATION TO WIRELESS COMMUNICATION		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr Vivek Dwivedi
	Teacher(s) (Alphabetically)	Dr Vivek Dwivedi

COURSE OUTCOMES: At the completion of the course, students will be able to:		**COGNITIVE LEVELS**
C310. 1	Understand concepts of MIMO diversity, OFDM and various generation wireless communication	Understanding Level (C2)
C310.2	Analyze effect of frequency offset, channels and its importance in real life communication systems.	Applying Level (C4)
C310.3	Identify theoretical and practical requirements for implementing MIMO OFDM	Applying Level (C4)
C310.4	Analyze the different Systems of future communication	Analyzing Level (C4)

Module No.	**Subtitle of the Module**	**Topics in Module**	**No. of Lectures**
1.	Introduction	Introduction to wireless networks, basic principles of orthogonality, Single vs multi carrier systems, orthogonal frequency-division multiplexing (OFDM) block diagram, modulation, demodulation, synchronization, peak-to-average power ratio (PAPR) reduction.	8
2.	ICI cancellation	Inter carrier interference (ICI) cancellation , ICI self cancellation, correlative coding based ICI cancellation, conjugate cancellation etc.	6
3.	PAPR reduction	Various PAPR reduction techniques, clipping and filtering/Windowing, selective mapping (SLM), partial transmit sequence (PTS),tone reservation (TR), tone injection, peak insertion (PI) techniques etc	4
4.	MIMO systems	MIMO channel model, antenna diversity, space-time coding, MIMO detection algorithms, channel capacity	4
5	MIMO OFDM in 4G/LTE Networks	LTE, LTE advance, beam forming for LTEA,	10
6	MIMO OFDM in 5G Networks	Introduction to 5G-NR, Massive MIMO, beam forming in 5G-NR	10
		Total number of Lectures	**42**
Evaluation Criteria Components		**Maximum Marks**	

T1	20
T2	20
End Semester	35
TA	25
Total	**100**

Project Based Learning: Student will be able to develop code for computing PAPR, MIMO detection Algorithm

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. MIMO-OFDM Wireless Communications with MATLAB , by Yong Soo Cho, Jaekwon Kim, Won Young Yang, Chung-Gu Kang , Wiley, 2018.
2. OFDM for Wireless Communication Systems, Ramjee Prasad, ARTECH house

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17B1NEC736	**Semester:** ODD	**Semester VII Session 2022 -2023 Month from August –December**
Subject Name	Essentials of VLSI Testing		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Akansha Bansal
	Teacher(s) (Alphabetically)	Dr. Akansha Bansal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-2.1	Understand the fundamental of Digital System testing	Analyzing Level (C4)
C432-2.2	Analyze Stuck-at faults model and Fault Simulation algorithms	Analyzing Level (C4)
C432-2.3	Perform Combinational and Sequential ATPG	Evaluating Level (C5)
C432-2.4	Analyze Controllability and Observability of Combinational and Sequential circuits	Analyzing Level (C4)
C432-2.5	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 VII Session 2022-2023 Month from August to December**
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 students 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
Lab-wise Breakup

Course Code	15B19EC791	**Semester** Odd **(specify Odd/Even)**	**Semester VII Session 2022 -2023 Month from August –December**
Course Name	Major Project Part-1		
Credits	4	**Contact Hours**	

Faculty (Names)	**Coordinator(s)**	Dr. Megha Aggarwal, Dr. Rahul Kaushik
	Teacher(s) (Alphabetically)	Dr. Abhishek Kashyap, Mr. Shivaji Tyagi,

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	15B19EC793	**Semester -:** Odd (specify Odd/Even)	**Semester-: VII Session** 2022-23 **Month- : August-December**
Course Name	Summer Training Viva		
Credits	Qualifying	**Contact Hours**	-

Faculty (Names)	**Coordinator(s)**	Dr. Ashish Gupta, Mr. Mandeep Narula
	Teacher(s)	Dr. Ashish Gupta, Mr. Mandeep Narula

