Detailed Syllabus
Lecture-wise Breakup

Subject Code	**16BINEC831**	**Semester: Even (specify Odd/Even)**	**Semester** 8th Even **Session** 2020-21 **Month** from Jan to June
Subject Name	**Sonar system and acoustic imaging**		
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)
C434-5.1	define and explain sonar terminology and choose parameters for side scan sonar according to the required azimuth and range resolutions.	Applying (Level C3)
C434-5.2	select parameters for synthetic aperture sonar (SAS) as per the design requirements.	Applying (Level C3)
C434-5.3	analyze the continuous time frequency modulation (CTFM) technique for sonar applications.	Analyzing (Level C4)
C434-5.4	apply and discover signal processing application for ship speed measurement system like JANUS.	Analyzing (Level C4)
C434-5.5	take part in the development of simple array design for acoustic localization.	Analyzing (Level C4)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Side Scan and Sector Scan Sonar**	Introduction to sonar system. Side scan sonar, sector scan sonar, beam-forming methods in sector scans sonar.	6
2.	**Modulation Scanning**	Swept frequency delay line scanning, phase beam-forming, modulation scanning, multistage beam-forming, DFT beam-former.	8
3.	**Synthetic aperture sonar**	Limitation of scanning sonar, Basic of synthetic aperture sonar, matched filtering, Doppler shift aspects, range resolution in synthetic aperture sonar, minimum sampling rate for synthetic aperture sonar, spot lights, and squints in synthetic aperture sonar.	8

4.	**CTFM**	Continuous time frequency modulation technique (CTFM), blind time problem in CTFM,dual demodulator CTFM technique, phase difference radial projection method.	8
5.	**Signal processing for Ship speed measurement**	Estimation of moving target speed in water,GPS, DGPS, SQUID, Doppler log, JANUS, Issues in Doppler log methods, correlation-log,	6
6.	**Acoustic localization**	Localization using time delay estimation, Beacons, Pingers.Localization using three hydrophones, Localization using four hydrophones, Non-planar array using five hydrophones.	6
Total number of Lectures			**42**

Evaluation Criteria

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

Practical implementation of theory based learning: On each topic covered in the course an experiment is designed and assigned to the students,so that the concept/algorithm covered can be written in the code form in MATLAB software.

Project based learning: Group of 3 students are formed to solve simulation based coding problems. This helps in deeper understating of the theory and motivate students to think on real world applications and problems. Practical knowledge acquired by the students during this course will boost their confidence and clarity on various topics and this ultimately help them in placement interviews and further motivate them to be an entrepreneur.After schemes like “Atmanirbhar Bharat”many project in the area of sonar will provide many entrepreneurialopportunities to the students specialized in the sonar system.

List of Simulation Experiments in Sonar system and acoustic imaging

Ex1. Generate the sine wave of 1 kHz with sampling frequency of 10 kHz with constant amplitude and with initial phase of (i) 0 rad, (ii) pi/3 radians, (iii) pi/6 radians. Calculate the FFT of these signals and plot the magnitude and phase of these signals. Scale the frequency axis in Hz/kHz (take the Y scale normalized with maximum amplitude).

Ex2. Linear Chirp signal of with starting frequency of 100 Hz ending frequency of 2 KHz and duration of 1 sec.

Ex3. Generate Sine waves of 1 kHz with sampling frequency of 10 kHz and amplitude decreasing exponentially with different slops.

Ex4.Calculate the FFT of the signal plotted in Q1 a. b. and c. and scale the frequency axis in Hz/kHz (take the Y scale normalized with

maximum amplitude). Ex5.Draw the radiation pattern of a N element uniform array as a function of angle. Reference document is given in the study material. Ex6.Let Fourier transform corresponding to a signal contains 10 impulses starting at 45 kHz at a gap of 5 kHz. Plot the time domain signal corresponding to this Fourier transform. Ex7.Generate a signal s(t) consisting of three linear chirp signals. Each chirp signal c(t) has starting frequency of 100 Hz, ending frequency of 2 KHz and duration of 1 sec. In s(t) the first chirp signal c(t) has zero delay, the second has 100 ms delay and the third one has 300 ms delay. Take sampling rate 1 MHz. Correlate this composite signal with the chirp signal c(t) . Ex8.Generate a signal consisting of the following signals A. a chirp signal c(t) as mentioned above B. a 2 second delayed signal of 50 KHz with duration 20 us. C. Series of 3 second delayed pulses (10) of 65 kHz of duration 31.6 us. Plot the spectrogram take averaging duration of 50 us. Take sampling rate at 1 MHz.	

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.	Lawrence J. Ziomek,**An Introduction to Sonar Systems Engineering**, Taylor & Francis Inc, 2017.
2.	A. D. Waite, **Sonar for Practising Engineers**, 3rd edition, John Wiley & Sons, 2002.
3.	Authors: **Au**, Whitlow W.L.The Sonar of Dolphins, Springer-Verlag New York, ISBN 978-1-4612-4356-4, 1993.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	17B1NEC735	Semester Even	Semester 8th Session 2020-21 Month from Jan 21 to June 21
Subject Name	Information Theory and Applications		
Credits	4	Contact Hours	3+1

Faculty (Names)	Coordinator(s)	Dr. Alok Joshi
	Teacher(s) (Alphabetically)	Dr. Alok Joshi

COURSE OUTCOMES		COGNITIVE LEVELS
C434-6.1	Understand the concept of probability, its relation with information, entropy, and their application in communication systems.	Understanding Level (C2)
C434-6.2	Identify theoretical and practical requirements for implementing and designing compression algorithms.	Analysing Level (C4)
C434-6.3	Analyze the relationship between bandwidth and capacity of communication channels and its importance in real life communication systems.	Analysing Level (C4)
C434-6.4	Analyze the need for channel coding in digital communication systems.	Analysing Level (C4)
C434-6.5	Generate error correcting codes for error detection and correction.	Analysing Level (C4)

Module No.	title of the Module	Topics in the module	No. of Lectures for the module
1.	Review of Basic Probability	Probability spaces. Random variables. Distributions and densities. Functions of random variables. Statistical Averages. Inequalities of Markov and Chebyshev. Weak law of large numbers.	3
2.	Information Measure	Discrete entropy. Joint and conditional entropies. Entropy in the continuous case. Maximization of continuous entropy. Entropy of a bandlimited white Gaussian process.	5
3.	Data Compression	Uniquely decipherable and instantaneous codes. Kraft- McMillan inequality. Noiseless coding theorem. Construction of optimal codes.	4
4.	Data Transmission	Discrete memoryless channel. Mutual information and channel capacity. Shannon's fundamental theorem and its weak converse. Capacity of a bandlimited AWGN channel. Limits to communication – Shannon limit.	5
5.	Error Control Coding	Coding for reliable digital transmission and storage. Types of codes. Modulation and coding. ML decoding. Performance measures.	3
6.	Linear Block Codes	Algebra Background, Groups, Fields, Binary field arithmetic. Vector Spaces over GF(2). Generator and parity check matrices. Syndrome and error detection. Standard array and	8

		syndrome decoding. Hamming codes.	
7.	Cyclic Codes	Polynomial representation, Systematic encoding. Cyclic encoding, Syndrome decoding.	6
8.	Convolutional Codes	Generator Sequences. Structural properties. Convolutional encoders. Optimal decoding of convolutional codes- the Viterbi algorithm.	8
		Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning: Students will learn about the design and implementation of compression algorithms as well as error-correcting codes with the help of assignments. Using MATLAB the above concepts can be utilized for project too.

