Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC413	**Semester** ODD Sem	**Semester -VII Session** 2023 -2024 **Month from July**-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**
C432-3.1	Remember the basics of z transform, inverse z transform and solve the difference equation.	Remembering Level(C1)
C432-3.2	Understand the continuous and discrete time state space representation. Learn about different elements of a digital control system	Understanding Level (C2)
C432-3.3	Apply concepts of z transform and ZOH technique to determine z domain transfer function of open loop and closed loop systems and perform system stability tests.	Applying Level (C3)
C432-3.4	Analyze digital control systems using different techniques	Analyzing Level (C4)
C433-3.5	Design Digital Control Systems	Evaluating Level (C5)

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.	Transfer function and stability test	Digital control systems- Pulse transfer function. analysis of closed loop and open loop systems in z domain, Modified z- transfer function- Stability of linear digital control systems and Jury's stability test	8
5.	Analysis of digital control systems	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 and controller design using pole placement	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. Some designing and simulation (Using MATLAB) based problems will be assigned to 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.	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** 7th **Session** 2023-2024 **Month from** July 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	Explain digital image generation, pixel relationship, color models and image processing applications.	Understanding Level (C2)
C432-5.2	Apply mathematical operations on image and filtering in spatial domain for image enhancement.	Applying (C3)
C432-5.3	Analyze frequency transform of the image and perform filtering in frequency domain using high pass and low pass filters.	Analyzing Level (C4)
C432-5.4	Evaluate morphological processing, segmentation and nature inspired optimization algorithms for various applications.	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 Particle swarm optimization.	8

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	19B12EC413	**Semester** Odd	**Semester 7 Session** 2023 -2024 **Month from** July to December
Course Name	Convergence and Next Generation Network		
Credits	3	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
	At the completion of the course, students will be able to ...	
C430-3.1	Review the architectures of the existing networks and their limitations and need for a converged multimedia network.	Remembering level (C1)
C430-3.2	Understand principles of multimedia, quality of service (QoS), network security and various signaling systems.	Understanding level (C2)
C430-3.3	Apply above concepts for developing the frameworks/protocols required for secure transport of multimedia with required quality of service.	Applying level (C3)
C430-3.4	Analyze NGN architecture with application of frameworks of QOS, security and signaling systems, the current technology trends.	Analyzing level (C4)

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

5.	Media Gateway Control & Softswitch	a) Separation of media and call control functions, softswitch architecture, media gateway control, MEGACO/H.248.	2
6.	Next Generation Network	a) NGN architecture (ITU-T Y.2012). b) IP Multimedia subsystem (IMS) and its functional architecture. c) CSCF, HSS, SLF, BGCF, MGCF, MRFC, MRFP, PDP, PEP functions. d) IMS addressing, Private/public user identities. Globally routable user agent e) Discovery and session control. f) IMS services. Emergency service.	9
7.	Trends	a) Overview of fixed mobile convergence (FMC). b) Operations support system (OSS).	2
		Total number of Lectures	**40**

Evaluation Criteria

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

Project Based Learning: This course exposes the students to the technology used for ensuring quality of service & security for multimedia communications on a converged network. Exercises based on practical situations requiring application of this knowledge bandwidth requirements, network resource reservation and management are framed and included as part of assignments.

Recommended Reading material:

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

Detailed Syllabus

Lecture-wise Breakup

Course Code	19B12EC416	**Semester** odd	**Semester** 7th **Session** 2023 -2024 **Month from** July to December
Course Name	Deep Learning for Multimedia		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr Juhi Gupta
	Teacher(s) (Alphabetically)	B. Suresh and 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.	Preliminaries	Introduction to Linear Algebra, Calculus and Probability Theory	4
2.	Introduction to Neural Networks, Loss Functions and Optimization	Neuron Model and Network Architecture: Perceptron, Perceptron learning rule and proof of convergence. Performance Optimization, Steepest Descent, Stable Learning Rates and Widrow-Hoff Learning.	10
3.	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
4.	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
5.	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, and Neural Language Models: Word Embeddings and Word Analogies,	10

		Word2vec.	
		Total number of Lectures	42

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** 7th **Session** 2023-2024 **Month from** July 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)
CO1	Remember the concept of probability theory and Linear Algebra	Remembering Level (C1)
CO2	Understand the concept of Learning theory	Understanding Level (C2)
CO3	Apply the concept of Probability and Linear algebra theory in supervised learning, generative/discriminative learning, parametric/non-parametric learning,	Applying Level (C3)
CO4	Analyze unsupervised and Reinforcement learning techniques for real time data.	Analyzing Level (C4)
CO5	Develop the basic AI algorithms and evaluate them for text and web data processing applications.	Evaluating Level (C5)

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, kernel methods	11
3.	unsupervised learning	Clustering: K-means, Gaussian mixture model, dimensionality reduction: Principal component analysis, Independent Component analysis	8

