Detailed Syllabus
Lab-wise Breakup

Course Code	16B1NEC832	**Semester Odd (specify Odd/Even)**	**Semester** 7th **Session** 2021 -2022 **Month from** July - Dec
Course Name	MIMO-OFDM APPLICATION TO WIRELESS COMMUNICATION		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Pankaj Yadav
	Teacher(s) (Alphabetically)	Pankaj Yadav

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

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

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20

End Semester	35
TA	25
Total	**100**

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

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

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

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**20B12EC413**	**Semester (Odd)**	**Semester VII Session – 2021- 2022 Month Jul. – Dec. 2021**
Subject Name	**Basics of Antenna and Wave Propagation**		
Credits	4	**Contact Hours**	4 (3 - 1 – 0)

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

Course Objectives:

- To introduce the fundamental principles of different types of antennas and their applications.
- Emphasis will be on dipole antennas, loop antennas, antenna arrays, aperture antennas and microstrip patch antennas, their design considerations for use in wireless communication systems.
- Learn how to characterize antennas and use antenna design for communications, radar, remote sensing systems.
- Emphasis on modern antennas like Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and propagation of radio waves

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
C433-8.1	Recall the concepts of Electromagnetic field theory, classify different types of antennas, illustrate antenna parameters and demonstrate the effect on antenna parameters due to changes in the physical dimensions.	Understanding Level (C2)
C433-8.2	Compare Broadband Antennas, Frequency Independent antennas and Aperture antennas. Explain Dipole antenna and their characteristic, loop antenna	Applying Level (C3)
C433-8.3	Design Array Antennas and identify the E and H fields for the antennas. Design Reconfigurable antenna, Active antenna, Dielectric antennas and measure radiation pattern, polarization and VSWR.	Creating Level (C6)
C433-8.4	Define terminology relevant to mode of propagation and examine the propagation of radio waves in different atmospheres.	Analyzing Level (C4)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Radiation Fundamentals &	Antenna types, radiation, use of potential functions, radiated fields, far fields, Radiation from current	8

	Antenna Parameters	element, Infinitesimal dipole, antenna parameters, radiation pattern, Directivity, numerical evaluation of directivity, Gain, efficiency, impedance, Loss resistance, Polarization, equivalent area, effective area and its relation to gain	
2.	Linear Antennas Loop Antennas	Linear antennas, current distribution Total power, radiation resistance, Short-dipole, center-fed dipole, Half-wave dipole, dipole characteristics, folded dipole, Small loop antenna, Loop characteristics	7
3.	Antenna Arrays	Antenna arrays, Broadside and End-fire arrays, Hansen-Woodyard array, Binomial arrays, Array theory Scan blindness in array theory ,Aperiodic arrays	7
4.	Broadband Antennas, Frequency Independent antennas & Aperture antennas	Yagi-Uda arrays, helical antennas Log-periodic antenna Fields as sources of radiation; Horn antennas, Reflector antennas	7
5.	Modern antennas-	Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements - Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR	6
6.	Propagation of Radio Waves	Modes of propagation , Structure of atmosphere, Ground wave propagation , Free Space Wave Propagation, Ground Reflection, Surface Waves, Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept, Ionospheric propagation, Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation, Electrical Properties of Ionosphere	8
		Total number of Lectures	43

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
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	15B1NEC733	**Semester** ODD **(specify Odd/Even)**	**Semester** 7th **Session** 2021-2022 **Month from** July to Dec
Course Name	Fundamentals of Embedded Systems		
Credits	4	**Contact Hours**	3L+ 1T

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-4.1	Understanding of the fundamental concepts for embedded systems designandcomplete architecture of the ATMEGA16/32 microcontroller.	Understanding Level (C2)
C431-4.2	Identify various on chip peripherals of the ATMEGA16/32 microcontroller and make use of them for designing embedded applications.	Applying Level (C3)
C431-4.3	Experiment the basic concepts of embedded 'C' programming and make use of them in designing embedded system applications around various sensors and actuators.	Analyzing Level (C4)
C431-4.4	Understanding of the basic concept of RTOS, detailed study of ARM7 architecture (32 bit) and study of wireless protocols.	Understanding Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Fundamental for Embedded Developers.	Embedded System and its applications, Future Trends of Embedded System, Design Parameters of Embedded System and its significance, Microprocessor Versus Microcontrollers, Microcontrollers for Embedded Systems, Embedded Versus External Memory Devices, CISC Versus RISC Processors, and Harvard Versus Von-Neumann architecture.	4
2.	Detailed Study of AVR Microcontroller	ATmega16/32 Microcontroller (Basic architecture, Pin configuration, Memory organization (registers and i/o ports), Embedded C programming, Timers, on chip PWM, on chip ADC, Interrupts and Serial Communication.	10
3.	Concept of Embedded 'C' programming	Introduction to C, Difference between C and Embedded C, Data Types used in Embedded C, Arithmetic & Logical Operators, Control Flow, If & If – else, While & Do – while, For, Switch & Case, Continue & Break, Array & String, Functions and Header files, Pointers.	6
4.	Real World Interfacing with Microcontroller	Interfacing of single LED, Blinking of LED with timer and without timer, Interfacing of push-button and LED, Interfacing of 7-segment display, Interfacing of 8 push-buttons to control 7-segment display, Intelligent LCD Display, Interfacing of intelligent LCD display, Interfacing of Matrix Keyboard to control 7-segment display, ADC and	12

