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 OtherPower 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

Course Description

Course Code	15B19CI891	**Semester** Even **(specify Odd/Even)**	**Semester** VIII **Session** 2020 -2021 **Month from** Janto June 2021
Course Name	**Project Part – II (CSE)**		
Credits	12	**Contact Hours**	…

Faculty (Names)	**Coordinator(s)**	Dr. RajuPal Prashant Kaushik
	Teacher(s) (Alphabetically)	Entire Department

COURSE OUTCOMES		**COGNITIVE LEVELS**
C451.1	Summarize the contemporary scholarly literature, activities, and explored tools for hands-on in the respective project area	Understand Level (Level 2)
C451.2	List out the specific requirements to develop the workable solution for the identified computing problem.	Analyze Level (Level 4)
C451.3	Develop a workable computing solutions for the identified problem	Apply Level (Level 3)
C451.4	Evaluate the performance of the developed solution	Evaluate Level (Level 5)
C451.5	Compile the results and findings of the project in written and verbal formats	Create Level (Level 6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	…	…	…
2.	…	…	…
...	…	…	…
***n*.**	…	…	…

Evaluation Criteria

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

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

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	14

		Gain, Deductions under section 80C to 80U.	
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	17B2NCI743	**Semester** Even **(specify Odd/Even)**	**Semester** 8th **Session** 2020 -2021 **Month from** Jan 2021 – June 2021
Course Name	Cryptography and Network Security		
Credits	3	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Sangeeta Mittal, Himanshu Agrawal
	Teacher(s) (Alphabetically)	Himanshu Agrawal, Sangeeta Mittal, SulabhTyagi

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-1.1	Describe classical encryption methods based on Substitution and Permutation	Understand (Level 2)
C433-1.2	Implement and apply modern block and stream cipher techniques like DES, AES and RC4	Apply (Level 3)
C433-1.3	Understand the role of prime number theory and quadratic congruence in cryptography	Understand (Level 2)
C433-1.4	Implement and apply asymmetric encryption algorithms of RSA , ElGamal and Elliptic Curve Cryptography	Apply (Level 3)
C433-1.5	Criticize hashing algorithms like SHA-512 and SHA – 1024	Analyse (Level 4)
C433-1.6	Compare and Choose cryptographic techniques for using Digital Signatures and certificates in existing applications	Evaluate (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Classical Encryption Techniques	Modular Arithmetic , Substitution Ciphers: Shift , Playfair, Vernam, Vignere, Affine, Hill,Rail fence, Transposition Ciphers	6
2.	Modern Block Ciphers	Fiestel and Non Fiestel Encryptions, Data Encryption Standard, polynomial modular arithmetic, fields, generators, Advanced Encryption Standard	8
3.	Modern Stream Ciphers	Linear Feedback Shift Registers and RC4	4
4.	Mathematics for Public Key Cryptography	Prime number theory, Euler's theorem, Fermat's theorem Chinese Remainder Theorem, quadratic congruence, discrete logarithm, fast exponentation	6
5.	Public Key Cryptography	RSA, Knapsack, Rabin , ElGamal and Elliptic Curve Cryptography	10
6.	Hashing Algorithms	Requirements of Hashes for Cryptography, Message Digests,SHA-1	4
7.	Digital Signatures and Certificates	Elgamal Signatures, Digital Signature Standards, X.509 Certificates, Kerberos	4
		Total number of Lectures	**42**

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (5 Tutorial/Assignment+ 10 Attendance+10 Project)
Total	**100**

Project Based Learning: Mini Project is an important part of teacher's assessment component. Students will make applications that will make use of main cryptographic libraries available in various languages like Java and Python. Through project, they will also implement digital signatures to demonstrate secure and dependable communication in mobile apps and websites. Newer forms of encryption like homomorphic, searchable and adversarial neural cryptography that are more suited to applications in current scenario can also be worked upon.

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.	William Stallings, Cryptography and Network Security 7th Edition, Prentice Hall 2018
2.	B A Forouzan and DebdeepMukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill, 2015
3.	D Stinson, Cryptography: Theory and Practice, 4th Edition , CRC Press, 2019,
4.	Network security essentials: applications and standards by William Stallings.,5/e, Prentice Hall,2013
5.	ACM Transactions on Information and system security
6.	IEEE Press Computer Security and Privacy

Detailed Syllabus
Lecture-wise Breakup

Course Code	18B12CS413	**Semester Even**	**Semester VIII Session** 2020 -2021 **Month from January to May**
Course Name	Performance Analysis of Computing Systems		
Credits	**4**	**Contact Hours**	3-1-0 (L-T-P)