4.	learning theory	bias/variance tradeoffs; VC theory; large margins	9
5.	Reinforcement learning	Reinforcement learning, Markov Decision Process	4
6.	Recent applications of machine learning	Data mining, autonomous navigation, speech recognition, and text and web data processing	4
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 tas to design and implement any given task. Knowledge acquired during this course will boost their confidenc 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

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Detailed Syllabus

Lecture-wise Breakup

Subject Code	**20B12EC413**	**Semester: Odd**	**Semester VII Session – 2023-24** **Month - July-December**
Subject Name	**Basics of Antenna and Wave Propagation**		
Credits	3	**Contact Hours**	3 (3-0-0)

Faculty (Names)	**Coordinator(s)**	Ashish Gupta, Monika
	Teacher(s) (Alphabetically)	Ashish Gupta, Monika, Shweta Srivastava

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
C431-1.1	Recall the concepts of Electromagnetic field theory, relate different types of antennas, and define antenna parameters.	Remembering Level (C1)
C431-1.2	Explain the working of wired antennas. Classify and compare different dipole antennas and loop antennas.	Understanding Level (C2)
C431-1.3	Build different configurations of Array Antenna and utilize their terminologies to construct different array antennas.	Applying Level (C3)
C431-1.4	Distinguish modes of propagation and examine the propagation of radio waves in different atmospheres.	Analyzing Level (C4)
C431-1.5	Design and develop different Broadband antennas, Aperture antennas, Reflector antennas and modern antennas. Estimate the radiation pattern, polarization and VSWR of the antennas.	Creating Level (C6)

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	8

		pattern, Directivity, numerical evaluation of directivity, Gain, efficiency, impedance, Loss resistance, Polarization, equivalent area, effective area and its relation to gain	
2.	Linear Antennas Loop Antennas	Linear antennas, current distribution Total power, radiation resistance, Short-dipole, center-fed dipole, Half-wave dipole, dipole characteristics, folded dipole, Small loop antenna, Loop characteristics	7
3.	Antenna Arrays	Antenna arrays, Broadside and End-fire arrays, Hansen-Woodyard array, Binomial arrays, Array theory Scan blindness in array theory ,Aperiodic arrays	7
4.	Broadband Antennas, Frequency Independent antennas & Aperture antennas	Yagi-Uda arrays, helical antennas Log-periodic antenna Fields as sources of radiation; Horn antennas, Reflector antennas	7
5.	Modern antennas-	Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Microstrip Antennas, 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	8

		usable frequency – Skip distance, Fading , Multi hop propagation, Electrical Properties of Ionosphere	
		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

Course Code	22B12EC412	**Semester-** Odd **(specify Odd/Even)**	**Semester -7th / Session 2023-24** **Month from** July 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**
C430-4.1	Recall fundamental concepts and techniques used in power electronics	Remembering Level (C1)
C430-4.2	Explain rectifiers & converters and their basic operating principles used in power electronics circuits.	Understanding Level (C2)
C430-4.3	Apply various single phase and three phase power electronics circuit and understand their applications.	Applying Level (C3)
C430-4.4	Analyze the 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	8

		Controllers.	
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 (specify Odd/Even)**	**Semester:ODD Session: 2023-24** **Month from** July **to** December
Subject Name	**Low Power CMOS VLSI Circuit Design**		
Credits	3	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Dr. Shruti Kalra	
	Teacher(s) (Alphabetically)		

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
CO1	Recall the need for low power VLSI circuits, understand dynamic and static power dissipation and factors affecting them	Remembering (Level I)
CO2	Understand therole of simulation possible at various levels of design	Understanding (Level II)
CO3	Demonstrate theimportance of signal probability while calculating power dissipation of circuits and able to apply power reduction techniques possible at circuit, architecture, algorithmand logic level	Applying (Level III)
CO4	Analyzeclock as a major source of power dissipation and distinguish various methods to reduce power	Analyzing (Level IV)

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	8

		encoding, state machine encoding, pre-computation logic	
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(Attendance, Performance. Assignment/Quiz)
Total	**100**

Project Based Learning: **The course will teach the technical skill to accomplish as well as enhance project planning. Students will be doing projects (in groups of 2-3) with given specifications, which will result in a designing of digital integrated circuits for low power applications implemented through HSPICE.**

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.	Gary K. Yeap, “Practical Low Power Digital VLSI Design”, KAP, 2012
2.	Rabaey, Pedram, “Low power design methodologies” Kluwer Academic, 2012
3.	Kaushik Roy, Sharat Prasad, “Low-Power CMOS VLSI Circuit Design” Wiley, 2009