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.B. ASH: Information Theory, Dover, 1990.
2.	R. BOSE: Information theory, coding and cryptography, Mcgraw Hill 2016.
3.	R.W. YEUNG: Information Theory and Network Coding, Springer, 2010.
4.	S. LIN & D.J. COSTELLO: Error Control Coding, 2nd Edn, Pearson, 2011.
5.	T.K. MOON: Error Correction Coding, Wiley, 2006.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC411	**Semester** Even **(specify Odd/Even)**	**Semester** VIII **Session** 2020 -2021 **Month from** January to June
Course Name	Introduction to IOT		
Credits	3	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Gaurav Verma (62)
	Teacher(s) (Alphabetically)	Mr.Abhay Kumar (128)

COURSE OUTCOMES		**COGNITIVE LEVELS**
C434-7.1	Outline the basic concepts of IOT with networking and protocol considerations in IOT scenario.	Understand (C2)
C434-7.2	Identify various IOT hardware platforms and their utilization with various sensors and actuators.	Apply (C3)
C434-7.3	Experiment the basic concepts of python programming and make use of them in image processing, data analytics and machine learning applications.	Apply (C3)
C434-7.4	Examine various case studies and cloud platforms in an IOT scenario for monitoring, control and analysis.	Analyze (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	IOT Basics and its Importance	Introduction to IOT (People Connecting to Things, Things Connecting to Things, Definition of IOT, History of IOT), IOT Components (Sensors & Actuators, Things, Communications, Networks, The Internet, Protocol Stack), Evolution of Connected Devices, IOT Applications, IOT Companies, Baseline Technologies (Machine to Machine (M2M) Communication, Cyber Physical Systems (CPS), Web of Things (WOT)), Address Crunch in IOT, IOT Terminologies (IOT Node, LAN, MAN & WAN, IOT Gateway & Proxy), IOT Network Configuration (Gateway Prefix Allotment, Impact of Mobility on Addressing, Concept of Tunneling, Multi-homing), IPv4 Versus IPv6.	6
2.	Basics of IOT Networking	Introduction to IOT Networking, Networking Standards and Technologies (Network Access & Physical Layer, Internet Layer, Transport Layer, The application layer), IOT Networking Protocols, Network Access and Physical layer IoT Network Technologies ((LPWAN (Low Power Wide Area Network), Cellular, Bluetooth Low Energy (BLE), RFID, NFC, Zigbee, Wifi, Ethernet), Internet layer IoT network technologies (IPv6, 6LoWPAN, and RPL),	6

		Application layer IoT network technologies (HTTP, HTTPS, MQTT, AMQP, and XMPP), IoT networking considerations and challenges, IoT Platforms Capabilities.	
3.	IoT supported Hardware platforms (Arduino) & data visualization using cloud.	Introduction to Arduino (Different Arduino boards, Arduino Uno board description and its pin configuration, Arduino IDE and program uploading, different functions related to GPIOs and special functions (PWM and Serial communication), Interfacing with Arduino using processing language (LED, Switch, Seven Segment, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), Interrupts, use of simulator and compiler, basics of HTML, Arduino supported IOT modules (Ethernet &Wifi Shield) and their configuration, Monitoring of sensor data on cloud and Web based controlling of actuators.	12
4.	Introduction to Python, Data Analytics, Machine Learning and Case Studies.	Introduction to python, python IDE, Data types, various programming constructs (loops, if, else etc.), operators, functions, modules, data handling (pandas), file operations, Image operations (PIL-pillow), data plotting in python (Matplotlib), basics of machine learning in python (Scikit) and related case studies.	10
5.	IoT supported Hardware platforms (Raspberry pi) & its Applications	Introduction to Raspberry pi (Raspberry pi different model comparison, Pin Configuration, Raspberry Pi operating system choices, Set up your Raspberry pi, Raspbian OS, Remote Access using SSH, Remote Access using TightVNC), Interfacing with Raspberry pi using python and use of open source libraries (LED, Switch, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), IOT Applications (Water management system, Weather monitoring station on cloud, Smart Agriculture System, Smart Energy meter, Pollution Monitoring system, Smart Dustbin management system.	8
		Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning Component: This course teaches IoT using a building block approach, which allows one to visualize the requirement of an IoT framework and then to design it efficiently. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. The course will teach IoT based system design using IoT boards, namely Arduino, ESP8266, and Raspberry Pi. 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 python with application to image processing and Machine Learning. It will have a significant practical component, which will be achieved by providing real time demonstrations of various case studies based on IoT.

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.	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2.	"Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12EC413	**Semester** Even	**Semester VIII Session** 2020 - 2021 **Month from** Jan-June
Course Name	Digital Control System		
Credits	4	**Contact Hours**	3L+1T

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

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

Module No.	**Subtitle of the Module**	**Topics**	**No. of Lectures**
1.	Review of Z transform	z transform and inverse z transform . Relationship between s- plane and z- plane- Difference equation . Solution by recursion and z-transform.	3
2.	Review of state space techniques	Review of state space techniques to continuous data systems, state space representation of discrete time systems- Transfer function from state space model-various canonical forms- conversion of transfer function model to state space model-characteristics equation-solution to discrete state equations.	5
3.	Introduction to Digital Control System	Basic Elements of discrete data control systems, advantages of discrete data control systems, examples. Signal conversion & processing: Digital signals & coding, data conversion & quantization, sample and hold devices, Mathematical modeling of the sampling process; Data reconstruction and filtering of sampled signals: Zero order hold, first order Hold.	8

4.	Analysis of Digital Control Systems	Digital control systems- Pulse transfer function . z transform analysis of closed loop and open loop systems- Modified z- transfer function- Stability of linear digital control systems and Jury's stability test	8
5.	Stability tests	Stability tests- Steady state error analysis- Root loci - Frequency domain analysis- Bode plots- Gain margin and phase margin.	8
6.	State feedback concept	Controllability and Observability - Response between sampling instants using state variable approach-Pole placement using state feedback .	5
7.	Digital System Design	Observer Design for digital control, Pole placement design based on input-output models.	5
		Total number of Lectures	**42**

Evaluation Criteria

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

Project Based Learning: Students will learn about the analysis and Design of Digital controllers with the help of assignments/simulations based projects. Additionally, students in group sizes of two-three are required to prepare a review of any one application of the Digital Control System using one or more research publications.

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	18B12EC417	**Semester** Even **(specify Odd/Even)**	**Semester** 8th **Session** 2020-2021 **Month from** January to June
Course Name	Satellite Communication		
Credits	4	**Contact Hours**	3-1-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-4.1	Define Satellite and its historical background, outline the basic concepts of Satellite communications, recall the Kepler's laws of planetary motion	Remembering Level (C1)
C433-4.2	Develop the equations of the orbit, explain the satellite launching and launch vehicles and outline terminology of earth-orbiting Satellites.	Analyzing Level (C4)
C433-4.3	Demonstrate the space segment, antenna subsystem, estimate different parameters and design uplink and downlink.	Creating Level (C6)
C433-4.4	Apply various multiple access techniques for satellite communication and analyze Noise and Bandwidth. Also Interpret applications of various types of satellites established in different earth orbits.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to the Subject and its Importance. Contents. Books and Reading References. Evaluation. Space Environment. Artificial Satellites. Communication Satellites.	4
2.	Satellite Orbits and Frequency Bands	Orbital Mechanics. Orbits Employed for Satellite Communication like LEO, MEO & GEO, their Merits and Demerits. Satellite Launching. Launch Vehicles. Radio Wave Propagation Effects. Communication Window.	8
3.	Communication Satellites and Link Design	Geostationary Communication Satellite-Transponder. Ground Station System. Communication Link-Consideration, Calculation and Design. Power and Bandwidth Limitations and Budget.	10
4.	Modulation Techniques	Modulation and Demodulation Techniques. Performance Analysis- Noise and Bandwidth.	6
5.	Multiple Access	Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA)	8

6.	Different Communication Satellite Systems	VSAT. Navigational Satellites. Broadcasting Satellites. Remote Sensing Satellites. Low and Medium Earth Orbit Satellites. INSAT. INTELSAT.	5
7.	Some Communication Satellite Applications	DBS TV. Multimedia Transmission Related Issues, Advantages& Bit Rates for Digital TV, HDTV, Bandwidth Considerations and Introduction to Compression Standards. Convergence of Communication, Introduction to IPTV.	4
		Total number of Lectures	**45**

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 3 students select a topic related to latest development in the technology of satellite communication, This method of learning will help students to understand latest development in the industry like ISRO, 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.	T. Pratt, C.W. Bostian and J.E. Allnut, Satellite Communications, 2 Ed, John Wiley & Sons (Asia), 2003
2.	Dennis Roddy, Satellite Communications, 4 Ed, Tata Mcgraw Hill, 2006
3.	G. Maral & M. Bousquet, Satellite Communications Systems- Systems, Techniques and Technology, 4 Ed, John Wiley and Sons, 2002.
4.	Richard Brice, Newness Guide to Digital TV, 2Ed, 2003.
5.	Gerard O' Driscoll, Next Generation IPTV Services and Technologies, John Wiley & Sons, 2008