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

Evaluation Criteria

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

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

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

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

Detailed Syllabus

Course Code	15B19EC793	**Semester -:** Odd (specify Odd/Even)	**Semester-: 7th Session** 2021-22 **Month- :** July - December
Course Name	Summer Training Viva		
Credits	Qualifying	**Contact Hours**	-

Faculty (Names)	**Coordinator(s)**	Dr. Bajrang Bansal, Mrs. Smriti Bhatnagar
	Teacher(s)	Dr. Bajrang Bansal, Dr. Ashish Gupta, Mrs. Smriti Bhatnagar, Mr. Mandeep Narula

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

Evaluation Criteria

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

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NEC742**	**Semester: Odd (specify Odd/Even)**	**Semester** 7th **Session** 2021-2022 **Month** from Aug. 21 to Dec. 21
Subject Name	Introduction to data analysis with R		
Credits	4	**Contact Hours**	3-1-0

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

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

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Software**	Introduction to R and MATLAB programming for data analysis.	4
2.	Probabilistic models	Probabilistic models: Events and their probabilities, Rules of probability, Conditional probability and independence, Distribution of a random variable, Expectation and variance, Families of discrete distributions, Families of continuous distributions	10
3.	Statistics	Descriptive statistics, Inferential statistics, Hypothesis testing and estimation (z-test, t-test, proportional z-test) ANOVA, Regression Implementation of these algorithms in R language	12
4.	Machine Learning	Introduction to Unsupervised and Supervised machine learning algorithms like ordinary least squares method, k-NN technique, Logistic regression etc.	8
5.	Simulations of data analysis techniques	Detailed simulation of ANOVA, Regression, and Machine learning techniques in Matlab/R languages.	5

6.	Data smoothing (optional)	Introduction to smoothing functions. Nonparametric smoothing, functional linear models, dimensional reduction functional principle components analysis.	3
Total number of Lectures			**42**

Evaluation Criteria

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

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

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

1.	Anil Maheshwari, Business Intelligence and Data Mining Made Accessible, Createspace Independent Pub, 2014.
2.	Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Revised and Updated, John Wiley & Sons, 2016.
3.	Shai Shalev-Shwartz and Shai Ben-David,Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.
4.	https://www.datacamp.com/courses/free-introduction-to-r
5.	https://onlinecourses.science.psu.edu/statprogram/r
6.	http://www.iiserpune.ac.in/~ayan/MTH201/Sahoo_textbook.pdf

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17B11EC733	**Semester:** Odd **(specify Odd/Even)**	**Semester:** 7th **Session:** 2021-22 **Month :** from July to December
Subject Name	Optical Communication		
Credits	4	**Contact Hours**	3(L)+1(T)

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C412.1	Develop an understanding of optical fiber, its structure, types, and propagation and transmission properties.	Remembering (C1)
C412.2	Identify and examine the different kinds of losses and signal distortion in optical Fibers.	Analyzing (C4)
C412.3	Classify the Optical sources and detectors and their principle of operation .	Understanding (C2)
C412.4	Design a fiber optic link based on budget analysis.	Evaluating (C5)

Module No.	**Subtitle of the Module**	**Topics**	**No. of lectures for the module**
1.	Overview of Optical fiber Communications	Electromagnetic Spectrum, Historical development and advantages of optical fiber communication, Elements of optical fiber transmission link, Optical laws and definitions, optical fiber modes and configurations.	3
2.	Optical fibers Structures	Optical fiber wave guides, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers Modes, V Number, Mode Coupling, Step Index fibers, Graded Index fibers. Single mode	4

		fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index.	
3.	Signal Degradation in Optical fibers	Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity, Group delay, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion, Pulse broadening. Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss.	7
4.	Optical Sources	Light emitting diode (LEDs)-structures, materials, Figure of merits, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes - Modes & threshold conditions, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, temperature effects, external quantum efficiency, and laser diode rate equations. Reliability of LED & ILD.	6
5.	Power Launching and Coupling	Source to fiber power launching: - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, LED coupling to single mode fiber. Fiber Splicing- Splicing techniques, splicing single mode fibers. Multimode fiber joints and single mode fiber joints. Fibre alignment and joint loss.	6
6.	Photo detectors& Receivers	Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation:- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers.	7

7.	Optical System Design	Considerations, component choice, multiplexing.Point-to- point links, System considerations, Link considerations. Overall fiber dispersion in multi mode and single mode fibers. Rise time considerations. Distance consideration in optical transmission system. Line coding in Optical links, WDM Principles & Types of WDM, Measurement of Attenuation and Dispersion, Eye pattern.	7
		Total number of lectures	40

Evaluation Criteria

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

Project Based Learning: Students will learn about fundamental concepts, working and applications of an optical communication system. Understanding of various losses in an optical link provide requisite skills in design, analysis and evaluation of the performance of analog and digital optical fiber link. Students will be able to design an optical link with the given specifications. Designing based questions given in the assignments built-up the thought process of the students in the field applications.