Detailed Syllabus
Lecture-wise Breakup

Course Code	22B12EC414	**Semester:** Odd 2023	**Semester: VII, Session:** 2023-2024 **Month from** July to December
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		
C431-3.1	Recall the basic causes of failures, the significance of RAMS program, quality, repairable and non-repairable systems, etc.	Remembering Level (C1)
C431-3.2	Understand the fundamentals of reliability engineering and its application in critical real time scenarios.	Understanding Level (C2)
C431-3.3	Apply reliability analysis methods to assess both time independent and time dependent failure models.	Applying Level (C3)
C431-3.4	Analyse the role of RAMS in simple and complex systems, and explore concepts related to Reliability Economics and Management.	Analyzing Level (C4)
C431-3.5	Develop a comprehensive understanding of various reliability evaluation and life testing methods.	Evaluating Level (C5)

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,	8

		test planning, data reporting system, data reduction and analysis, reliability test standards.	
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 final grade of this course is assigned to research project(s). Students will read different papers and write short summaries of each paper. Students will undertake a significant research project. At the end of the term, students will present projects (along with computer simulation) in class and prepare a written project report. Grading will be based on a weighted combination of class participation, paper summaries, the final project presentation, the project report and final exam.

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.	K. K. Aggarwal, "Reliability engineering", Springer Science & Business Media; 1993 Oct 31.
2.	V. A. Naikan, "Reliability engineering and life testing," PHI Learning Pvt. Ltd.; 2008 Dec 12.
3.	R. Billinton, R. N. Allan, "Reliability evaluation of engineering systems", New York: Plenum press; 1992 Jun.
4.	C. E. Ebeling, "An introduction to reliability and maintainability engineering", Tata McGraw-Hill Education; 2004.
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 2023	**Semester: 7th Session:** 2023-24 **Month from** July to December
Course Name	5G Wireless Communication Systems		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-4.1	Recall the basic concepts and facts about different generations of wireless communication.	Remembering Level (C1)
C431-4.2	Demonstrate understanding of 5G RAN architecture and Integration of LTE and new air interface to fulfil 5G requirements.	Understanding Level (C2)
C431-4.3	Utilize the concept of 5G RAN architecture and Identify key 5G radio access technologies.	Applying Level (C3)
C431-4.4	Analyze the promising technologies like ultra-dense network (UDN), massive MIMO, cognitive radio (CR), IOT to address the network system capacity issue and spectrum sharing in 5G.	Analyzing Level (C4)
C431-4.5	Determine the importance of mmWave communication as a key disruptive technology for 5G.	Evaluating Level (C5)

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 mmWave 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 (Assignment, Attendance, Quiz)
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 Skold, "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
Lecture-wise Breakup

Course Code	23B12EC312	**Semester:** Even 2023	**Semester: VII Session:** 2023-2024 **Month from** July to December 2023
Course Name	Introduction to VLSI Fabrication Technology		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	List the basic environmental requirements for the fabrication of electronic devices along with the fabrication steps.	Remembering [Level I]
CO 2	Illustrate the basics of various gaseous growth techniques and impurity additions.	Understanding [Level II]
CO 3	To apply the series of processes that establish the shapes, dimensions, and placement of required physical components of IC on the wafer surface layer.	Applying [Level III]
CO 4	Examine the knowledge of lithography, ion-implantation, and masking for the formation of the circuits on the silicon chip including p-n junction and BJT.	Analyzing [Level IV]

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**	**COs Involved**
1.	Cleanroom technology and Epitaxy	Clean room concept – Growth of single crystal Si, surface contamination, Chemical Mechanical Polishing, wafer preparation, DI water, RCA and Chemical Cleaning. Processing considerations: Chemical cleaning, getting the thermal Stress factors etc. Epitaxy : Physical Vapour Deposition, Vapors phase Epitaxy Basic Transport processes & reaction kinetics, doping & auto doping, equipments, & safety considerations, epitaxial defects, molecular beam epitaxy, equipment used, film characteristics, SOI structure.	8	CO1 CO2 CO4
2.	Oxidation and Diffusion	Oxidation: Growth mechanism & kinetics, Silicon oxidation model, interface considerations, orientation dependence of oxidation rates thin oxides. Oxidation technique & systems dry & wet oxidation. Masking properties of SiO2. Diffusion: Diffusion from a chemical source in vapor form at high temperature, diffusion from doped oxide source, Ion Implantation,	8	CO2 CO4

		Annealing and diffusion from an ion implanted layer.		
3.	Film Deposition	Methods, Protection and Masking, Films for doping, Films for interconnections, Films for ohmic contacts	5	CO3
4.	Lithography and Etching	Optical Lithography: optical resists, contact & proximity printing, projection printing, electron lithography: resists, mask generation. Electron optics: roster scans & vector scans, variable beam shape. X-ray lithography: resists & printing, X-ray sources & masks. Ion lithography, Reactive plasma etching, AC & DC plasma excitation, plasma properties, chemistry & surface interactions, feature size control & apostrophic etching, ion enhanced & induced etching, properties of etch processing. Reactive Ion Beam etching, Specific etches processes: poly/polycide. Trench etching.	10	CO4
5.	Metallizatio n	Different types of metallization, uses & desired properties	4	CO3
6.	Device and Circuit Fabrication	Isolation, Self-Alignment, Planarization, Metallization, MOS based Silicon microcircuits, BJT based silicon microcircuits, GaAs based microcircuits	7	CO4
		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: The course will teach the technical skill to accomplish as well as enhance project planning. Students will be doing projects (in groups of 2-3) with given specifications, which will result them to know the steps of fabrication of any basic electronic device with given device process parameters.