Detailed Syllabus
Lecture-wise Breakup

Subject Code	19B12EC412	**Semester** Even	**Semester** 8th **Session** 2020-2021 **Month from** January to June
Subject Name	Advance Topics in Wireless Communications (19B12EC412)		
Credits	3	**Contact Hours**	3+1
Faculty (Names)	**Coordinator(s)**	Dr. Vivek Dwivedi	
Course Objectives: At the end of the course student should be able to			

S. No.	Course Outcomes	Cognitive Levels/ Blooms Taxonomy
C434-3.1	Explain basics of MIMO systems and need of diversity schemes	Remembering (Level I)
C434-3.2	Analyze the effect of fading in the wireless medium and mathematical modeling of fading channels	Analyzing (Level IV)
C434-3.3	Analyze channel capacity expression of MIMO systems	Analyzing (Level IV)
C434-3.4	Evaluate performance of the MIMO detection system andneed of UWB systems	Evaluating (Level V)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Introduction to MIMO systems	Evolution of wireless generation technologies and their transition challenges. Need and expectation of next generation of wireless technology. Basic concept of random variable,Introduction of Wireless communication systems, diversity-multiplexing, trade-off, and transmit diversity schemes. Concept of SISO, SIMO, MISO and MIMO systems.	8
2.	Fading Environments	Wireless Channel Fading and Distribution: Small scale, large scale and multipath fading channels. Rayleigh, Rician, Exponential, Nakagami-m, Lognormal and α-κ-μ distributions.	10

3.	Channel capacity of MIMO systems	Ergodic and deterministic Capacity for SISO and MIMO channels, Capacity of i.i.d., separately correlated and keyhole Rayleigh fading MIMO channels. Power allocation in MIMO systems: Uniform, adaptive and near optimal power allocation.	10
4.	Space time codes and MIMO detection	Space-Time codes: Advantages, code design criteria, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels. MIMO detection: ML, ZF, MMSE based detection.	10
5.	UWB Technology	Definition of UWB, FEC mask, properties and limitation of UWB signal. UWB channel Modelling: IEEE 802.15.3a and IEEE 8032.15.4a standards.	4
		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 multiple input multiple output (MIMO) wireless communications systems to improve the system performance. Further, they will study about various fading distributions to analyze the effect of channel over signal. Additionally, student will study and design the space time codes and MIMO detectors to mitigate the effect of fading in channels.

Recommended Reading (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format)	
1.	R. S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, Cambridge University Press, 2017.
2.	S. Emami, UWB Communication Systems: Conventional and 60 GHz, 2013
3.	Chung G. Kang, Jaekwon Kim, Wŏn-yŏng Yang, and Yong Soo Cho, MIMO-OFDM Wireless Communications with MATLAB, John Wiley & Sons, 2010.
4.	Mohinder Jankiraman-Space-Time Codes and MIMO Systems,Springer New York, 2004.
5.	B. Kumbhani and R. S. Kshetrimayum, MIMO Wireless Communications over Generalized Fading Channels, 2017.

Detailed Syllabus

Course Code	19B12EC414	**Semester : Even (specify Odd/Even)**	**Semester: 8th Session** 2020 -2021 **Month from** January to June
Course Name	Natural Language processing with Deep Learning		
Credits	**4**	**Contact Hours**	3-1-0

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-5.1	Understanding the problems associated with Natural language processing and recent technological developments.	Understanding (Level C2)
C433-5.2	Applying deep learning approaches to improve the performance NLP tasks.	Applying (Level C3)
C433-5.3	Develop the basic concepts of python programming to NNM models which can deal with NLP.	Applying (Level C3)
C433-5.4	Analyzing performance of various neural networks in the NLP applications.	Analyzing (Level C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction and Word Vectors	Word2Vec The Skip-Gram Model Efficient Estimation of Word Representations in Vector Space, Distributed Representations of Words and Phrases and their Compositionality Word Vectors 2 and Word Senses Implementation of these module topics using Python	5
2.	Word2Vec - The Skip-Gram Model	Efficient Estimation of Word Representations in Vector, Space Distributed Representations of Words and Phrases and their Compositionality Word Vectors 2 and Word Senses Implementation of these module topics using Python	10
3.	GloVe: Global Vectors for Word Representation	Improving Distributional Similarity with Lessons Learned from Word Embeddings, Evaluation methods for unsupervised word embeddings, A Latent Variable Model Approach to PMI-based Word Embeddings,Linear Algebraic Structure of Word Senses, with Applications to Polysemy On the Dimensionality of Word Embedding. Word Window Classification, Neural Networks, and Matrix Calculus	11

		Implementation of these module topics using Python	
4.	Backpropagation and Computation Graphs	Learning Representations by Backpropagating Errors Derivatives, Backpropagation, and Vectorization understand backprop Linguistic Structure: Dependency Parsing Incrementality in Deterministic Dependency Parsing A Fast and Accurate Dependency Parser using Neural Networks Dependency Parsing Globally Normalized Transition-Based Neural Networks Implementation of these module topics using Python	9
5.	N-gram Language Models	The Unreasonable Effectiveness of Recurrent Neural Networks Sequence Modeling: Recurrent and Recursive Neural Nets On Chomsky and the Two Cultures of Statistical Learning, Vanishing Gradients and Fancy RNNs Implementation of these module topics using Python	10
		Total number of Lectures	**45**

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 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.	Deep Learning in Natural Language Processing 1st ed. 2018 Edition by Li Deng (Editor), Yang Liu (Editor)
2.	Neural Network Methods in Natural Language Processing (Synthesis Lectures on Human Language Technologies) Paperback – April 17, 2017 by Yoav Goldberg (Author), Graeme Hirst (Editor)
3.	Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit 1st Edition, Kindle Edition by Steven Bird (Author), Ewan Klein (Author), Edward Loper (Author)Dec 12, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	19B12EC415	**Semester Odd (specify Odd/Even)**	**Semester** VIII **Session** 2020-21 **Month from** Jan **to** June
Course Name	**Digital Integrated Circuits in Deep Submicron Technology**		
Credits	3	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Dr. Shruti Kalra
	Teacher(s) (Alphabetically)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C434.1	Recall the important concepts of logic gates, static input-output characteristics, noise margins and propagation delay	Remembering Level (C1)
C434.2	Illustrate the key issues in deep submicron technology node.	Understanding Level (C2)
C434.3	Identify and solve static and dynamic design issues for high speed combinational and sequential circuits.	Applying Level (C3)
C434.4	Analysis and design of VLSI memories	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to deep submicron digital IC Design	Review of digital logic gate design and digital integrated circuit design, MOS transistor operation in deep submicron technology.	6
2.	MOS inverter circuits	Analytical modeling of CMOS inverter in submicron technology node, Pseudo NMOS inverters, sizing inverters.	9
3.	Static MOS gate circuits	Analytical modeling of CMOS gate circuits, complex CMOS gates, Multiplexer circuits, D Flip flop and latches	9
4.	High speed CMOS logic design	Load capacitance calculations, improved delay calculations with input slope, gate sizing for optimal path delay, optimizing paths with logical effort.	7
5.	Transfer gate and dynamic logic design	Pass Transistor, capacitive feedthrough, charge sharing, sources of charge loss, TG logic, Dynamic D-Latch	6
6.	Introduction to semiconductor memory design.	MOS Decoders, Static RAM cell design, SRAM column I/o circuitry.	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 component: The student will be able to understand the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design at submicron technology node. Students in group of 2-3 will complete a design project having a set of objective criteria and design constraints.

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

1.	Veendrick, Harry. Deep-submicron CMOS ICs: from basics to ASICs. Springer Publishing Company, Incorporated, 2015.
2.	Hodges, David A. Analysis And Design Of Digital Integrated Circuits, In Deep Submicron Technology (special Indian Edition). Tata McGraw-Hill Education, 2005.