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**

Project Based Learning:

The scope of this subject is to aware the students from latest technology available in the industry and also to make them familiar with the working environment in the industry. Under this course students undergoes 6-8 weeks training from different industries as per their area of interests. Students often work on different projects assigned by the mentors available in the industry.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**15B1NHS731**	**Semester** ODD **(specify Odd/Even)**	**Semester** VII **Session** 2022-2023 **Month from August to December**
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	Analyze 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**	Theoretical orientation: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks	4
2.	**Disasters: Types Of Disaster**	Understanding Natural and manmade disasters: its Impacts & Hazards.	4
3.	**Impact of Disaster on Caste, Class and Gender**	Caste and disaster, Disaster discrimination, in terms of caste, class, gender, age location, Role of Women's in Disaster..	5
4.	**Disaster Management Cycle and 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, plans, Programmes and Legislation.	2
9	**Global trends in disasters, Urban Disaster, Pandemics, Climatic Change and Complex Emergencies**	Agenda 21: For Local actions, Global trends in disasters, urban disasters, pandemics(COVID2019), 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(Assignments/Case Study, Project, Attendance)
Total	**100**

Project Based Learning: Students in group of 5-6 will be given project to understand the menace of disaster through waste deposition in our environment. To make this subject application based students develop cost effective and environmentally sound techniques and strategies for solid waste management. By installing high tech driven composters students can analyse the implications of waste in our environment, through this live project. Converting solid waste in organic manure ,produced in college mess -canteen, later on that organic manure and liquid manure can be used for open areas, gardens and parks in college premises.

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.	Government of India, 2009. National Disaster Management Policy.
2.	Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
3.	Indian Journal of Social Work 2002. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April
4.	Alexander David, Introduction in "Confronting Catastrophe", Oxford University Press, 2000
5	Coppola P Damon, 2007. Introduction to International Disaster Management
6	Yojana :A DEVELOPMENT MONTHLY Magazine, Volume 61,January 2017
7	S.K. Misra& V. K. Puri, Indian Economy, Himalaya Publishing House, 2011.
8	Parasuraman, S. & P.V. Unnikrishnan, 2005, “Disaster Response in India: An Overview,” India Disasters Report, Punjablok.
9	Satapathy S. (2009) Psychosocial care in Disaster management, A training of trainers manual (ToT),

	NIDM publication.
10	Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
11	Dave, R.K. (2018) , Disaster Management in India : Challenges and Strategies
12	Disaster Management and Rehabilitation, Rajdeep Dasgupta, 2007
13	Jensen, John R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Ed., Up Saddle River, NJ: Prentice Hall
14	NDMA, 2010, National Disaster Management Guidelines , Role of NGOs in Disaster Management

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NBT531**	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from August –December**
Course Name	**Networks of Life**		
Credits	3	**Contact Hours**	**LTP 3 0 0**

Faculty (Names)	**Coordinator(s)**	1. Dr. Shazia Haider
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Jain 2. Dr. Shazia Haider

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-15.1	Explain different type of networks	C2
C401-15.2	Explain models, motifs and network analytics	C2
C401-15.3	Apply networks to solve biological and social problems.	C3
C401-15.4	Case studies on pathogen informatics, metabolic pathways	C4

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Network Sciences**	Introduction to network sciences, Graph Theory, Random network, Scale Free Property, Various Models- Erdos Renyi, Barabasi-Albert etc. Centrality and Weighted Networks, Degree, Communities Identification, Robustness, Motifs and Evolving Networks.	18
2.	**Computational Resources**	Hands-on Cytoscape tool, Gephi, etc.	4
3.	**Applications & advanced topics**	Multi-Layered Networks, Spreading phenomenon, Temporal Networks, Networks in epidemics, networks in business, social networks, controlling networks, percolation, rewiring, machine learning in networks	10
4.	**Miscellaneous**	Case studies, projects, hands on workshop on advanced modules on python.	10