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.	S.M. Sze, " VLSI Technology", John Wiley & Sons, 2000.
2.	Ghandhi, Sorab K. VLSI fabrication principles: silicon and gallium arsenide. John Wiley & Sons, 2008.
3.	Plummer, Deal and Griffin, "Silicon VLSI Technology", Pearson, 2015
4.	Sarkar, Chandan. Technology computer aided design. CRC Press, 2018.

Detailed Syllabus

Course Code	15B19EC791	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2023 -2024 **Month from** July to 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 After completion of this course, students will be able to		**COGNITIVE LEVELS**
C450.1	Understand the scholarly literature, identify the gaps and define project objectives in the area of Electronics and Communication Engineering.	**Understanding level** (C2)
C450.2	Apply the available resources to obtain the solution of project objectives within stipulated time and following ethical and professional norms.	**Applying level** (C3)
C450.3	Evaluate the outcomes of the project and find the applications based on analysis.	**Evaluating level** (C5)
C450.4	Develop the skills to communicate technical and scientific findings effectively in verbal and written forms.	**Creating 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** 2023-24 **Month- : July-December**
Course Name	Summer Training Viva		
Credits	Qualifying	**Contact Hours**	-

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C455.1	Understand the basics of specific domain area through exhaustive literature survey	Understanding Level (C1)
C455.2	Apply the theoretical knowledge to a real time application in industry using critical reasoning and learning to solve problems	Applying Level (C3)
C455.3	Analyze and evaluate the different techniques/algorithms involved	Evaluating Level (C5)
C455.4	Develop skills to write effective technical report and demonstrate through presentation	Creating Level (C6)

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	15B1NEC731	Semester Even (specify Odd/Even)	Semester VII Session 2023 -2024 Month from: July to December
Course Name	Soft Computing in Electronics		
Credits	3	Contact Hours	3

Faculty (Names)	Coordinator(s)	Dr. Vijay Khare, Dr. Abhay Kumar
	Teacher(s) (Alphabetically)	Dr. Abhay Kumar, Dr. Vijay Khare

COURSE OUTCOMES		COGNITIVE LEVELS
CO1	Explain Soft computing techniques and their role in problem solving.	Understanding Level (C2)
CO2	Apply basic concepts of soft computing techniques in various linear separable problems.	Applying Level (C3)
CO3	Analyze the Neural Network for classification and regression in nonlinear separable problems	Analyzing Level (C4)
CO4	Evaluate and compare solutions of different application using various soft computing approaches.	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 analyze different types of data in the area of electronics like Defense , Biomedical data, Images, Robotics and Fuzzy logic based controllers. Students will understand different types of algorithms which are used for feature extraction, classification and 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)

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

Subject Code	17B1NEC736	**Semester:** ODD	**Semester**: 7th **Session** 2023 -24 **Month:** Aug **to** Dec
Subject Name	Essentials of VLSI Testing		
Credits	3	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C432-2.1	Remember the fundamental of Digital System testing	**Remembering Level (C1)**
C432-2.2	Understand Stuck-at faults model and Fault Simulation algorithms	**Understanding Level (C2)**
C432-2.3	Applying ATPG on Combinational and Sequential circuits	**Applying Level (C3)**
C432-2.4	Analyzing Controllability and Observability of Combinational and Sequential circuits	**Analyzing Level (C4)**
C432-2.5	Design for Testability (DFT), Built-In-Self-Test(BIST), and Test Vector Compression	**Evaluating Level (C5)**

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

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

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

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

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NEC742**	**Semester: Odd (specify Odd/Even)**	**Semester** 7th **Session** 2023-2024 **Month** from July. 23 to Dec. 23
Subject Name	Introduction to data analysis with R		
Credits	3	**Contact Hours**	3-0-0

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

S. NO.	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C430-2.1	Demonstrate MATLAB and R languages utilization for data analysis and explain fundamental machine learning algorithms.	Understanding Level (C2)
C430-2.2	Apply continuous and discrete probabilistic models to fit distributions of given random variables.	Applying Level (C3)
C430-2.3	Analyze statistical tests such as z-test, t-test, Chi-square test etc. to inspect hypotheses.	Analyzing Level (C4)
C430-2.4	Choosing suitable data analysis techniques for solving given practical problems.	Evaluating Level (C5)

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**	

Practical implementation 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

Lecture-wise Breakup

Subject Code	17B11EC733	**Semester: ODD**	**Semester: 7th Session : 2023-24** **Month : from July to December**
Subject Name	Optical Communication		
Credits	3	**Contact Hours**	3-0-0