Detailed Syllabus

Lecture-wise Breakup

Subject Code	**20B12EC413**	**Semester (Even)**	**Semester VIII** **Session – 2020- 2021** **Month Jan –June 2021**
Subject Name	**Basics of Antenna and Wave Propagation**		
Credits	4	**Contact Hours**	4 (3 - 1 – 0)
Faculty (Names)	**Coordinator(s)**	Vishal Narain Saxena	
	Teacher(s) (Alphabetically)	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
CO1	Recall the concepts of Electromagnetic field theory, classify different types of antennas, illustrate antenna parameters and demonstrate the effect on antenna parameters due to changes in the physical dimensions.	Understanding (Level II)
CO2	Compare Broadband Antennas, Frequency Independent antennas and Aperture antennas. Explain Dipole antenna and their characteristic, loop antenna	Applying (Level III)
CO3	Design Array Antennas and identify the E and H fields for the antennas. Design Reconfigurable antenna, Active antenna, Dielectric antennas and measure radiation pattern, polarization and VSWR.	Creating (Level VI)
CO4	Define terminology relevant to mode of propagation and examine the propagation of radio waves in different atmospheres.	Analyzing (Level IV)

Module No.	Subtitle of the Module	Topics	No. of Lectures
1.	Radiation Fundamentals & Antenna Parameters	Antenna types, radiation, use of potential functions, radiated fields, far fields, Radiation from current element, Infinitesimal dipole, antenna parameters, radiation pattern, Directivity, numerical evaluation of directivity, Gain, efficiency, impedance, Loss resistance, Polarization, equivalent area, effective area and its relation to gain	8
2.	Linear Antennas Loop 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

Course Code	15B19EC891	**Semester:** Even **(specify Odd/Even)**	**Semester:** 8th **Session** 2020 -2021 **Month from:** January to May
Course Name	Project Part-2		
Credits	12	**Contact Hours**	----

Faculty (Names)	**Coordinator(s)**	Dr. Sajai Vir Singh, Ms. Shradha Saxena
	Teacher(s) (Alphabetically)	Sajai Vir Singh, Shivaji Tyagi, Shradha Saxena, Varun Goel

COURSE OUTCOMES- At the completion of the course, students will be able to,		**COGNITIVE LEVELS**
C451.1	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 level (C2)
C451.2	Analyze/Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time	Analyzing level (C4)
C451.3	Evaluate /Validate sound conclusions based on evidence and analysis	Evaluating level (C5)
C451.4	Develop the skill in student so that they can communicate effectively in both verbal and written form.	Creating Level (C6)

Evaluation Criteria

Components	**Maximum Marks**
MidSem Viva	20
Final Viva	30
D2D	30
Thesis	20
Total	**100**

Project based learningProject part II is the continuation of Project part 1 done in the previous semester. The Project Work is by far the most important single piece of work in the B. Tech programme. It provides the opportunity for student to demonstrate independence and originality, to plan and organize a large Project over a long period and to put into practice some of the techniques, student have been taught throughout the course.In Project work initially, first all students are advised to make groups having 2-3 students in each group and also to select the supervisor of their own choice and research field. The students are also advised to choose a Project that involves a combination of sound background research, software skill, or piece of theoretical work. Interdisciplinary Project proposals and innovative Projects are encouraged and more appreciable. Objective of project part II is for the students to learn and experience all the major phases and processes involved in solving "real life engineering problems related to electronics and communication or Interdisciplinary area. The major outcome of this project work must be well-trained the students. More specifically students must have acquired:

- System integration skills
- Documentation skills
- Project management skills
- Problem solving skills
- team work skill.

Detailed Syllabus

Course Code	15B1NHS832	**Semester** Even **(specify Odd/Even)**	**Semester** VIII **Session** 2020 -2021 **Month from :** Jan - June
Course Name	International Studies		
Credits	3	**Contact Hours**	**3** (3-0-0)

Faculty (Names)	**Coordinator(s)**	Dr. Chandrima Chaudhuri
	Teacher(s) (Alphabetically)	Dr. Chandrima Chaudhuri

CO Code	COURSE OUTCOMES	COGNITIVE LEVELS
C402-8.1	Demonstrate an understanding of the basic concepts in the area of international studies	Understanding (C2)
C402-8.2	Compare the changes in India's foreign policy in the Cold War era and the post Cold War era	Applying (C3)
C402-8.3	Analyze the major political developments and events since the 20th century	Analyzing (C4)
C402-8.4	Demonstrate an understanding of the rise of new power centers in the changing world order	Understanding (C2)

Module No.	Title of the Module	Topics in the Module	No. of Lectures for the module
1.	Basic Concepts	Balance of power and Collective security National Interest and its instruments	4
2.	An Overview of Twentieth Century International Relations History	World War I: Causes and Consequences Significance of the Bolshevik Revolution Rise of Fascism / Nazism World War II: Causes and Consequences	8
3.	Cold War Politics	Origin of the Cold War Evolution of the Cold War Collapse of the Soviet Union Causes of the End of the Cold War	8
4.	India's foreign policy during the Cold War era	Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic) India's Policy of Non-alignment	6
5.	India's foreign policy in the Post-Cold War era	India and SAARC India and the Look East policy Impediments to regional co-operation: river water disputes; illegal cross-border migration; ethnic conflicts and insurgencies; border disputes	8
6.	Emergence of Other Power Centres	European Union Rise of Asia Powers- Russia, China and Japan	8
		Total number of Lectures	**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Quiz, 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.	A. Chatterjee, *International Relations Today*. Noida, India: Pearson, 2019
2.	Appadorai, & M.S.Rajan, *India's Foreign Policy and Relations*. New Delhi, India: South Asian Publisher, 1985
3.	E.H. Carr, *International Relations between the Two World Wars: 1919-1939*. New York, USA: Palgrave, 2009
4.	J. Baylis &S. Smith, Ed. *The Globalization of World Politics: An Introduction to International Relations*. Oxford, UK: Oxford University Press, 2011
5.	P. Calvocoressi, *World Politics: 1945—2000*. Essex, UK: Pearson,2009

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**17B1NHS732**	**Semester: Even**	**Semester : 8th** **Session : 2020 -2021** **Month: January to June**
Subject Name	**INDIAN FINANCIAL SYSTEM**		
Credits	**3**	**Contact Hours**	**3 (3-0-0)**

Faculty (Names)	**Coordinator(s)**	1. Dr. Mukta Mani (Sec 62) 2. Dr.Sakshi Varshney (Sec 128)
	Teacher(s) (Alphabetically)	2. Dr. Mukta Mani 2. Dr.Sakshi Varshney

NBA Code	Course Outcomes	Cognitive Level
C401-31.1	Understand the inter-linkage of components of financial system and financial instruments of Money market and Capital market.	C2
C401-31.2	Analyze ways of fund raising in domestic and international markets	C4
C401-31.3	Understand functioning of Stock market and evaluate securities for investment.	C5
C401-31.4	Apply the knowledge of Mutual Funds and Insurance in personal investment decisions	C3
C401-31.5	Apply knowledge of Income tax for calculation of tax liability of individual.	C3

Module No.	Subtitle of the Module	Topics in the module	No. of Hours
1.	Introduction	Meaning, Importance, and functions of Financial system. Informal and Formal financial system, Financial markets, Financial Institutions, Financial services and Financial instrument	3
2.	Money Market	Features of money market Instruments: Treasury bills, commercial bills, commercial papers, certificates of deposit, call and notice money, Functions of money market, Linking of money market with Monetary policy in India	3
3.	Capital Market	Features of Capital market instrument: Equity shares, Bonds. Fund raising through Initial Public Offering, Rights issue, Preferential allotment and Private Placement. Process of IPO-Intermediaries in IPO, Book building process and allotment of shares	3

4.	Foreign investments in India	Fund raising from foreign market through: Foreign direct investment and foreign institutional investment, ADR, GDR, ECB, and Private equity.	3
5.	Stock Market	Trading in secondary market- Stock exchanges, regulations, demutualisation, broker, listing of securities, dematerialisation, trading, short selling, circuit breaker, stock market indices- methods of calculation of indices.	3
6.	Stock Valuation and Analysis	Investing basics: Consideration of Risk and Return, Stock Valuation and Analysis- Fundamental analysis: Economy, industry and company analysis; Technical Analysis of stocks using technical charts	7
7.	Investing in Mutual Funds and Insurance	Mutual Funds: Basics, Types of funds, risk and return considerations in selection of funds; Insurance: Basics, Life insurance and health insurance, types of policies	6
8.	Overview of Income Tax	Basics of Income tax- Concept of previous year, assessment year, person, income. Calculation of Income tax liability for individuals: Income from salaries- basic, DA, HRA, leave salary, Gratuity, Pension, Allowances and Perquisites; Income from Capital Gain, Deductions under section 80C to 80U.	14
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Class participation and Attendance)
Total	**100**

Project Based learning: The students will form groups of 4-5 students. They will carry-out stock analysis of a selected company on the basis of fundamental and technical analysis techniques studied in lecture classes. Finally they will give their recommendation about the performance of stock.