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

1.	Govind P. Agarwal, Fiber Optic Communication Systems, 5th Edition, John Wiley, 2021.
2.	Gerd Keiser, Optical Fiber Communications, 5th Edition, Mc Graw-Hill International Edition, 2017.
3.	John M. Senior, Optical Fiber Communications, 5th Edition, PHI, 2014.
4.	D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Fiber Optic Communications, Pearson Education, 2005.
5.	Joseph C. Palais, Fiber Optic Communications, 5th Edition, Pearson Education, 2005

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC413	**Semester** ODD Sem	**Semester -VII Session** 2021 -2022 **Month from** Aug-Dec
Course Name	Digital Control Systems		
Credits	3	**Contact Hours**	3L+1T

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C434-8.1	To represent the systems in the Z domain and in state space representation.	Remembering Level(C1)
C434-8.2	To analyze transient and steady state behaviors of linear discrete time control systems with modified transfer function.	Analyzing Level (C4)
C434-8.3	To understand and gain knowledge in stability analysis of digital control systems.	Understanding Level (C2)
C434-8.4	To Design Digital Control Systems	Designing Level (C6)

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

Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning: Students will learn about the analysis and Design of Digital controllers with the help of assignments/simulations based projects. Some designing and simulation 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** 2021-2022 **Month from** August to December
Course Name	Image Analysis and Feature Extraction		
Credits	4	**Contact Hours**	3-0-2

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

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

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

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

Evaluation Criteria

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

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

1.	Milan Sonka et al: Image Processing, Analysis and Computer Vision
2.	Gonzalez and Woods: Digital Image Processing
3.	Rafael C.G. and Woods R.E.(1992) Digital Image Processing.

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12EC413	**Semester**	Odd	**Semester 7** **Session** 2021 -2022 **Month from** August to December	
Course Name	Convergence and Next Generation Networks				
Credits	3	**Contact Hours**		3-0-0	

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

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

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

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

Evaluation Criteria

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

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

Recommended Reading material:

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

Detailed Syllabus

Lecture-wise Breakup

Course Code	19B12EC416	**Semester** odd	**Semester** 7th **Session** 2021 -2022 **Month from** August 21 to December 21
Course Name	Deep Learning for Multimedia		
Credits	4	**Contact Hours**	3-1-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-7.1	Compare various loss functions and optimization methods for deep learning approaches	Understanding Level (C2)
C431-7.2	Experiment with various CNN architectures for related applications	Applying Level (C3)
C431-7.3	Apply and analyze sequence models for natural language processing	Analyzing Level (C4)
C431-7.4	Utilize and compare various deep learning techniques in real life problems	Evaluating Level (C5)

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

		Total number of Lectures	41

Evaluation Criteria

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

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

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

1.	Introduction to Deep Learning, S. Kansi, Springer 2018
2.	Pattern Recognition and Machine Learning, C.M. Bishop, 2nd Edition, Springer, 2011.
3.	Deep Learning, I. Goodfellow, Y, Bengio, A. Courville, MIT Press, 2016.
4.	The Elements of Statistical Learning , T. Hastie, R. Tibshirani, J. Friedman., 2nd Edition, 2008
5.	Machine Learning Yearning , A. Ng, 2018

Detailed Syllabus

Lecture-wise Breakup

Subject Code	19B12EC417	**Semester: Odd (specify: Odd/Even)**	**Semester** 7th **Session** 2021-2022 **Month from** August to December
Subject Name	**Machine Learning and Statistical Pattern Recognition**		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	B Suresh	
	Teacher(s) (Alphabetically)	Parul Arora, B Suresh	

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

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

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

Evaluation Criteria

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

Project based learning: Each student in a group of 3-4 select a topic related to latest development in the technology and write down Algorithms and their corresponding code, This method of learning will help students to understand latest development in the industry once they land in industry. It will be a simple 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	**21B12EC412**	**Semester (specify Odd/Even)**	**Semester** odd **Session** 2021-22 **Month from** July **to** Dec
Subject Name	Modeling and Simulation of Semiconductor Devices		
Credits	3	**Contact Hours**	3

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

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
CO1	Develop an understanding of semiconductor physics, different modeling techniques and models.	Understanding Level (C2)
CO2	Perform mathematical modeling for different transport equations and given boundary conditions.	Applying Level (C3)
CO3	Analyze the electrical performances of Semiconductor devices.	Analyzing Level (C4)
CO4	Analyze the electrical performances of Optical and Photonic devices.	Analyzing Level (C4)

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

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

Evaluation Criteria

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

Project Based Learning: Students will learn about the modeling & analysis of semiconductor devices with the help of assignments/simulations based projects. Some modeling and simulation based problems will be assigned to students.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	Sophocles J. Orfanidis, Electromagnetic Waves and Antennas, Rutgers University, 2016
2.	Sarkar C. K., Technology Computer Aided Design: Simulation for VLSI MOSFET, 2018.
3.	Sahay S., Mamidala M. J., Junctionless Field-Effect Transistors: Design, Modeling, and Simulation, 2018.
4.	IEEE, Elsevier, and IOPscience Journals

Detailed Syllabus
Lecture-wise Breakup

Course Code	21B12EC411	**Semester** ODD **(specify Odd/Even)**	**Semester** 7th **Session** 2021 -2022 **Month from** Sep to Dec
Course Name	Introduction to CMOS Data Converters		
Credits	3	**Contact Hours**	3L + 1T