Total number of lectures	42

Evaluation Criteria

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

Project Based Learning: Students will choose any topic on Biological Network, Python language, Analysis tools and it's application to solve the biological problem linked to a particular disease in a group of 4-5 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.	R. Cohen and S. Havlin, Complex Networks - Structure, Robustness and Function, Cambridge Univ Press, 2010.
2.	M.O. Jackson, Social and Economic Networks, Princeton Univ Press, 2008.
3.	A. Barrat, M. Barthelemy and A. Vespignani, Dynamical Processes on Complex Networks, Cambridge Univ Press, 2008.
4.	E. Kolaczyk, Statistical analysis of network data, Springer, 2009.
5.	S. Wasserman, K. Faust, Social Network Analysis: Methods and Applications, Cambridge Univ Press, 1994.
6.	P. Van Mieghem, Graph Spectra for Complex Networks, Cambridge Univ Press, 2011.
7.	R. Diestel, Graph Theory (4th edition), Springer, 2010.
8.	R.K.Ahuja and T.L.Magnanti, Network Flows: Theory, Algorithms, and Application , Pearson, 1993.
9.	Mark Newman, Albert-László Barabási, and Duncan J. Watts, The Structure and Dynamics of Networks, ISBN: 9780691113579, Princeton University press, 2006
10.	Albert-László Barabási, Network Science, Cambridge University Press in 2015.

Detailed Syllabus

Lecture-Wise Breakup

Course Code	16B1NPH732	**Semester : ODD**	**Semester VII Session 2022-2023** **Month from August to December**
Course Name	Green Energy and Climate Modelling		
Credits	3	**Contact Hours**	40

Faculty (Names)	**Coordinator(s)**	Dr. Prashant Chauhan – JIIT 128
	Teacher(s)	Dr. Prashant Chauhan

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Recall the basic information about different energy resources, reserves and define the problem with fossil fuel	Remember Level (Level 1)
CO2	Explain green house effect, modelling of temperature measurement and physics behind the global warming	Understand Level (Level 2)
CO3	Demonstrate the basic principles and designs of different solar collectors and concentrators, and identify the best design/material/location to absorb maximum solar energy	Apply Level (Level 3)
CO4	Analyze the potential of different renewable energy sources like wind, ocean and bio mass energy	Analyzing Level (Level 4)
CO5	Compare the output of renewable energy source using different design under different conditions/location	Evaluate Level (Level 5)

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	06

		absorption. Device for thermal collection and storage	
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 (Quiz/Assignments: 7 marks, PBL: 6 marks, internal assessment: 5marks, Attendance: 7 marks)
Total	**100**

Project based Learning: Students will be given small projects in groups to enhance their understanding on the topics of energy issues including production, reserve, limitation and issues of conventional energy sources, alternative energy sources like solar energy, wind energy, ocean energy and fusion energy. Students will be asked to submit the report of given project and give presentations of the same.

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	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022-2023 **Month from** August to December
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain healthcare market, drugs and devices, role of various stakeholders	Understand Level (C2)
CO2	Apply related intellectual property laws and regulatory approvals for healthcare sector	Apply Level (C3)
CO3	Analyze the various business models/ innovations in the healthcare industry	Analyze Level (C4)
CO4	Compare economic aspects pertaining to the sector	Analyze Level (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 2	**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 their roles, 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**

Project Based Learning: Students analyze the site https://pmjay.gov.in/about/pmjay, understand the following sections:

- Coverage under PM-JAY
- Implementation Model
- Financing of the Scheme

And represent them in one comprehensive diagram, integrating all the above components. This helps them in understanding recent innovations in healthcare market and integration of healthcare informatics.

