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
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

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	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

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	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	17M11EC118	**Semester Odd (specify Odd/Even**	**Semester VII Session** 2022-2023 **Month from August to December**
Course Name	ADVANCED DIGITAL SIGNAL PROCESSING		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Madhu Jain
	Teacher(s) (Alphabetically)	NIL

COURSE OUTCOMES At the end of the semester, students will be able to		**COGNITIVE LEVELS**
C110.1	Recall the principles of various transform techniques like Z, Chirp Z, Hilbert, Discrete Fourier transform and Fast Fourier Transform.	Applying Level (C3)
C110.2	Demonstrate the ability to apply different methods to design and analyze digital FIR (Finite Impulse Response) and IIR (Infinite Impulse Response) filters with its structural realization.	Analyzing Level(C4)
C110.3	Analyze Multirate signal processing and examine its application.	Analyzing Level(C4)
C110.4	Comprehend different methods for designing adaptive filters and examine its application	Analyzing Level(C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Design of IIR and FIR Filters**	Digital filter specifications, selection of filter type, and filter order, FIR filter design; using windowing Techniques, Fourier Series and frequency sampling method, Design of IIR Filters Using Butterworth, Chebyshev and Elliptic Approximations, Frequency Transformation Techniques; approximation of derivatives, Impulse invariant method, Bilinear transformation, Structures for IIR Systems – Direct Form I & II, Cascade, Parallel, Lattice & Lattice-Ladder Structures, Structures For FIR Systems – Direct , Cascade, Parallel, Lattice & Lattice ladder Structures.	12
2.	**Multirate Digital Signal Processing**	Decimation & Interpolation, Sampling rate conversion, Identities, polyphase decomposition, General polyphase framework for Decimator and Interpolator, Multistage decimator and Interpolator, Efficient transversal structure for Decimator and Interpolator, FIR and IIR structure for Decimator, Filter design for FIR decimator and Interpolator, Application of Multirate Signal processing.	12
3.	**Time-frequency analysis**	Uncertainty principle, Short-time Fourier transform, Properties of STFT, Practical aspects of STFT, Wigner-Ville distribution, Properties of WVD, Discrete WVD, Psuedo and smooth WVD, Kernel design, Gabor wavelets, multi-resolution analysis.	10

4.	**Adaptive Filters**	Introduction, Application of adaptive filters, correlation structure, FIR Weiner Filter, Adaptive Direct-form FIR filters Adaptive Lattice-Ladder filters, Introduction to linear prediction, linear prediction and autoregressive modeling.	10
		Total number of Lectures	44

Evaluation Criteria

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

Project based learning: Students will learn different techniques used for the design of the adaptive DSP systems that are used to condition, extract and interpret information bearing signal which is essential for smart phones, home appliances, biomedical devices and multimedia systems. These systems have dynamic transfer function whose frequency response are changed or controlled by varying certain variable parameters by means of an optimization algorithm. Student shall be given various practical situation-based design exercises to be implemented in MATLAB. This would enable them to recall and apply various techniques and algorithms taught in course to design and analyse the required system that meets the given technical specification.

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

1.	J.G. Proakis & D.G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 4th Edition, PHI, 2012
2.	Aurelio Uncini, "Fundamentals of Adaptive Signal Processing", Springer Nature, Jan 2015.
3.	Tulay Adah and Simon Haykins, "Adaptive Signal Processing: Next Generation Solutions", Wiley India, 2012.
4.	Franz Hlawatsch and François Auger ," Time-Frequency Analysis",Wiley,2013

Detailed Syllabus
Lecture-wise Breakup

Course Code	**20M41EC117**	**Semester:** ODD **(specify Odd/Even)**	**Semester: VII Session: 2022-23 Month from Aug 2022 to Dec 2022**
Course Name	**ADVANCED DIGITAL COMMUNICATION SYSTEMS**		
Credits	3	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Dr. Ashish Goel	
	Teacher(s) (Alphabetically)	Dr. Ashish Goel	

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

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

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

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

Evaluation Criteria

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

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	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

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

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.