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

S. No.	Course Outcomes	Cognitive Levels
C412.1	Understand the conceptsrelated to structure, types, modes and transmission and propagation of optical fibers.	Understanding (C2)
C412.2	Illustratethe principles of operation and characteristics of Optical sources andreceivers.	Applying (C3)
C412.3	Analyze different kinds of losses and signal distortion in optical fiber transmission.	Analyzing (C4)
C412.4	Evaluate the power and rise time budget of fiber optic link.	Evaluating (C5)

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

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

		WDM Principles & Types of WDM, Measurement of Attenuation and Dispersion, Eye pattern.	
		Total number of Lectures	40

Evaluation Criteria

Components **Maximum Marks**

T1 20

T2 20

End Semester Examination35

TA 25

Total 100

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

Recommended Reading(Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	Gerd Keiser, Optical Fiber Communications, 5th Edition, McGraw-Hill International edition, 2017.
2.	John M. Senior, Optical Fiber Communications, 5thEdition, PHI, 2014.
3.	D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner,Fiber Optic Communications,Pearson Education, 2005.
4.	Govind P. Agarwal, Fiber Optic Communication Systems, 5th Edition, John Wiley, 2021.
5.	Joseph C. Palais,Fiber Optic Communications, 5th Edition, Pearson Education, 2005

Detailed Syllabus
Lecture-wise Breakup

Course Code	**15B1NHS731**	**Semester** ODD **(specify Odd/Even)**	**Semester Session** 2023-24 **Month from** July 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 basic concept of disasters, and its types, disaster prevention and risk reduction	Understand(C2)
C4O1-2.2	Apply different approaches of Disaster Risk Reduction (DRR)	Apply (C3)
C4O1-2.3	Analyze and enhance awareness of institutional processes in the country during disaster.	Analyze (C4)
C4O1-2.4	Evaluate strategies and develop skills to respond potential disaster with due sensitivity.	Evaluate (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Disasters**	Concepts and definitions of Disaster(Hazard, Vulnerability, Resilience, Risks)	4
2.	**Disasters: Classifications & Causes**	Understanding Natural and manmade disasters. Social ,Economic, Political, Environmental, Health, Psychological.	4
3.	**Impact of Disaster on Caste, Class and Gender**	Caste and disaster, Disaster discrimination, in terms of caste, class, gender, age location, disability, Role of Women's in Disaster..	5
4.	**Approaches to Disaster Risk reduction**	Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness, community based DRR, Structural - nonstructural measures roles and responsibilities of community.	5
5.	**Disaster Management Act(2005)**	DM Act and Policy, plans, Programmes and Legislation.	3
6.	**Inter-relationship between Disasters and Development**	Factors affecting Vulnerabilities, differential impacts, impact of development of projects such as dams, embankments, changes in land-use and relevance of	5

		indigenous knowledge, appropriate technology and local resources.	
7.	**Disaster Risk Management in India**	Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, and Health	5
8	**Risk Society**	Risk Society in 1992,Ulrick Beck, Processes of Modernization, The new paradigm of risk society	3
9	**Global trends in disasters**	Urban disasters, Pandemics(COVID2019), Epidemics, complex emergencies, Climate change, Agenda21:For Local actions,	4
10	**Disaster, Environment and Development**	Environment Management, 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 analyze and evaluate 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 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	16B1NPH732	**Semester : ODD**	**Semester** VII **Session** 2023 -2024 **Month : July-December**
Course Name	Green Energy and Climate Modeling		
Credits	3	**Contact Hours**	40

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-6.1	Recall the basic information about different energy resources, reserves and define the problem with fossil fuel	Remember Level (Level 1)
C401-6.2	Explain green house effect, modelling of temperature measurement and physics behind the global warming	Understand Level (Level 2)
C401-6.3	Demonstrate the basic principles and designs of different solar collectors and concentrators, and identify the best design/material/location to absorb maximum solar energy	Apply Level (Level 3)
C401-6.4	Analyse the potential and the output of renewable energy source using different designs under different conditions/location	Analyzing Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Man and energy, world and Indian production /reserve of conventional energy sources, alternative energy sources.	02
2.	The greenhouse effect	Physics behind greenhouse effect, Blackbody radiation, layer model depending on energy flux and temperature at earth surface, radiation effect on Greenhouse gases, temperature structure of the atmosphere, Heat, pressure, wind, feedback mechanism. Carbon Cycle and Climate, Fossil Fuels, Effect of Conventional energy sources.	10
3.	Solar energy	Nature and availability of radiation, estimation of solar energy radiation. Effect of receiving surface, location and orientation, heat transfer consideration relevant to solar energy, Characteristics of materials and surface used in solar energy absorption. Device for thermal collection and storage	06