Faculty (Names)	**Coordinator(s)**	Shivaji Tyagi
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C435-2.1	**Develop an understanding of the fundamentals of data conversion systems**	Understanding Level (C2)
C435-2.2	**Analyze and design the basic building blocks of data converters including CMOS sampling circuits, operational amplifiers, comparators, and sample-and-hold architectures.**	Applying Level (C3)
C435-2.3	**Identify basic types of analog-to-digital converters focusing on design issues, sources of errors, and performance improvement techniques.**	Analyzing Level (C4)
C435-2.4	**Design techniques for analog-to-digital converters in CMOS technologies**	Understanding Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of CMOS Technology and Analog Integrated Circuit Techniques	From the Idea to the Chip, Microelectronics vs Electronic Design, Evolution of CMOS Technologies, Trends in Analog and Mixed IC Design, Device Modeling, The Operational Amplifier and its Figure of Merits	06
2.	Fundamentals of Data conversion systems	The Ideal Data Converter, Sampling, Amplitude Quantization, kTC Noise, Discrete and Fast Fourier Transforms, Coding Schemes, A/D and D/A Conversion Principles, ADC and DAC specifications and Figures of Merit	08
3.	Building Blocks of Data Conversion Systems	Basic Sampling circuits – MOSFETs as Switches, Speed Considerations, Precision Considerations, Charge Injection Cancellation, Capacitor and Switch Implementation, Track and Hold and Sample and Hold Circuits, Amplifiers – Open-Loop Amplifiers, Closed-Loop Amplifiers, Operational Amplifiers, Differential Circuits with CMFB, Gain-Enhancement Techniques, Multi-Stage Opamps, CMOS Comparators for ADC Application, Reference Circuits, Filters Topologies	14
4.	Switched-Capacitor Circuits and Precision Techniques	Switched-Capacitor Amplifiers, Switched-Capacitor Integrator SC-Common mode Feedback, Low-frequency errors, Offset Cancellation Techniques, Charge-Injection Compensation Techniques	06

5.	Principles of Σ-Δ ADC	Basic Analog to Digital Conversion, Oversampling and Noise shaping, Traditional Σ-Δ topologies with performance comparison	06
6.	Case study – Design techniques for ADC	Low-Power Low-Voltage Σ-Δ ADC Design in CMOS Technology for sensor based applications	04
		Total number of Lectures	**44**

Evaluation Criteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	35
TA	25 (Assignments &Quiz)
Total	**100**

Project Based Learning Component: This course teaches principles of VLSI data conversion systems using a building blockapproach. Upon successive completion of the module, students are able to understand the concepts and structures of CMOS digital-to-analog and analog-to-digital converters, at system level and at transistor level, from basic to advanced architectures. Students understand the non-idealities of such circuits and are able to consider them for topology selection and device sizing, developing practical circuits according to given specifications. At the end of the course the students will design a second-order single-bit/two-bit sigma-delta modulator using selected CMOS technology.

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. van de Plassche, CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters, 2nd Edition, Springer Science, LLC, 2013
2.	Shanti Pavan, Richard Schreier, Gabor C. Temes, Understanding Delta-Sigma Data Converters, 2nd Edition,
3.	Behzad Razavi, Principles of Data Conversion System Design, Wiley-IEEE Press, 1995
4.	Libin Yao, Michiel Steyart and Willy Sensen, "Low-Power Low-Voltage Sigma-Delta Modulators in Nanometer CMOS, Springer, 2006, Netherlands
4.	NPTEL Video Lectures – VLSI Data Conversion Circuits, Shanti Pavan, IITM

Detailed Syllabus
Lab-wise Breakup

Course Code	15B19EC791	**Semester** Odd **(specify Odd/Even)**	**Semester** 7th **Session** 2021-22 **Month from** August to December
Course Name	Major Project Part-1		
Credits	4	**Contact Hours**	

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

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

Evaluation Criteria

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	**15B1NHS731**	**Semester** ODD **(specify Odd/Even)**	**Semester Session** 2021-22 **Month from** July2021 to December2021
Course Name	Disaster Management		
Credits	3	**Contact Hours**	3-0-0

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

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

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

7.	**Risk Society**	Risk Society in 1992,Ulrick Beck, Processes of Modernization, The new paradigm of risk society	4
8	**Disaster Management Act(2005)**	DM Act and Policy, plans, Programmes and Legislation.	2
9	**Global trends in disasters, Urban Disaster, Pandemics, Climatic Change and Complex Emergencies**	Agenda 21: For Local actions, Global trends in disasters, urban disasters, pandemics(COVID2019), Epidemics, complex emergencies, Climate change	4
10	**Disaster,Environment and Development**	Environment Management, Importance of Waste Management, Types of Disaster Waste, Sources of Waste	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25(Assignments/Case Study, Project, Attendance)
Total	**100**

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

1.	Government of India, 2009. National Disaster Management Policy.
2.	Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi
3.	Indian Journal of Social Work 2002. Special Issue on Psychosocial Aspects of Disasters, Volume 63, Issue 2, April
4.	Alexander David, Introduction in "Confronting Catastrophe", Oxford University Press, 2000
5	Coppola P Damon, 2007. Introduction to International Disaster Management
6	Yojana :A DEVELOPMENT MONTHLY Magazine, Volume 61,January 2017
7	S.K. Misra& V. K. Puri, Indian Economy, Himalaya Publishing House, 2011.
8	Parasuraman, S. & P.V. Unnikrishnan, 2005, “Disaster Response in India: An Overview,” India Disasters Report, Punjablok.
9	Satapathy S. (2009) Psychosocial care in Disaster management, A training of trainers manual (ToT), NIDM publication.
10	Blaikie, P, Cannon T, Davis I, Wisner B 1997. At Risk Natural Hazards, Peoples' Vulnerability and Disasters, Routledge.
11	Dave, R.K. (2018) , Disaster Management in India : Challenges and Strategies