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	Pathak Bharti V, *Indian Financial System*, 5th Edition, Pearson Education, 2018
2	Madura Jeff, *Personal Finance*, 6th Ed, Pearson Education, 2017.
3	Machiraju H R, *Indian Financial System*, 4th Ed, Vikas Publication, 2010
4	Bhole L M, *Financial Institutions and Markets*, 4th ed. Tata McGraw Hill Publication,

	2006.
5	Singhania & Singhania, Students Guide to Income Tax, Taxmann Publication, 2019.
6	*How to Stimulate the Economy Essay* [Online]Available: https://www.bartleby.com/essay/How-to-Stimulate-the-Economy-FKJP5QGATC
7	Reserve Bank of India, 'Money Kumar & the Monetary Policy', 2007
8	Ashiwini Kumar,Sharma,' De-jargoned: Book building process, Live Mint,2015.
9	Madhavan, N. "Pushing the accelerator instead of brakes: Can Subhiksha make a comeback?", Business Today, 28th June 2009.
10	Kaul, Vivek, "Master Move: How Dhirubhai Ambani turned the tables on the Kolkata bear cartel", The Economic Times, July 1, 2011.

Detailed Syllabus

Lecture-wise Breakup

Course Code	18B12HS814	**Semester** Even	**Semester** VIII **Session** 2020 -2021 **Month from** Jan 2021 to June 2021
Course Name	Knowledge Management		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Anshu Banwari	
	Teacher(s) (Alphabetically)	Dr. Anshu Banwari	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-30.1	Demonstrate the way knowledge is embedded in today's organization and behavioral aspects involved in managing it	Understanding Level (C2)
C402-30.2	Compare and contrast different methods of KM to preserve, nurture, share and manage knowledge	Understanding Level (C2)
C402-30.3	Identify appropriate methods for knowledge integration to gain competitive advantage	Applying Level (C3)
C402-30.4	Identify the legal ramifications arising from knowledge sharing and an insight into the ethical concerns faced by individuals and organizations	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Knowledge Management	Cognition and Knowledge Management, Data, Information and Knowledge, Types of Knowledge, Reasoning and Heuristics, Expert Knowledge, Human thinking and Learning, Knowledge Management myths	4
2.	Life Cycle of a knowledge Management System	Challenges in building Knowledge Management Systems, Conventional V/S Knowledge Management System Lifecycle, Knowledge Management System Life Cycle, System Justification, Role of Rapid Prototyping, Selecting an expert, Role of Knowledge developer	6
3.	Knowledge Creation and Knowledge Architecture	Models of Knowledge Creation and Transformation, Knowledge Architecture, The people Core, Identifying Knowledge centers, The technical core	5
4.	Capturing Tacit Knowledge	Evaluating the expert, Developing a Relationship with expert, Fuzzy reasoning and the quality of Knowledge capture, Interview as a tool, Knowledge capture techniques	6
5.	Knowledge	Codification Tools and Procedures, The knowledge	6

	Codification and System Implementation	Developer's Skill set, Quality assurance, Approaches to Logical testing and Acceptance testing, Issues related to deployment	
6.	Knowledge Transfer and Knowledge Sharing	Transfer strategies, Inhibitors of Knowledge transfer, Role of Internet in Knowledge Transfer	5
7.	Managing Knowledge Workers	Business Roles in the Learning Organizations, Work adjustment and the Knowledge Worker, Technology and the Knowledge worker, Role of the CKO, Managing Considerations, Managing Knowledge Projects	5
8.	Ethical, Legal and Managerial Issues	Knowledge Owners, Legal Issues, Ethical Decision cycle, Major threats to Ethics, The Privacy factor	5
Total number of Lectures			**42**

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

Project based learning: Students have to form a group (maximum 5 students in each group) and have to identify an organization who has successfully implemented knowledge management. Students have to analyze techniques, tools and methods adopted by organization to preserve, nurture, share and manage knowledge. Understanding of different methods, processes and techniques used by organizations for successful KM implementation enhances the students practical understanding on how knowledge management is integrated into different business functions. These days most of the organizations are using knowledge management in their various endeavors. This subject surely enhances student's employability in all those organizations where knowledge management has been implemented or where they are planning to implement knowledge management.

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

1	**D. Hislop,** Knowledge Management in Organizations, Oxford University Press, 2013
2.	**E. M. Awad and H. M. Ghaziri,** Knowledge Management, Pearson Education, 2007
3.	**S. Warier**, Knowledge Management, Vikas Publishing House, 2011
4.	**Tan, H., Carrillo, P. and Anumba, C.J**., Case study of knowledge management implementation in a medium-sized construction sector firm. Journal of Management in Engineering, 28 (3), pp. 338 – 347, 2012
5.	**RagsdelL, G., Ortoll Espinet, E. and Norris, M.,** Knowledge management in the voluntary sector: a focus on sharing project know-how and expertise. Knowledge Management Research and Practice, 12(4), pp.351–361, 2014

Detailed Syllabus
Lecture-wise Breakup

Subject Code	16B1NHS832	Semester:**EVEN** (specify Odd/Even)	Semester VIII Session 2020-2021 Month from Jan-June
Subject Name	Service Management Marketing		
Credits	3	Contact Hours	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr Swati Sharma
	Teacher(s) (Alphabetically)	Dr Swati Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-1.1	Understand service products, consumers and markets	C2
C402-1.2	Apply 4P's of marketing to service	C3
C402-1.3	Determine and Interpret the customer Interface	C5
C402-1.4	Create and design profitable service strategies	C6

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Introduction to Services	Product to Services—The Challenges • The Gaps Model • The Services Marketing Mix	5
2.	Consumer Behavior In Services	Managing Customer Behavior— The three-stage model of Service Consumption	3
3.	Delivering Quality Service	Challenges of Measuring Service Quality • Measures of Service Quality • Dimensions of Service Quality SERVQUAL	5
4.	Positioning Services in Competitive Markets	Focus Strategies Developing effective positioning strategies	4
5.	Creating value in a competitive market and service promotion	Developing and positioning a service in the market Applying the 4 Ps of Marketing to	8

		services Value addition to the service product Planning and branding service products Crafting the service environment New service development.	
7	Culture and Service	People and Service National Cultures, Managing and marketing of Service across boundaries	5
6.	Technology & Service Strategy	Introduction to e services Electronic Commerce Models, Types of E services Value Chains in E Service	6
7	Planning and managing service delivery	Creating delivery systems in price, cyberspace and time, The physical evidence of the service space. The role of intermediaries, enhancing value by improving quality and productivity.	6
Total number of Lectures			42

Evaluation Criteria

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

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

1.	Valarie A. Zeithaml& Mary Jo-Bitner: Services Marketing-Integrating Customer Focus Acros the Firm, 7/e, TMH, 2018.
2.	Christopher Lovelock: Services Marketing People, Technology, Strategy, Fourth Edition, Pearson Education, 2011
3.	Rao, Services Marketing, Pearson Education, 2/e,2011
4.	Thomas J. Delong& Asish Nanda: Managing Professional Servies-Text and Cases, McGraw-Hil International, 2002
5	Roland T. Rust and P.K. Kannan, e-Service New Directions in Theory and Practice, Prentice-Hal of India Pvt. Ltd., 2002

Detailed Syllabus
Lecture-wise Breakup

Subject Code	18B12PH814	**Semester :Even**	**Semester:VIII**, **Session : 2020-2021** Month from: January to June
Subject Name	Plasma Physics		
Credits	**03**	**Contact Hours**	**3+1**