4.	Ocean Energy	Tidal energy, and its characteristics, tidal energy estimation, important component of tidal energy plant, single basin plant, double basin plant, turbine, tidal power plant development in India, wave energy, design parameters of wave energy plant, introduction and working of ocean thermal energy conversion,	06
5.	Wind Energy and Bio Mass energy	Introduction to wind energy, Nature, power, forces, conversion and estimation. Components of wind energy system types, safety and environment, Introduction to bio mass energy, conversion and utilization of biogas plants and gas fiers	10
6.	Fusion Energy	Basics of DT fusion, Magnetic confinement fusion, laser inertial fusion, present status of fusion reactors and future scope at international and national level	6
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [Attendance (5 M), Class Test/Quizzes (6 M), Internal assessment (04M) Assignments in PBL mode (10 M)]
Total	**100**

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

1.	Global Warming : Understanding the forecast by David Archer, Wiley
2.	Kothari D.P. renewable energy resources and emerging technologies, Prentice of India
3.	G D, Non-conventional energy sources, Khanna Publishers
4.	Duffie J A & Beckmann W A, Solar engineering of thermal process, Wiley-International Publication

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.

Detailed Syllabus

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2023-2024 **Month from** July to Decemeber
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 g	**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

Course Code	17B1NBT733	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2023 -2024 **Month from** July-December
Course Name	Stress: Biology, Behaviour and Management		
Credits	3 (3-0-0)	**Contact Hours**	3

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

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

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

	techniques and therapeutic strategies	Relief; HIC4- Meditation/Mindfulness/Belly Breathing/Visual Imagery/Progressive Muscle Relaxation Psychological interventions; Developing Cognitive 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

Course Description

Course Code	17B1NMA731	**Semester Odd (specify Odd/Even)**		**Semester** VII **Session** 2023 -2024 **Month from** July 2023-Dec. 2023	
Course Name	Applied Linear Algebra				
Credits	**3**		**Contact Hours**	**3-0-0**	
Faculty (Names)	**Coordinator(s)**	Dr. Ram Surat Chauhan			
	Teacher(s) (Alphabetically)	Dr. Ram Surat Chauhan			

COURSE OUTCOMES : After pursuing the above mentioned course, the students will be able to:		**COGNITIVE LEVELS**
C401-7.1	Explain basic concepts of vector spaces, metric spaces, normed spaces, and inner product spaces.	Understanding level (C2)
C401-7.2	Solve the problems related to linear transformations, eigenvalue and eigenvectors and its applications.	Applying Level (C3)
C401-7.3	Make use of the concepts of norms, orthogonalization, bilinear, and quadratic forms in solving related problems.	Applying Level (C3)
C401-7.4	Analyze the existence and uniqueness of solution of a system of linear equations, diagonalizability of matrices and linear transformations.	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

Course Code	17B1NMA732	**Semester** - Odd	**Semester** VII **Session** 2023-24 **Month from** July 2023 - Dec 2023
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Pankaj Kumar Srivastava and Dr. Yogesh Gupta	
	Teacher(s) (Alphabetically)	Dr. Pankaj Kumar Srivastava and Dr. Yogesh Gupta	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above-mentioned course, the students will be able to:		
C401-8.1	explain the methods for roots of non-linear equations, interpolation and numerical linear algebra.	Understanding (C2)
C401-8.2	apply numerical methods for system of linear and non-linear equations, interpolation, differentiation, integration and differential equations.	Applying (C3)
C401-8.3	analyse numerical methods for finding approximate solutions of related problems.	Analyzing (C4)
C401-8.4	evaluate computational techniques for approximation, initial and boundary value problems.	Evaluating (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Roots of Non-linear Equations	Concept of round-off and truncation errors. Iterative methods to find roots for one or more nonlinear equations with their convergence	6
2.	Interpolation and Approximation	Interpolating polynomial, Lagrange formula with error, Formulae for equi-spaced points, Divided differences, Spline Interpolation, Least square approximation	7
3.	Numerical Differentiation and Integration	Approximation of derivatives, Newton-Cote's formulae, Gauss-Legendre quadrature formulae, Double integration	7
4.	Numerical Linear Algebra	Gauss-elimination and LU-Decomposition Methods, Iterative methods: Jacobi and Gauss Seidel Methods and their convergence, Power's method for the largest eigen-value, Jacobi and Householder's methods for eigen-values of real symmetric matrices	10
5.	Numerical Solutions of ODE and PDE	Runge-Kutta and predictor corrector methods for IVPs, Finite difference methods for BVPs, Shooting methods, Numerical solutions of parabolic and elliptic partial differential equations by Finite Difference Methods	12
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35

TA	25 (Quiz , Assignments, PBL)
Total	**100**
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 deBoor, C.**, Elementary Numerical Analysis, 3rd Ed., McGraw-Hill, 1980.
3.	**Gupta, R.S.**, Elements of Numerical Analysis, 1st Ed., Macmillan 2009.
4.	**Jain, M.K., Iyengar, S.R.K. and Jain, R.K.**, Numerical Methods for Scientific and Engineering Computation 5th Ed., New Age International, New Delhi, 2007.
5.	**Smith, G.D.**, Numerical Solution of Partial Differential Equations, 2nd Ed., Oxford, 1978.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17B1NPH731	**Semester: Odd**	**Semester: VII Session: 2023-2024** **Month from**: July to December
Subject Name	Introduction to Quantum Information Processing		
Credits	**03**	**Contact Hours**	**03**