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (PBL, 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.	https://www.who.int/nationalpolicies/processes/stakeholders/en/
2.	Conflict of interests. I. Lo, Bernard. II. Field, Marilyn J. (Marilyn Jane) III. Institute of Medicine (U.S.). Committee on Conflict of Interest in Medical Research, Education, and Practice. IV. National Academies Press (U.S.), 2009
3.	Research papers and online resources

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT733	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** August-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**

Project based learning:

To identify factors responsible for stress and steer 2 people on a joyful path by becoming their "Happiness Coach"

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

Subject Code	**17B1NHS733**	**Semester: ODD**	**Semester VII Session 2022 - 2023 Month from August –December**
Subject Name	**Human Rights and Social Justice**		
Credits	**3 (3-0-0)**	**Contact Hours**	**(3-0-0)**

Faculty (Names)	**Coordinator(s)**	**Dr. Namreeta Kumari**
	Teacher	**Dr. Namreeta Kumari**

CO Code	**COURSE OUTCOMES**	**COGNITIVE LEVELS**
C401-18.1	Demonstrate an understanding of the concept and idea of human rights and social justice	Understand (C2)
C401-18.2	Evaluate and interpret information about human rights issues from various sources like print and electronic media, film, documentary and other information technologies	Evaluate(C5)
C401-18.3	Demonstrate an understanding of the International norms and standards of human rights	Understand (C2)
C401-18.4	Analyze the emerging dimensions of human rights and the challenges posed by them	Analyze (C4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Hours for the module**
.1.	Conceptual Background of Human Rights and Social Justice	● Meaning and Concept of Human Rights & Social Justice ● Notion and Classification of Rights: Natural, Moral and Legal Rights, ● Concept of Civil Rights ● Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights; Collective/Solidarity Rights), Distinction between CPR & ESCR	6

2.	Evolution of Human Rights	Human Rights in Middle Ages: ● Magna Carta Modern Movement for Human Rights: ● The United States Declaration of Independence ● The French Declaration of the Rights of Man and the Citizen ● United States Bill of Rights ● Geneva Convention of 1864	9
3.	International Human Rights Standards	● Universal Declaration of Human Rights, 1948. ● International Covenant on Civil and Political Rights, 1966 ● International Covenant on Economic, Social and Cultural Rights, 1966	8
4.	Human Rights of the specially disadvantaged sections of the society	● Scheduled Castes/Scheduled Tribes and Other Backward Classes: Caste Prejudice and Discrimination ● Minorities: Human Rights Issues of Ethnic minorities ● Women and Children: Gender Discrimination, Domestic Violence and Offences against Women; Gender Sensitive Laws, Children: Child Abuse, Child Labour, Street Children ● Aged and Disabled Persons: Vulnerability and social taboos	8
5.	Human Rights of the Working Class	● Migrant Workers ● Bonded Labourers ● Agricultural Labourers ● Casual Workers	5
6.	Emerging Dimensions Of Human Rights	● National Sovereignty versus 'international enforcement' of human rights ● International politics of human rights and selective application of international sanctions ● Unilateral use of coercion and implementation of human rights ● Human rights, and science and technology	6
Total number of Hours			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (assignment)

Total	**100**
Project Based Learning: The students will be required to form groups of 4-5 and review documentaries/movies which are based on the violation/issues of human rights and social justice	

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.	Banton, M. (1996). *International Action against Racial Discrimination*. Oxford: Clarendon Press
2.	Cassese, J. (1990). *Human Rights in Changing World.* Philadelphia: Temple University Press
3.	Cruft, R., Liao, S.M.& Renzo. M. (2015). *Philosophical Foundations of Human Rights*. Oxford: Oxford University Press
4.	Dhiman, O.P. (2011). *Understanding Human Rights An Overview*. New Delhi: Kalpaz Publication
5.	Donnelly, J. (2013).*Universal Human Rights and Practices*. Ithaca: Cornell University Press
6.	Easterly, W. (2014). *The tyranny of experts: Economists, dictators, and the forgotten rights of the poor*. New York: Basic Books
7.	Joshi. K.C. (2019). *International Law and Human Rights*. Lucknow: Eastern Book Company
8.	Saksena, K.P. (ed.) (1984). *Human Rights in Asia: Problems and Perspectives*. New Delhi: HURITER
9.	Sen, A. (1999). *Development as Freedom*. Oxford: Oxford University Press
10.	Sinha, M.K, (2000). *Basic Documents on International Human Rights and Refugee Laws*. New Delhi: Manak Publications
11.	Verma, R.S., (2000). *Human Rights: Burning Issues of the World*. Volumes I, II and III. Delhi: Radiant Publishers
12.	U.N. Department of Public Information. (2018). *Universal Declaration of Human Rights*. U.SA.: United Nations