Faculty (Names)	**Coordinator(s)**	Dr. Anuraj Panwar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-6.1	Define terminology and concepts of plasma physics with various natural phenomena and engineering applications.	Remembering Level (C1)
C402-6.2	Summarize plasma and explain its electric, magnetic, dielectric and thermal properties.	Understand Level (C2)
C402-6.3	Develop magneto-hydrodynamic fluid and kinetic models to explain various phenomena taking place in homogeneous, isotropic and anisotropic plasma conditions.	Apply Level (C3)
C402-6.4	Analyze and formulate mathematical / analytical expressions for various nonlinear processes in plasmas.	Analyze Level (C4)
C402-6.5	Evaluate physical problems, estimate their numerical solutions and draw inferences from the results.	Evaluate Level (C5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	**Introdu-ction to the Plasma State**	Elementary concepts, definition of temperature Debye Shielding, plasma parameters, applications of Plasma Physics, Production of Plasmas in the laboratory, Drifts of charged particles under the effect of different combinations of electric and magnetic fields and Mirror Machine.	**10**
2.	**Fluid description of plasmas**	Relations of Plasma Physics to ordinary electromagnetics, dielectric constant of a plasma, collisions, equation of continuity, macroscopic parameters of plasma, two and one fluid equations for plasma.	**04**
3.	**Nonlinear Waves in Plasmas**	Plasma oscillations, space charge waves of warm plasma, ion-acoustic waves and electromagnetic waves in magnetized plasma.	**08**
4.	**Diffusion and Resistivity**	Decay of Plasma by diffusion, diffusion across a magnetic field, single fluid MHD equations, Diffusion in fully ionized Plasmas, Bohm diffusion and Neoclassical diffusion.	**06**
5.	**Stability of fluid plasma**	The equilibrium of plasma, classification of plasma instabilities, stability analysis: Two stream instability and Gravitational instability or Rayleigh Taylor instability	**04**

		(Plasma supported against gravity by magnetic field).	
6.	**Nonlinear effects**	Ponderomotive force, Parametric instabilities, decay instability, two plasmon decay, stimulated Raman scattering and stimulated Brillouin scattering, non linear Landau damping.	**06**
7.	**Controlled thermo-nuclear fusion**	Magnetic and inertial confinement schemes, ITER, TOKAMAK.	**02**
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 (7 M) and PBL and Class performance (8M)]
Total	**100**

Recommended Reading material:

1.	F. F. Chen., *Introduction to Plasma Physics*,Springer (2016).
2.	Krall and Trievelpiece, *Principles of Plasma Physics*, McGraw-Hill (1973).
3.	W. L. Kruer, *The Physics of laser plasma interactions*, Addison Wesley (1988).
4.	Liu and Tripathi,*Interaction of electromagnetic waves with electron beams and plasmas*, World Scientific (1994).

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12PH811	**Semester: Even**	**Semester: VIII Session** 2020 -2021 **Month from** January to June
Course Name	Photonics and Applications		
Credits	3	**Contact Hours**	3+1

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Recall the fundamental properties of light and the processes involved in the generation of light	Remember Level (C1)
CO2	Interpret the theory of fiber optics	Understand Level (C2)
CO3	Apply the fundamentals of various nonlinear optical effects in technology; make use of holography and its applications	Apply Level (C3)
CO4	Compare the operational principles, characteristics and trade-offs of optical detectors and modulators of light	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Lasers	Review of different types of laser systems. LEDs, Semiconductor lasers, Quantum well lasers, Modes of laser cavity, Q-switching and Mode locking in lasers.	8
2.	Fiber Optics	Numerical aperture, Step and graded index multimode fibers, attenuation and dispersion, modes in optical fibers. Single mode fiber, mode cutoff and mode field diameter. Connector and splice losses, Erbium doped fiber amplifier and Characterization techniques including OTDR.	10
3.	Photo detectors	Semiconductor photo detectors.	5
4.	Optical Electronics	Wave propagation in anisotropic media, Electro-optic effect: phase and amplitude modulation. Acousto-optic effect: modulators, deflectors and tunable filters, Magneto-optic effect: modulators.	4
5.	Optical devices	Electro-optical device, Acousto-optical device, Magneto-optical device, Voice communication, Optical communication.	2
6.	Nonlinear Optics	SHG, Sum and Difference frequency generation, parametric amplification, wavelength converters, Self focusing with lasers.	6
7.	Holography	Recording and Reproduction of Hologram, Applications of holography.	4
8.	Applications of Photons in Memory devices	CD, VCD, DVD.	1
		Total number of Lectures	**40**

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

Project based learning: Each student in a group of 4-5 students will opt a topic and will do the theoretical study in detail. The students will submit their report. To make the subject application based, the students analyze the optical fiber applications, holography applications and use of photons in memory devices. This shall improve the skills and employability of the students in laser and photonic industries.

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. P. Khare, *Fiber Optics and Optoelectronics*, Oxford University Press.
2.	A. K. Ghatak and K. Thyagarajan, *Optical Electronics*, Cambridge university Press.
3.	A. K. Ghatak and K. Thyagarajan, *An Introduction to Fiber Optics*, Cambridge university Press.
4.	B. B. Laud, *Lasers and Nonlinear Optics*, New Age International.

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12PH812	**Semester: Even**	**Semester: 8**, **Session :** 2020 -2021 **Month from: January to June**
Course Name	**Astrophysics**		
Credits	3	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Prof.Anirban Pathak and Dr. Sandeep Chhoker
	Teacher(s) (Alphabetically)	Anirban Pathak Sandeep Chhoker

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-4.1	Relate historical development of astrophysics with the modern concepts and recall the mathematical techniques used & definition of different units	Remembering (C1)
C402-4.2	Explain the models of universe, ideas of stellar astrophysics, life cycles of stars, physical principles that rules galaxies, and general theory of relativity	Understanding (C2)
C402-4.3	Apply mathematical principles and laws of physics to solve problems related to astrophysical systems	Applying (C3)
C402-4.4	Compare different models of universe and decide which one is logically acceptable and why	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1	Introduction to Astrophysics	Historical development of astrophysics (from mythology to contemporary astrophysics), Mass, length and time scales in astrophysics, sources of astronomical information (effect of discovery of spectroscopes and photography), astronomy in different bands of electromagnetic radiation (e.g. Optical astronomy, infra-red astronomy radio astronomy, X-ray astronomy. Gamma-ray astronomy etc. with specific mention of Hubble space telescope). Kirchoff's law, Doppler effect and Hubble's law.	**8**
2.	Stellar Astrophysics	Classification and nomenclature of stars. Basic equations of stellar structure, main sequence, red giants and white dwarfs, HR diagram, stellar evolution, supernovae, extra solar planets.	**8**
3.	Death of a star	End states of stellar collapse: degeneracy pressure of a Fermi gas, structure of white dwarfs, Chandrasekhar mass limit, neutron stars pulsars and black holes.	**6**
4.	Our galaxy	The shape and size of Milky way and its interstellar mater	**2**
5.	Extragalactic astrophysics	Normal galaxies, active galaxies, cluster of galaxies, large-scale distribution of galaxies.	**6**
6.	GTR and Models of Universe	Qualitative idea of general theory of relativity (without using tensor calculus) and its implications. Different models of universe. Specific attention to the ideas	**6**

		related to big bang, cosmological constants, dark matter and dark energy.	
7.	Astrobiology	Drake equation and related questions.	**2**
8.	Conclusion	Review of the present status of Astrophysics and open questions.	**2**
		Total number of Lectures	**40**

Evaluation Criteria

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

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

1.	Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press, Delhi, 2010.
2.	Astrophysics: Stars and Galaxies, K D Abhyankar, University Press, Hyderabad, 2009.
3.	Facts and Speculations in Cosmology, J V Narlikar and G Burbidge, Cambridge University Press, Delhi, 2009.
4.	The Cosmic Century, Malcolm Longair, Cambridge University Press, Cambridge, 2006.
5.	An Introduction to Astrophysics, BaidyanathBasu, Prentice Hall of India, Delhi 1997.
6.	Fundamentals of Equations of State, S. Eliezer, A Ghatak and Heinrich Hora, World Scientific, Singapore, 2002. Only Chapter 15.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	15B1NPH831	**Semester: Even**	**Semester: 8th Session: 2020-21** **Month:** January **to** June
Subject Name	Integrated Optics and Applications		
Credits	**03**	**Contact Hours**	**3+1**