Faculty (Names)	**Coordinator(s)**	Anirban Pathak and Sudip Kumar Haldar
	Teacher(s) (Alphabetically)	Anirban Pathak and Sudip Kumar Haldar

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

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	What is information? Why do we need to know how to manage the information growth? Is the information independent of physical laws used to store and process it? What is the present status of the subject and how far can we go? Definitions of classical information, Quantum information and their differences.	**3**
2.	Thermodynamics and statistical mechanics	Introduction to thermodynamics; First and second law of thermodynamics; Microstates and Macro states; Entropy, Conditional entropy; Entropy as a measure of disorder (upto S = kln omega)	**6**

3.	Classical theory of information	Basic ideas of classical information theory, Measures of information (information content and entropy); Maxwell's Demon; Data compression; The binary symmetric channel; error correcting codes; Classical theory of computation; Universal computer; Turing machine; Computational complexity; Uncomputable functions; Shortcomings of classical information theory and necessity of information theory.	**8**
4.	Introduction to quantum mechanics	Basic ideas of quantum mechanics; Probability interpretation; Measurement problem; Hilbert space; Schrodinger equation.	**8**
5.	Quantum information	Qubit; Quantum gates; No cloning theorem (Why quantum information can't be perfectly copied); Dense coding; Quantum teleportation; Quantum data compression; Quantum cryptography; The universal quantum computer; Universal gate; Church-Turing principle; Quantum algorithms; Simulation of Physical systems; Shor's factorization algorithm; Grovers's search algorithm; Experimental quantum information processors; Quantum error correction.	**9**
6.	Computers and Intelligent machines	Basic ideas of quantum computers and intelligent machines.	**4**
7.	Summary	Summary of entire course and a short of introduction to the present goals of quantum information technology.	**2**
		Total number of Lectures	**40**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [Attendance (05 M), Class Test, Quizzes, etc. (06 M), Assignments in PBL mode (10 M), and Internal assessment (04 M)]
Total	**100**

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

1.	Neil Gershenfeld, The Physics of information technology, Cambridge University Press.
2.	H Hirvensalo, Quantum computing, Springer Verlag.
3.	Lecture notes for Physics 229: Quantum Information and Computation, John Preskil http://www.theory.caltech.edu/people/preskill/ph229/#describe
4.	Andewsteane, Quantum computing, Rep. Prog. Phys. 61, 117-173 (1998) or quant-ph/9708022 http://xxx.lanl.gov
5.	P A M Dirac, The principles of Quantum mechnaics, Oxford University Press.
6.	David J.C. MacKay, Information Theory, Inference and Learning Algorithm.
7.	A. Barenco, Quantum Physics and Computers, Contemporary Physics, **37**, 375-89 (1996).

8.	C.H. Bennett, Quantum Information and Computattion, Physics Today, Oct., 1995, **24-30** (1995).
9.	A. Ekert, P. Hayden, H Inamori, Basic concepts in quantum computation, quant-ph/ 0011013.
10.	D. Gottesman and H K Lo, From quantum cheating to quantum security, Physics Today, Nov., 2000.
11.	J Preskill, battling decoherence: the fault – tolerent quantum computer. Physics Today, 24-30, June 1999.
12.	A. M. Steane and W. Van Dam, Physicists triumph at guess my number, Physics Today, 35-39, Feb. 2000.
13.	V. Vedral and M. B. Plenio, Basics of quantum computation, Prog. Quant. Electron, 22 1-39 (1998)
14.	A. Zeilinger, Fundamentals of quantum information, Physcs World, 11, March, 1998.

Project based learning: Students will be given a task to design a multi qubit quantum circuit by their own. This design will help students in understanding the basic working of quantum gates, quantum cryptography and computation. It will improve their analytical skills and problem-solving capability and help them in getting jobs in the quantum computation industries.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	**Semester: ODD**	**Semester: 7th Session:** 2023 -2024 **Month from July to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3

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

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

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

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

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [PBL (10 M), 2 Quiz (6 M), Attendance (5 M) and Internal Assessment (4 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	18B12CS424	**Semester Odd**	**Semester** VII **Session** 2023-24 **Month from July to December**
Course Name	Algorithm Analysis and Artificial Intelligence		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Dr. Alka Singhal (J62) / Dr. Varsha Garg (J128)
	Teacher(s) (Alphabetically)	Dr. Alka Singhal (J62) / Dr. Varsha Garg (J128)