12	Disaster Management and Rehabilitation, Rajdeep Dasgupta, 2007
13	Jensen, John R., 2007, Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Ed., Up Saddle River, NJ: Prentice Hall
14	NDMA, 2010, National Disaster Management Guidelines , Role of NGOs in Disaster Management

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NBT531**	**Semester Odd** **(specify Odd/Even)**	**Semester** VII **Session** 2021 -2022 **Month from June -Dec**
Course Name	**Networks of Life**		
Credits	3	**Contact Hours**	**LTP 3 0 0**

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

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

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Network Sciences**	Introduction to network sciences, Graph Theory, Random network, Scale Free Property, Various Models- Erdos Renyi, Barabasi-Albert etc. Centrality and Weighted Networks, Degree, Communities Identification, Robustness, Motifs and Evolving Networks.	18
2.	**Computational Resources**	Hands-on Cytoscape tool, Gephi, etc.	4

3.	**Applications & advanced topics**	Multi-Layered Networks, Spreading phenomenon, Temporal Networks, Networks in epidemics, networks in business, social networks, controlling networks, percolation, rewiring, machine learning in networks	10
4.	**Miscellaneous**	Case studies, projects, hands on workshop on advanced modules on python.	10
		Total number of lectures	42

Evaluation Criteria

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

PBL: Students will choose any topic on Biological Network, Python language, Analysis tools and it's an application to solve the biological problem linked to a particular disease in a group of 4-5 students.

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

1.	R. Cohen and S. Havlin, Complex Networks - Structure, Robustness and Function, Cambridge Univ Press, 2010.
2.	M.O. Jackson, Social and Economic Networks, Princeton Univ Press, 2008.
3.	A. Barrat, M. Barthelemy and A. Vespignani, Dynamical Processes on Complex Networks, Cambridge Univ Press, 2008.
4.	E. Kolaczyk, Statistical analysis of network data, Springer, 2009.
5.	S. Wasserman, K. Faust, Social Network Analysis: Methods and Applications, Cambridge Univ Press, 1994.
6.	P. Van Mieghem, Graph Spectra for Complex Networks, Cambridge Univ Press, 2011.
7.	R. Diestel, Graph Theory (4th edition), Springer, 2010.
8.	R.K.Ahuja and T.L.Magnanti, Network Flows: Theory, Algorithms, and Application , Pearson, 1993.
9.	Mark Newman, Albert-László Barabási, and Duncan J. Watts, The Structure and Dynamics of Networks, ISBN: 9780691113579, Princeton University press, 2006
10.	Albert-László Barabási, Network Science, Cambridge University Press in 2015.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NHS831**	**Semester: Odd (specify Odd/Even)**	**Semester: VII Session** 2021 -2022 **Month: Aug2021 -Dec2021**
Course Name	Gender Studies		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Ms. Shikha Kumari
	Teacher(s) (Alphabetically)	Ms. Shikha Kumari

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

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introducing Gender Issues**	• Sex andGender • Types ofGender • Gender Roles • Gender Division ofLabor • Gender Stereotyping and GenderDiscrimination	9
2.	**Gender Perspectives of Body & Language**	• Socio-Cultural Perspectives ofbody • Body as a Site and Articulation of PowerRelations • Cultural Meaning of Female Body andWomen's Lived Experiences • The Other andObjectification	6
3.	**Social Construction of Femininity &Feminism**	• Bio-Social Perspective ofGender • Gender as AttributionalFact • Feminine &Feminist • Major Theorists of Feminism Challenging Cultural Notions of Femininity • Feminism Today: Radical, Liberal, Socialist, Cultural, Eco feminism & Cyberfeminism • Images of Women in Sports, Arts, Entertainment, Media and Fashion Industry ;Cultural Feminism&	9

		Celebrating Womanhood • Analysis of role women have played acrosscultures	
4.	**Social Construction of Masculinity**	• Definition and Understanding ofMasculinities • Sociology of Masculinity& itsTypes • Social Organization of Masculinity and Privileged Position ofMasculinity • Politics of Masculinity andPower • Major Theorists ofMasculinity • Masculine Identities in Literature, Cinema & Media.	9
5.	**Gender Sensitization Empowerment &Gender Inclusivity**	• Women & Women Rights InIndia • From Women's Studies to Gender Studies:A ParadigmShift • Gender Sensitization & Gender Inclusivity • Gender Studies & Media: Creating NewParadigms in Gender &Culture	9
		Total number of Lectures	**42**

Evaluation Criteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	35
TA	25 (Project/ Assignment)
Total	**100**

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT732	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2021-2022 **Month from** July to Dec
Course Name	Healthcare Marketplace		
Credits	3	**Contact Hours**	3

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

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

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

8	**Innovations in the marketplace**	Health to market innovations	**4**
9	**Healthcare informatics**	e-health, collection of health data, data processing, evaluation, health information systems, case studies	**2**
		Total number of Lectures	**42**

Evaluation Criteria

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

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.

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

1.	https://www.who.int/nationalpolicies/processes/stakeholders/en/
2.	Conflict of interests. I. Lo, Bernard. II. Field, Marilyn J. (Marilyn Jane) III. Institute of Medicine (U.S.). Committee on Conflict of Interest in Medical Research, Education, and Practice. IV. National Academies Press (U.S.), 2009
3.	Research papers and online resources

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NBT733	**Semester** Odd **(specify Odd/Even)**	**Semester** VII **Session** 2021 -2022 **Month from** Sept-December
Course Name	Stress: Biology, Behaviour and Management		
Credits	3 (3-0-0)	**Contact Hours**	4 (includes 1 hour /week for discussion)

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 Relief; HIC4- Meditation/Mindfulness/Belly Breathing/Visual Imagery/Progressive Muscle Relaxation	HICs to be delivered in the modules 1-6

	techniques and therapeutic strategies	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 in the final year of B.Tech Engineering program and to develop a stress reducing intervention strategy.