Course Description
Lecture wise Breakup

Course Code	19B12MA412	**Semester** Odd	**Semester VII Session 2022-2023 Month from August to December**
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	6

		function, Plausibility and basic probability assignments.	
		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**

Project based learning: Students are divided in a group of 4-5 to do a survey on the application based study of highlighted topics. The student can recognize the real life problems and try to understand by themselves that the structure of the problem similar to the application of the topics coloured above in the course.

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.	**CengizKahraman, UzayKaymak, 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, ZeshuiXu,** Hesitant Fuzzy Decision Making Methodologies and Applications, Uncertainty and Operations Research, Springer Verlag, 2017.

Course Description
Lecture Wise Breakup

Course Code	17B1NMA731	**Semester Odd (specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** Aug 2022-Dec. 2022
Course Name	Applied Linear Algebra		
Credits	**3**	**Contact Hours**	**3-0-0**
Faculty (Names)	**Coordinator(s)**	Prof. R.C. Mittal	
	Teacher(s) (Alphabetically)	Prof. 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 matrices	9

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**

Project Based Learning: Each student in a group of 4-5 students will apply the concepts of eigenvalues and eigenvectors to solve the ordinary differential equations arising in various real-life problems.

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

Course Description
Lecture wise Breakup

Course Code	17B1NMA732	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2022 -2023 **Month from** August 2022 – December
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. Mohd. Sarfaraz, Dr. Neha Ahlawat, Dr. Pinkey Chauhan and Dr. Yogesh Gupta

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 (C3)
C401-8.2	explain finite and divided difference formulae for numerical interpolation.	Understanding Level (C2)
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 of one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equispaced points, Divided differences, Spline interpolation, Least square approximation	7
3.	Numerical Differentiation and integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods, Iterative methods: Jacobi and Gauss Seidel Methods and their convergence, Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of parabolic and elliptic partial differential equations by finite difference methods	12

Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning: Each student in a group of 4-6 will apply the concepts of numerical methods for the solution of ODE and PDE.

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 De Boor, 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.

Course Description
Lecture wise Breakup

Course Code	22B12MA411	**Semester:** Odd	**Semester VII Session- 2022-23** **Month from** Aug 2022 –Dec 2022
Course Name	Advanced Statistical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Shikha Pandey	
	Teacher(s) (Alphabetically)	Dr. Shikha Pandey	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
CO1	Apply univariate statistics in Time series, control charts.	Applying Level (C2)
CO2	Apply linear and normal regression to fit data.	Applying Level (C2)
CO3	Understand multivariate statistics related statistical measures.	Understanding Level (C2)
CO4	Apply hypothesis testing for mean and variance in multivariate data.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures**
1.	Univariate Statistics	Univariate descriptive statistics, central limit theorem, Sampling Distribution associated with normal population, Sampling distributions, (chi square, t, F and Z) and hypothesis tests, Time Series: Components, Measurement of trends by graphical method and method of semi averages, Techniques of statistical quality control, control charts for variables and attributes.	12
2.	Regression analysis	Linear Regression, Least Squares Estimation, Normal Regression, Tests of hypothesis for regression coefficients and mean.	8
3.	Introduction to Multivariate Statistics	Introduction of random vectors, Descriptive Statistics, Covariances, Correlations matrices, Multivariate normal distribution.	10

4.	Multivariate Hypothesis Testing	Tests of hypothesis: Tests on μ with Σ Known and Σ unknown (Hotelling T^2 statistic) of a multivariate normal population, one way and two- way analysis of variance (ANOVA) (populations with equal variance), Wilk's test statistic.	12
Total number of lectures			**42**

Evaluation Criteria

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

Project based learning: Students in groups will collect multivariate data and use it for hypothesis testing.