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-12.1	Apply Substitution method, Recursion tree and Master's theorem to find the algorithmic time complexities.	Apply Level (Level 3)
C401-12.2	Apply the various programming paradigms like greedy, divide & conquer and dynamic programming techniques to solve the real life problems	Apply Level (Level 3)
C401-12.3	Apply inference mechanisms such as propositional logic, first order predicate logic, and probabilistic reasoning for knowledge based systems.	Apply Level (Level 3)
C401-12.4	Analyze the constraint satisfaction problems	Analyze Level (Level 4)
C401-12.5	Evaluate various informed, uninformed and adversarial search algorithms to optimize AI-related problems and game playing accordingly.	Evaluate Level (Level 5)

Sr.	**Module**	**Chapters**	**Lectures**
1.	Introduction	Time Complexity analysis: Master's Method. Divide and Conquer methods: Insertion Sort, Merge Sort, Quick Sort	04
2.	Divide and Conquer and Greedy Algorithms	Finding closest pair in 1D and 2D search spaces ,Knapsack Problem; Coin change Problem; Huffman Coding; Activity Selection; Minimum Spanning tree, shortest path.	06
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)	08
5.	Genetic Algorithms	Travelling Salesman Problem, Knapsack Problem	02
6.	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)	07
7.	Propositional Logic	Knowledge based agents, PL, FOPL, Syntax and semantics, use, knowledge engineering) , Inference in FOPL(Propositional vs First order inference	07
8.	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	03

Total number of Lectures	**42**

Evaluation Criteria

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

Project based learning: Each student in a group of 3-4 will be creating a mini-project that employs informed or uninformed searching algorithms or genetic algorithm-based code optimization. The implementation of the mini-project should be done using an open-source programming language of their choice. This project development endeavor will not only expand the students' knowledge but also enhance their employability in the IT sector.

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	**18B12HS412**	**Semester Odd**	**Semester VII Session 2023-2024** **Month from July 2023 - December 2023**
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	19B12MA412	**Semester** Odd	**Semester** VII **Session** 2023-24 **Month from** July -December
Course Name	Generalized Fuzzy Set Theory with Applications		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Amit Srivastava	
	Teacher(s) (Alphabetically)	Dr. Amit Srivastava	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-21.1	Explain the concepts of fuzzy sets, its various generalizations and possibility theory.	**Understanding level (C2)**
C401-21.2	Apply the theory of generalized fuzzy sets in pattern recognition and medical diagnosis problems.	**Applying level (C3)**
C401-21.3	Analyze generalized fuzzy information measures in multiple attribute decision making (MADM) problems.	**Analyzing level (C4)**
C401-21.4	Examine the problems related to Dempster-Shafer theory and possibility measures.	**Analyzing level (C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Intuitionistic fuzzy sets	Intuitionistic fuzzy sets (*IFS*s) – Basic definitions and operations. Measures of entropy, similarity and discrimination between Intuitionistic fuzzy sets (*IFS*s). Applications of *IFS*s in medical diagnosis and pattern recognition.	10
2.	Hesitant fuzzy sets	Hesitant fuzzy sets – concepts, basic operations and basic properties. Extensions of hesitant fuzzy sets – Dual Hesitant fuzzy sets, Interval valued Hesitant fuzzy sets, Triangular Fuzzy Hesitant Fuzzy Sets, Hesitant Fuzzy Linguistic Term Sets.	10
3.	Aggregation Operators	Aggregation Operators – concepts, basic operations and basic properties, weighted aggregation operators, Ordered weighted averaging operator,Induced ordered weighted averaging operator.	8
4.	Pythagorean fuzzy sets	Pythagorean fuzzy sets - concepts, basic operations and basic properties, Hesitant Pythagorean fuzzy sets and their aggregation operators in multiple attribute decision making.	8
5.	Dempster-Shafer Theory	Dempster-Shafer Theory as an alternative to Bayesian networks. Frame of discernment, Belief function, Plausibility and basic probability assignments.	6
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**

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

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.

Detailed Syllabus

Lecture-wise Breakup

Course Code	20B12PH411	**Semester** ODD	**Semester 7th Session** 2023 -2024 **Month from July 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**
C401-13.1	Define unusual properties exhibited by superconducting materials and how these properties are important in the development of superconducting Devices.	Remember Level (Level 1)
C401-13.2	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)
C401-13.3	Solve the various issues related to fabrication of superconducting wires, tapes, design of superconducting magnets and devices.	Apply Level (Level 3)
C401-13.4	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	16B1NBT531	Semester Odd (specify Odd/Even)	Semester VII Session 2023-24 Month from July -Dec
Course Name	Networks of Life		
Credits	3	Contact Hours	LTP 3 0 0

Faculty (Names)		
	Coordinator(s)	1. Dr. Chakresh Jain
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Jain

COURSE OUTCOMES		COGNITIVE LEVELS
C401-15.1	Explain types of networks and network analytics.	C2
C401-15.2	Apply networks to solve biological and social problems.	C3
C401-15.3	Analyze networks for understanding the biological interactions	C4
C401-15.4	Evaluate computational approaches for network analysis	C5

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

PBL: 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.