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS731	Semester:Odd	Semester: VII Session: 2021 -2022 Month from September to December
Course Name	Customer Relationship Management		
Credits	3	**Contact Hours**	3-0-0

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

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

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

		Importance of CRM in B2B Markets, Customer Emotion, Customer Knowledge, Reciprocity, Voice of the Customer, Participation. ***Dominos using different types of content to practice engagement	
5.	Components of e CRM solutions (Overview) and Role of Digital Technologies	Data warehousing, Datamining and CRM, Market Basket Analysis and Retail sector, Campaign Management, Sales Force Automation, Customer Service and Support, Corporate Blogs, Online communities, Twitter, Wikis. The Experience ecosystem. CEM, Consumer engagement, segmentation and differentiation. ** Exercise on online campaign management solutions	7
6.	Product offerings in the CRM Marketplace (Overview) and CRM Roadmap	Evaluating Technological solutions for CRM, Comparison of Siebel, Oracle, MySAP.com and People Soft Enterprise solutions, Comparison of Talisma, Sales logix, Microsoft and Sales notes for small and medium enterprises, Defining a CRM strategy, CRM Implementation Roadmap, Developing a relationship orientation, Customer centric marketing and processes, Building organizational capabilities through internal marketing, Issues inimplementing a technology solution for CRM.	7
7.	Operational issues in implementing CRM, Social CRM	Process view of CRM, Budgeting for attraction vs. retention, Learning from customer defections, Customer Retention Plans, Evaluating Retention programs, Social Customer Relationship Management, SocialCustomer Insights, Social CRM Strategy, and Social Customer Analytics. * Excercise on Mckinsey's social media model	5
Total number of Lectures			**42**

Evaluation Criteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	35
TA	25 (Project:Report, Viva,Class Participation)
Total	**100**

Project Based Learning:The project is to be done in group size of 4-5 members each. Student groups can choose an organization from one of the industry vertical like banking, IT, hospitality, telecom, airlines, logistics and consulting. Students need to study the CRM processes (internal CRM processes for improving employee productivity and external processes improving the organization-consumer interface) in the vertical/organization chosen. They need to develop a conceptual modelto depict the processes. A questionnaire needs to be developed it can either be an employee-based survey or consumer-based survey. Based on data collection and analysis, CRM strategies have to be formulated, for better consumer segmentation/process improvement/productivity enhancement/ identification of customers with greater Customer Life Time Value/ Customer Retention Program. Strategies can be developed for Key Account Management and Campaign Management. This adds to the employability skills of customer management in an organization.

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.	Berry, Michael, J. A, Linoff, Gordon S., Datamining Techniques for Sales, Marketing and CRM, 3rd Edition, Wiley Publications, 2011.
2.	Customer Relationship Management, Ed. Peelan Rob Beltman, 2nd Edition, Pearson, 2014.
3.	Customer Relationship Management-A strategic perspective, G. Shainesh, Jagdish Sheth, Reprinted Macmillan Publishers India Limited, 21st edition 2017.

4.	Customer Relationship Management Concepts and Technologies-Francis Buttle, 3rd Edition Taylor and Francis, 2015.
5.	Lin, Y. C., Lee, Y. C., & Lin, S. Y. The influence of the personality traits of webcasters on online games. International Journal of Electronic Customer Relationship Management, *11*(1), 94-103, 2017
6.	Menzel, C. M., &Reiners, T.Customer relationship management system a case study on small-medium-sized companies in north Germany. In *Information Systems for Small and Medium-sized Enterprises* pp. 169-197. Springer, Berlin, Heidelberg, 2014.
7.	Mukerjee, K., Customer Relationship Management-A Strategic approach to Marketing, 3rd Edition Prentice Hall of India, 2007.
8.	Ou, Y. C., Verhoef, P. C., & Wiesel, T. The effects of customer equity drivers on loyalty across services industries and firms. Journal of the Academy of Marketing Science, *45*(3), 336-356, 2017.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**17B1NHS734**	**Semester:** Odd	**Semester: VII Session** 2021 -2022 **Month from** Sept. 21 to Dec 2021
Course Name	Managerial and Communication Skills		
Credits	3	**Contact Hours**	(3-0-0)

Faculty (Names)	**Coordinator(s)**	Dr. Deepak Verma
	Teacher(s) (Alphabetically)	Dr. Deepak Verma

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

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

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

Evaluation Criteria

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

Professional/employability Skills development: Each student is supposed to participate in group discussion. Different Topics were given to each group (comprised of 8-10 students). Student's participation was observed and analyzed and they were given marks (component of TA) based on their performance in group discussion. This activity helped students in campus recruitment and also helped them in understanding how to participate in group interaction and put their opinion effectively in such discussions. Business communication is very important in today's corporate world and helps greatly in fulfilling the managerial roles and responsibilities. This subject is focused not only on developing business communication but also on analytical skills thus enhances student's employability in every sector.