Faculty (Names)	**Coordinator(s)**	Dr Amit Verma
	Teacher(s) (Alphabetically)	Dr Amit Verma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-26.1	Recall Integrated optical circuits and their applications in communication and photonics.	Remember Level (Level 1)
C402-26.2	Explain Elements of optics, ray transformation, optical sources, detectors, waveguides and their applications in photonics and communications.	Understand Level (Level 2)
C402-26.3	Demonstrate the use of Matrix optics and Fourier transform in solving various problems related to waveguides and optical integrated circuits.	Apply Level (Level 3)
C402-26.4	Prove and estimate solution of numerical problems using physical and mathematical concepts involved with various optical circuits and switches.	Evaluate Level (Level 5)
C402-26.5	Design of optical circuits of desired output for communication applications.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Matrix Optics	Introduction, Postulates of Ray Optics, Matrix optics; The ray transfer Matrix, Matrices of some simple, cascaded optical components and Periodic optical systems (Light Guides).	7
2.	Fourier Optics	Fourier series and analysis of periodic functions, Exponential form of Fourier series and Fourier transform Convolution and applications in image processing; frequency filtering, low pass, high pass and band pass filters.	7
3.	Lasers	Lasers; threshold condition, resonator wave guides and Types of Lasers, Laser diodes; Fabry-Perot lasers. DFB, DBR lasers, ultrafast optics and Applications.	7
4.	Optical waveguides	Optical waveguides and fibers, Planar and strip waveguides, Amplifiers (EDFA), Directional couplers, Diffraction Grating couplers, Grating-assisted optical components. Fiber sensors, fiber optic network and communication,	7
5.	Micro and nano	Lithography. Etching, Metallization, Packaging, Nanoscale waveguide, micro-ring resonator, micro-disk resonator and	4

	lithography	applications.	
6.	Photonic integrated circuits	Integrated optical Devices; Design and Processing TechnologyPhotonic switches, PIC (Photonic Integrated Circuits), Photonic crystal cavity, plasmonic waveguide based devices, NRI (negative refractive index) Optics, perfect lens, near-field scanning optical microscope (NSOM) and Applications.	8
		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.	R. P. Khare, *Fiber Optics and Optoelectronics*, Oxford University Press.
2.	A. K. Ghatak and K.Thyagarajan, *Optical Electronics*, Cambridge university Press.
3.	A. K. Ghatak and K.Thyagarajan, *An Introduction to Fiber Optics*, Cambridge university Press.
4.	B. B. Laud, *Lasers and Nonlinear Optics*, New Age International.

Optimization Techniques (16B1NMA831)

Course Description

Course Code	16B1NMA831	**Semester** Even	**Semester** VIII **Session** 2020-21 **Month from** Jan 2021 - June 2021		
Course Name	Optimization Techniques				
Credits	3		**Contact Hours**	3-0-0	
Faculty (Names)	**Coordinator(s)**	Prof. Amrish K. Aggarwal			
	Teacher(s) (Alphabetically)	Prof. Amrish K. Aggarwal			

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C402-2.1	apply generalized, revised and dual simplex method for linear programming problems (LPP).	Applying Level (C3)
C402-2.2	apply graphical, algebraic and linear programming techniques for pure and mixed strategy problems in game theory.	Applying Level (C3)
C402-2.3	classify and solve the problems on queuing and inventory models.	Analyzing Level (C4)
C402-2.4	solve and analyze the network scheduling and sequencing problems.	Analyzing Level (C4)
C402-2.5	make use of dynamic programming technique to solve complex linear programming problems.	Applying Level (C3)
C402-2.6	determine numerical solution of nonlinear multidimensional problems.	Evaluating Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Review of Linear Programming	Convex sets, Linear Programming Problems (LPP), graphical and simplex method, Big-M method, Two phase method, generalized simplex method, revised simplex method, Duality theory, dual simplex method.	08
2.	Game Theory	Rectangular Games, Minmax Theorem, Graphical Solution of 2×n, 3×n, m×2, m×3 and mxn Games, Reduction to Linear Programming Problems.	06
3.	Queuing Theory & Inventory Model:	Introduction, Steady-State Solutions of Markovian Queuing Models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited space, M/G/1, Inventory Models.	08
4.	Sequencing & Scheduling	Processing of Jobs through Machines, CPM and PERT.	06
5.	Dynamic Programming	Discrete and Continuous Dynamic Programming, Simple Illustrations.	06
6.	Nonlinear Programming	Unimodal function, One Dimensional minimization problem, Newton's Method Golden Section, Fibonacci Search, Bisection, Steepest Descent Method, Multidimensional Newton's method.	08

		Total number of Lectures	**42**

Evaluation Criteria

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

Project based learning: Each student in a group of 4-5 will analyse literature on mathematical application of discrete and continuous dynamic programming technique to solve complex linear programming problems. To make the subject application based, the students analyze the optimized way to deal with dynamic programming problems.

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

1.	Taha, H. A., Operations Research - An Introduction, Tenth Edition, Pearson Education, 2017.
2.	Rao, S. S. - Engineering Optimization, Theory and Practice, Third Edition, New Age International Publishers, 2010.
3.	Hillier F., Lieberman G. J., Nag,B. and Basu, P., Introduction to Operations Research, 10th edition, McGraw-Hill, 2017.
4.	Wagner, H. M., Principles of Operations Research with Applications to Managerial Decisions, 2nd edition, Prentice Hall of India Pvt. Ltd., 1980.

Multi Attribute Decision Making (20B12MA411)

Course Description

Course Code	20B12MA411	**Semester** Even	**Semester** VIII **Session** 2020-21 **Month from** Jan 2021 - June 2021		
Course Name	Multi Attribute Decision Making				
Credits	3		**Contact Hours**	3-0-0	
Faculty (Names)	**Coordinator(s)**	Dr. Pankaj Kumar Srivastava			
	Teacher(s) (Alphabetically)	Dr. Pankaj Kumar Srivastava, Dr. DCS Bisht			

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C402-6.1	explain basic steps in decision analysis and decision making environments.	Understanding Level (C2)
C402-6.2	apply group decision making methods to reach a collective decision.	Applying Level (C3)
C402-6.3	develop the concept of multi-criteria decision making process and attributes.	Applying Level (C3)
C402-6.4	apply elementary methods to solve multi-attribute decision making problems.	Applying Level (C3)
C402-6.5	analyze value based and outranking methods to solve multi attribute decision making problems.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Decision Analysis	Basic steps in decision analysis, decision-making environments, decision making under uncertainty, decision making under risk, utility theory, decision tree.	8
2.	Group Decision Making	GDM methods, content-oriented methods, and disadvantages of non ranked voting, preferential voting system, and social choice functions.	7
3.	Multicriteria Decision Making	Multiattribute decision making, multi objective decision making, decision making process, structuring process, decision matrix, attributes, normalization, attribute weight assignment methods.	8
4.	Elementary Methods for MADM	Dominance relation method, even-swap method, lexicographic method maximax method, maximin method, conjunctive method, disjunctive method, median ranking, analytic hierarchy process, analytic network process.	8

5	Value Based and Outranking Methods	Multi attribute value theory, simple additive weighting, weighted product, TOPSIS outranking methods.	11
Total number of Lectures			**42**

Evaluation Criteria

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

Project based learning: Students are divided in a group of 4-5 to do a survey on the applications of classical and recent multi attribute decision making techniques in their respective branches. The student recognizes the multi attribute decision making problems arising in real life and solves these problems with the help of MADM techniques learnt in this course.

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

1.	**Ishizaka, Alessio, and Philippe Nemery**. Multi-criteria decision analysis: methods and software. John Wiley & Sons, 2013.
2.	**Xu, Zeshui.** Uncertain multi-attribute decision making: Methods and applications. Springer, 2015.
3.	**Tzeng, Gwo-Hshiung, and Jih-Jeng Huang**. "Multi Attribute Decision Making: Methods and Applications." USA, CRC Press. 2016.