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. W. Anderson**, *Introduction to multivariate analysis*, John Wiley, 1984.
2.	**Biswas and Srivastava**, *A Textbook, Mathematical Statistics* 1st Edition, Narosa Publishing House, New Delhi, 2011.
3.	**A. M. Kshirsagar**, *Multivariate analysis*, Marcel Dekker, 1983.
4.	**R. A. Johnson and D. W. Wichern**, *Applied multivariate statistical analysis*, Prentice hall Inc., 1988.
5.	**D. F. Morrison**, *Multivariate Statistical Methods*, McGraw Hill Co.,3rd ed., 1990.
6.	**W. K. Hardle and L. Simar**, *Applied Multivariate Statistical analysis*, Springer, New York, 2019.
7.	**Alvin C. Rencher**, *Methods of Multivariate Analysis*, A JOHN WILEY & SONS, INC. PUBLICATION, Newyork, 2001.

Detailed Syllabus

Lecture-wise Breakup

Course Code	20B12PH411	**Semester** ODD	**Semester VII Session** 2022 -2023 **Month from August to December**
Course Name	SUPERCONDUCTING MATERIALS, MAGNETS AND DEVICES		
Credits	3	**Contact Hours**	3

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: Quizzes (7 marks), Attend. (7 marks), PBL (6 marks) and class performance (5 marks)
Total	**100**

Project based learning: To make a better understanding about the subject, groups of 4-5 students will be formed and a project on materials and applied superconductivity viz. synthesis technique of superconducting materials, fabrication of superconducting wires and tapes, design of superconducting magnet, SQUID, SFCL, SMES, IR detector, Superconducting switches, Maglev etc. will be allotted to each of the groups. The students will collect all the information's and understand about the basic principle, fabrication process and current research activities going on in the particular field. The students will also be encouraged to explore the field and create interactive simulations based on these devices.

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	**Semester: ODD**	**Semester: VII Session:** 2022 -2023 **Month from August to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Prof. Navendu Goswami Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Prof. Navendu Goswami 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 Nanomaterials	Nanoelectronics, Nanobiotechnology, Catalysis by nanoparticles, Quantum dot devices, Quantum well devices, High T_c nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS	10
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [PBL (6 M), 2 Quiz (7 M), Attendance (7 M) and Internal Assessment (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.

Project based learning: Students would work on a project of their choice in the field of Nanoelectronics, Nanobiotechnology, Catalysis by nanoparticles, Quantum dot devices, Quantum well devices, High Tc nano-Superconductors, Nanomaterials for memory application, CNT based devices, MEMS and NEMS. In such projects students can apply the basic concepts of Nanoscience for solving theoretical and numerical problems. They can also work on analysis of a nanomaterial to determine its properties through suitable characterization tools such as SEM, TEM, AFM etc. The learning gained through this project would consolidate the understanding and provide skills of analysis and application in Nanoscience and Technology and thereby providing the employability prospects in the organizations and industries involved in the research and development of nanomaterials synthesis and characterizations, nanoelectronics, nanobiotechnology/nanomedicine etc.

Detailed Syllabus
Lecture-wise Breakup

Course Code **NBA Code**	18B12CS424 C440	**Semester:** Odd	**Semester:** VII **Session:** 2022-23 **Month from** Aug 22 to Dec 22
Course Name	Algorithm Analysis and Artificial Intelligence		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Prof. Satish Chandra (J62) / Dr. Gaurav Kumar Nigam (J128)
	Teacher(s) (Alphabetically)	Prof. Satish Chandra (J62) / Dr. Gaurav Kumar Nigam (J128)

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 Algorithms	Travelling Salesman Problem,Knapsack Problem	01
		Total number of Lectures	**43**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Attendance-10Quiz/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