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

1.	R.V. Lesikar, & M.E. Flatley, *Basic Business Communication Skills for Empowering the Internet Generation*, Tenth Edition, Tata McGraw Hill Publishing Company, 2005
2.	S. Sengupta, *Business and Managerial Communication*, Prentice Hall of India, 2011.
3.	A.C. Krizan, P. Merrier, J. Logan, & K. Williams, *Business Communication*, Eight Edition, Thomson South-Western, 2011.
4.	C.L.Bovee, J.V.Thill , *Business Communication Essentials: Fundamental skills for the Mobile-Digital-*

	Social Workplace, Eighth Edition, Pearson Education, 2018
5.	J. Higgins., *Ten skills for Effective Business Communication*, Tyco Pr, 2018
6.	M. Munter, L. Hamilton, *Guide to Managerial Communication*, Tenth Edition, Pearson, 2014

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12CS424	**Semester Odd**	**Semester** VII **Session** 2021-22 **Month from July to December**
Course Name	Algorithm Analysis and Artificial Intelligence		
Credits	**3**	**Contact Hours**	**3-0-0**

Faculty (Names)	**Coordinator(s)**	Alka Singhal
	Teacher(s) (Alphabetically)	Alka Singhal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-12.1	Analyze algorithm's time complexities (Master's method, Recursion tree and substitution method- Sorting and Searching algorithms)	Analyzing Level (C4)
C401-12.2	Propose solutions for real life computing problems using greedy, divide & conquer, and dynamic programming techniques.	Creating Level (C6)
C401-12.3	Apply informed and uninformed searching algorithms(A*, Hill Climbing and Simulated Annealing) in AI related problems.	Applying Level (C3)
C401-12.4	Solve constraint satisfaction problems and adversarial search algorithms	Creating Level (C6)
C401-12.5	Apply inference mechanisms(propositional logic , first order predicate logic, and probabilistic reasoning)	Applying Level (C3)
C401-12.6	Design and simulate Genetic Algorithms for Optimization.	Creating Level (C6)

Sr.	**Module**	**Chapters**	**Lectures**
1.	Introduction	Time Complexity analysis: Master's Method. Divide and Conquer methods: Insertion Sort, Merge Sort, Quick Sort	06
2.	Divide and Conquer and Greedy Algorithms	Strassen's Matrix multiplication , Knapsack Problem; Coin change Problem; Huffman Coding; Activity Selection; Minimum Spanning tree, shortest path.	09
3.	Dynamic Programming Algorithms	Knapsack Problem; Coin change Problem; Matrix chain Multiplication, Longest common subsequence etc.	05
4.	Artificial Intelligence : Problem Spaces and Problem Solving by search	State Spaces, Uninformed search strategies (BFS, DFS, DLS, IDS, Bidirectional search),Informed Search & exploration (A*,Heuristic, Local search algorithms, online search agents)	07
5.	Constraint satisfaction problems	Constraint satisfaction problems (backtracking, variable and value ordering, local search), Adversarial Search (games, alpha beta pruning, elements of chance, state of art games)	06
6.	Propositional Logic	Knowledge based agents, PL, FOPL, Syntax and semantics, use, knowledge engineering) , Inference in FOPL(Propositional vs First order inference	06
7.	Uncertainty	Probabilistic reasoning, Bayesian rule, Bayesian network, Inference, Reasoning over time	03

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

Evaluation Criteria

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

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

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

TEXT BOOKS

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

Detailed syllabus
Lecture-wise Breakup

Subject Code	**18B12HS211**	**Semester: ODD**	**Semester VII Session 2021-2022** **Months: from July to December**
Subject Name	**PSYCHOLOGY OF PERSONALITY**		
Credits	**3**	**Contact Hours**	**(3-0-0)**
Faculty (Names)	**Coordinator(s)**	Dr. Badri Bajaj	
	Teacher(s) (Alphabetically)	Dr. Badri Bajaj	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Demonstrate a basic understanding of concepts of personality	Understanding (Level 2)
CO2	Apply the concepts of personality in day to day life	Applying (Level 3)
CO3	Examine the different theoretical perspectives and approaches of personality	Analyzing (Level 4)
CO4	Develop solutions for handling problems and achieving goals using personality concepts, theories and approaches	Creating (Level 6)

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

Evaluation Criteria

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

TA	25 (Project, Oral questions, Attendance)
Total	**100**

Project based learning: Students of Psychology of personality will choose any two theories from the syllabus and study these theories. Make group of 2-3 students. Write everyday applications of some aspects of these theories. Submit the report of the project through Google Classroom link. Make presentations in the respective tutorial classes.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Schultz, D. P., and Schultz, S. E., *Theories of personality*, 11th Ed, Cengage Learning, 2016.
2.	Feist, J., Feist, G.J., Roberts, T.Y., *Theories of personality*, 9th Ed, McGraw Hill, 2018.
3.	Carver, C. S., & Scheier, M. F., *Perspectives on personality*, 8th Ed Pearson education, 2017.
4.	Burger, Jerry M. *Personality: an introduction*. 10th Ed, Cengage Learning, 2019.
5.	Mayer, John D. *Personality: A systems approach*. 2nd Ed., Rowman & Littlefield, 2017.