Fuzzy Optimization & Decision Making (18B12MA811)

Course Description

Course Code	18B12MA811	**Semester** Even	**Semester** VIII **Session** 2020-21 **Month from** Jan 2021 - June 2021
Course Name	Fuzzy Optimization and Decision Making		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Amit Srivastava	
	Teacher(s) (Alphabetically)	Dr. Amit Srivastava, Dr. Lakhveer Kaur	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C402-24.1	explain the concept of fuzzy sets and fuzzy numbers.	Understanding level(C2)
C402-24.2	explain various fuzzy and generalized fuzzy operations.	Understanding level(C2)
C402-24.3	apply the concept of fuzzy relations and approximate reasoning.	Apply level(C3)
C402-24.4	apply the concept of fuzzy sets and their generalizations in various decision making processes.	Evaluate level(C5)
C402-24.5	apply various ranking techniques in solving fuzzy transportation problems.	Apply level(C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Fuzzy sets and fuzzy numbers	Fuzzy sets and fuzzy numbers, basic operations, operations on [0, 1] – fuzzy negation, triangular norms, t-conorms, fuzzy implications, aggregation operations, fuzzy functional equations.	7
2.	Fuzzy and generalized fuzzy operations	Type - 1 and Type - 2 fuzzy sets, intuitionistic fuzzy sets. triangular fuzzy numbers, trapezoidal fuzzy numbers, bell shaped fuzzy numbers, fuzzy numbers with a flat, piecewise quadratic fuzzy numbers.	7
3.	Fuzzy relations and approximate reasoning	Fuzzy binary and n-ary relations, composition of fuzzy relations, fuzzy equivalence relations, fuzzy compatibility relations -fuzzy relational equations, applications of fuzzy relations in approximate reasoning.	8

4.	Decision making in fuzzy environment	Decision making in a fuzzy environment, individual decision making, multiperson decision making, multicriteria decision making, multistage decision making, fuzzy zero-based budgeting, fuzzy averaging for decision making.	10
5.	Ranking techniques in fuzzy transportation problems	Fuzzy ranking methods, fuzzy linear programming, fuzzy transportation, basic definitions associated with fuzzy transportation, algorithms for solution of fuzzy transportation problem.	10
Total number of Lectures			**42**

Evaluation Criteria

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

Project based learning: Students are divided in a group of 4-5 to do a survey on the applications of applications of fuzzy relations in approximate reasoning in their respective branches. The students recognize decision making problems in fuzzy environment arising in practical situations and solve these problems with the aid of different techniques learnt in this course. The students also apply various ranking techniques for solving fuzzy transportation problems.

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

1.	**Bhargava, A. K.,** Fuzzy Set Theory, Fuzzy Logic and Their Applications, S. Chand & Company Pvt. Ltd., 2013.
2.	**Zimmermann, H. J.**, Fuzzy Set Theory and its Applications, 4th Edition, Allied Publishers, New Delhi, 1991.
3.	**Ross, T.J.**, Fuzzy logic with engineering applications, 2nd Edition, John Wiley and Sons, Ltd, 2004.
4.	**Baczynski, M. and Jayaram, B.**, Fuzzy Implications, Springer Verlag, Heidelberg, 2008.
5.	**Klir, G. J. & Yuan, B.**, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall NJ, 1995.

Detailed Syllabus [Integrated M. Tech]

Course Code	18B12BT414	**Semester** Even	**Semester** VIIIth **Session 2020-2021** **Month from** Jan - June
Course Name	Machine Learning tools in Bioinformatics		
Credits	3	**Contact Hours**	3

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-13.1	Explain about the machine learning principle biological complexities and resources	Understand Level (C2)
C402-13.2	Apply Pattern Identification methods for motif discovery	Apply Level (C3)
C402-13.3	Apply machine learning in solving biological problems.	Apply Level (C3)
C402-13.4	Analyzing the use of machine learning in disease-drug discovery	Analyze Level (C4)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Overview of machine learning methods and scope in bioinformatics	Fundamentals of machine learning, algorithms, introduction to biological problem and mapping, gene and genome, Structure, function and organization, biological database, Scope of machine learning in bioinformatics (Genomics, proteomics, transcriptomics etc.)	7
2.	Pattern identification	Pattern and motif, domain, profile in Bioinformatics, Search algorithms, String search, Boyer moore, Robin Karp algorithm KMP algorithm, Dynamics programming and greedy approach etc. case studies	4
3.	Data classification: Clustering and tree algorithm	Gene finding tools, Discrimination analysis ; LDA, Clustering methods: Hierarchical , K mean, Normalization, similarity measure (distances), Basics of tree, suffix tree and its applications in Bioinformatics , validations, statistical inferences and biological interpretation (Gene ontology and microarray	8

		data)	
4.	Basics of ANN and HMM	Fundamental of ANN, Back propagation algorithm, kNN, ANN model, Biological tools like PHD, Intron identifier, splice site prediction etc. Basics of HMM Stochastic algorithm, profile generation, Pfam, protein families, Gibbs sampling, Viterbi algorithm, tools evaluation	10
5.	SVM	Introduction to SVM. Feature selection, kernel methods, case studies(Bioinformatics application ; protein structure and function prediction , data mining in drug discovery etc.)	5
6.	Applications and tools	SVM_light, GIST server, applications of SVM, QSAR prediction, ADMET predictions, case studies, Protein coding region prediction, gene identification, folding problems in protein sequences, network analysis, RNAi Designing, PSORT, Genscan, HMMTOP, DAS, Genemark , Glimmer, etc., case studies	8
		Total number of Lectures	**42**

Evaluation Criteria

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

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

1.	Pierre Baldi and Søren Brunak “Bioinformatics The Machine Learning Approach” , February 1998, 371 pp., 62 illus.,
2.	Thomas H. Cormen “Introduction to Algorithms” , 2nd edition McGraw-Hill Science,2001, 1056 pages.
3	Yang, Zheng Rong, “ Machine :Learning Approaches to Bioinformatics”, New Delhi world Scientific, Pp 336, 2017
4	Research papers and manuals

Detailed Syllabus
Lecture-wise Breakup

Course Code	20B12EC415	**Semester** Even **(specify Odd/Even)**	**Semester 8** **Session** 2020 -2021 **Month from** Jan to June
Course Name	Network Security		
Credits	4	**Contact Hours**	3-1

Faculty (Names)	**Coordinator(s)**	P C Gupta
	Teacher(s) (Alphabetically)	P C Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-6.1	At the completion of the course, students will be able to understand the security requirements of networked information systems and general principles of cryptography.	Understanding (C2)
C433-6.2	At the completion of the course, students will be able to apply above concepts for developing security mechanisms used for network access, message confidentiality, message authentication non-repudiation.	Applying (C3)
C433-6.3	At the completion of the course, students will be able to apply the above security mechanisms to understand of standard security protocols used in the IP network.	Applying (C3)
C433-6.4	At the completion of the course, students will be able to analyze a) network vulnerabilities to adversarial attacks/intrusions, and b) security solutions for preventing such attacks/intrusions.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Security concepts and terminology	General security concepts, need for security & security mechanisms	2
2.	Symmetric-key & Asymmetric-key Cryptosystems	(a) Classical encryption methods (b) Mathematical foundations I – Modular arithmetic (c) Block ciphers, DES, 3 DES, AES (d) Modes of operation of block ciphers (e) Stream ciphers, RC4 (f) Mathematical foundations II – Finite fields (g) Asymmetric-key cryptography, RSA, ElGamal (h) Elliptic curve cryptography	14
3.	Message Authentication & Digital Signatures	(a) Content integrity verification, hash functions, SHA, Whirlpool (b) Message Authentication Code (MAC), (c) HMAC, CMAC (d) Digital signature, RSA and ElGamal, applications of digital signatures	4
4.	Entity Authentication & Security for Remote Access	(a) Fixed and one-time passwords, authentication based on challenge-response. (b) PPP, PAP, CHAP, EAP protocols, RADIUS & L2TP	3

		tunneling	
5.	Key Distribution	(a) Symmetric-key distribution, Diffie-Hellman key exchange, (b) Key Distribution Centre (KDC), Kerberos (c) Public Key distribution, Digital certificates, X.509, Certification Authority (CA), Public Key Infrastructure	3
6.	Security at the Transport and Network Layers	(a) Security at the Transport layer, (b) TLS protocol (c) Security at the IP layer, VPN, IPsec, AH, ESP protocols	3
7.	Security in Wireless Networks	(a) Architecture of wireless LAN (b) WEP, RSN protocols	2
8.	Network Vulnerabilities & Malware	(a) IP attacks, TCP attacks, DOD & DDOS attacks (b) Firewalls – packet filtering, stateful inspection, proxy, circuit level (c) Intrusion Detection Systems (IDS) (d) Malware	7
9.	Security at the Application Layer	(a) Secure Electronic Transaction (SET)	2
		Total number of Lectures	**40**

Evaluation Criteria

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

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

1.	Gupta, Prakash C., *Cryptography and Network Security*, PHI, 2014
2.	Stallings W., *Cryptography & Network Security*, 6th Ed., Pearson, 2014
3.	Forouzan, BA., *Cryptography & Network Security*, 3rd Ed., McGraw-Hill, 2015