Detailed Syllabus
Lecture-wise Breakup

Course Code	**18B12HS412**	**Semester Odd**	**Semester VII Session 2021 -2022** **Month from July 2021 - December 2021**
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

SYLLABUS AND EVALUATION SCHEME

CourseCode:	**21B12HS411**	**Semester:ODD**	**Semester: 7th Session: 2021-2022 Months:August to December**
CourseName	Urban Sociology		
Credits	03	Contact Hours	3-0-0

Faculty (Names)	**Coordinator(s)**	Prof. Alka Sharma
	Teacher(s) (Alphabetically)	Prof. Alka Sharma Dr.Priyanka Chhaparia

COURSE OUTCOMES		**COGNITIVE LEVELS**
C401-25.1	Understand the concepts and theories of Urban Sociology	Understanding Level (C2)
C401-25.2	Apply an analytical framework to understand the structural characteristics of cities students are residing in	Applying Level (C3)
C401-25.3	Analyze the role of agencies and actor in shaping the process of urbanisation	Analyzing Level (C4)
C401-25.4	Evaluate the importanceofgood governance and urban planning	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Urban Sociology	Basic Concepts and terminologies of Urban Sociology, Origin of urban societies, Rural-Urban Continuum	4
2.	Theories in Urban Sociology	The Classical Foundations of Simmel, Max Weber, Tonnies, Louis Wirth, Durkhiem and Friedrich Engels	5
3.	The Ecological View	The Chicago School,Concentric zone theory (Burgess), Sector theory (Hoyt), Multiple Nuclei theory (Harris and Ullman)	3
4.	Contemporary Urban Sociology	Political Economy of Cities, Henry Lefebvre, Class Conflict Theories, Accumulation Theory, Neoliberalism, Neo-Weberian, Neo- Marxism, Colonialism	4
5.	Mapping and Organisation	Social Area Analysis, Urban Social Divisions, Concentration and Centralization, Segregation, Cooperatives, Role of Cooperatives in Urban planning and development	4
6.	Urbanisation in India	Development of Urban Sociology in India, Evolution of and from different structures, Spatial Structures and classification of cities	4
7.	Urban Planning	Historical timeline of urban planning, Principles	5

		of Urban Planning, Need for planning, Governance, Agencies Involved, Urban local bodies	
8.	Urban Issues in India	Level, trends, and pattern, Issues (poverty, slum, and environment) and Implications, Lessons from a pandemic	4
9.	Technology and Urbanisation	Digitisation and expansion of cities, Impact of technology on Urbanisation, role of technology in governance	4
10.	Globalisation and Urban Development	Concept of globalisation and its impact on urbanisation, new perspectives on urbanisation, emergence of Mega cities	4
11.	Sustainable Urban Development	Challenges in current model of urbanisation, Need for sustainable urban development, Tenets of sustainable development, Introduction to SDGs and their relevance to urbanisation, sustainable structures	4
		Total number of Lectures	**45**

Evaluation Criteria

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

Project Based Learning: The students would be divided into a group of 4-5. They would be asked to map and discuss the different parts of their cities. The lectures and readings on the process of urbanization and models of urbanization will form the basis for this exercise. Students would be required to critically analyse the urban spaces using sociological perspectives and theories. The students would be needed to make a presentation and also submit a report.

Recommended Reading material:

1.	Gottdiener, M., Budd, L., &Lehtovuori, P. *Key concepts in urban studies*. Sage. (2015)
2.	Lin Jan and Mele Christopher, ed. *The Urban Sociology Reader*. London: Routledge. (2005)
3.	Rao, M. S. A., ed. *Urban Sociology in India: Reader and Source Book*. New Delhi: Orient Longman. (1974)
4.	Savage, M., and Warde, A. *Urban sociology, capitalism and modernity*. Macmillan International Higher Education. (1993)
5.	Sivaramakrishnan, K.C., Kundu, Amitabh & Singh, B.N. *Handbook of Urbanization in India*. Oxford University Press (2007)
6.	Wirth, Louis. *Urbanism as a Way of Life*. American Journal of Sociology. (1938)
7.	Sharma, A.K. and Misra, B.D. *Urbanization in India: Issues &Challenges*.New Delhi: Ane Books Pvt.Ltd.(2018)

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NPH732	**Semester: ODD**	**Semester: 7th Session:** 2021 -2022 **Month from July to December**
Course Name	Nanoscience and Technology		
Credits	3	**Contact Hours**	3+1

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

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

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

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

Evaluation Criteria

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

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

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

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.

SYLLABUS AND EVALUATION SCHEME

Lecture-wise Breakup

Course Code	16B1NPH732	**Semester : ODD**	**Semester** VII **Session** 2021 -2022 **Month : July-December**
Course Name	Green Energy and Climate Modeling		
Credits	3	**Contact Hours**	3-0-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Recall the basic information about different energy resources, reserves and define the problem with fossil fuel	Remembering Level (C1)
CO2	Explain green house effect, modelling of temperature measurement and physics behind the global warming	Understanding Level (C2)
CO3	Demonstrate the basic principles and designs of different solar collectors and concentrators, and identify the best design/material/location to absorb maximum solar energy	Applying Level (C3)
CO4	Analyze the potential of different renewable energy sources like wind, ocean and bio mass energy	Analyzing Level (C4)
CO5	Compare the output of renewable energy source using different design under different conditions/location	Evaluating Level (C5)

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

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

Evaluation Criteria

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

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

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

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NMA732	**Semester** - Odd **(specify Odd/Even)**	**Semester** VII **Session** 2021 -2022 **Month from** August 2021 – Dec 2021
Course Name	Applied Numerical Methods		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Yogesh Gupta and Dr. Neha Ahlawat
	Teacher(s) (Alphabetically)	Dr. Neha Ahlawat and Dr. Yogesh Gupta

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

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

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

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.