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

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-5.1	Demonstrate the performance goals for methods and algorithms in computational systems and understand the various random variables with its applications.	Understand Level (C2)
C433-5.2	Inspect and examine the outcome of experiments using various approaches or techniques.	Analyze Level (C4)
C433-5.3	Select and interpret appropriate evaluation techniques, performance metrics and workloads for a system.	Evaluate Level (C5)
C433-5.4	Apply and build Markovian model to develop continuous & discrete-time queuing process by discussing various queuing models.	Apply Level (C3)
C433-5.5	Classify and examine various probability distribution model for a given applications and compare the performance of various techniques or algorithms.	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Probability Models and Simulation:**	Probability space, Random variables; Discrete and Continuous distribution: uniform, geometric, exponential, normal distribution etc, System Modeling, Measurement techniques, Experimental design, workload design, Simulations, Data analysis and Visualization.	14
2.	**Basics of Modeling:**	Performance metrics: Bandwidth utilization, throughput, delays, error rate, network reliability etc., Poisson process, Bernoulli splitting, PASTA, and Markov chain theory.	8
3.	**Queuing Theory:**	Arrival and service processes, Server disciplines, Queuing networks: Open vs. closed networks, Product-form queuing networks, M/M/1, M/M/1/K, M/M/m, M/M/m/m. M/G/1 full analysis;	12
4.	**Simulation and Analysis of Computing systems:**	Simulations: time averages versus ensemble averages, Asymptotic bounds and limit theorems, confidence intervals, generating random variables for simulation, Monte-Carlo simulation, Inspection Paradox; Empirical Workload Measurements: heavy-tailed property, Pareto distributions, self-similarity, heavy-tailed distributions;	6
5.	**Applications of Computing**	Analysis of Scheduling: FCFS,LCFS, SJF etc., analyze the different computing system based on real life application	2

	Systems:		
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
Attendance:	7
Class Test/Quizzes	7
Internal Assessment	5
Assignment In PBL Mode	6
Total	**100**

Project Based Learning: A group (of 3-4 students) has to submit a mini-project based on the analysis of real time computing system using Random Process, MArkov chain or Queuing Model. Analysis have to be done on the basis of different performance metric (i.e. Reliability, Utilization etc). These analyses can be simulated in the Python, MATLAB or any other simulation tool.

Text Books:

T1.	Sheldon M. Ross: Introduction to Probability Models 11th Edition, Academic Press, 2014.
T2.	Mor Harchol-Balter, Performance modeling and design of computer systems: queueing theory in action. Cambridge University Press, 2013.
T3.	Kishor S. Trivedi, Probability and Statistics with Reliability, Queueing, and Computer Science Applications, Wiley, 2nd edition, 2016.

Reference Books:

R1.	Sanjay K. Bose, "An Introduction to Queuing System", Springer 2002
R2.	Bertsekas D. and Gallager R., Data Networks. Englewood Cliffs, NJ: Prentice-Hall, 1992
R3.	L. Kleinrock, Queueing Systems, Vol. I: Theory, John Wiley & Sons, Inc., 1975.
R4.	Edited by P. Chretienne, E. G. Coffman, J. K. Lenstra and Z. Liu, Scheduling Theory and its Applications, John Wiley and Sons, 1995.
R5.	Larry L. Peterson and Bruce S. Davie, " Computer Networks: A Systems Approach ", 3rd Edition, Elsevier Publication, 2003.
R6.	R. Jain, The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling, John Wiley & sons, 1991.

Detailed Syllabus

Lecture-wise Breakup

Course Code	**18B12CS415**	**Semester** EVEN **(specify Odd/Even)**	**Semester VIII Session** 2020 -2021 **Month from January** 2021 – June 2021
Course Name	**Search-Based Software Engineering (SBSE)**		
Credits	4	**Contact Hours**	3-1-0

Faculty (Names)	**Coordinator(s)**	Dr. Amarjeet Prajapati
	Teacher(s) (Alphabetically)	Dr. Amarjeet Prajapati

S.N.	DESCRIPTION	COGNITIVE LEVEL (BLOOM TAXONOMY)
C434-2.1	Explain the concepts of search-based software engineering and various types of optimization problems in the context of different software engineering problems.	Remember Level (Level 1)
C434-2.2	Identify and define/formulate various software engineering activities/tasks as search-based optimization problem.	Understand Level (Level 2)
C434-2.3	Design and develop methods for encoding the software engineering problems for finding optimal solutions from larger search space using search-based techniques	Create Level (Level 6)
C434-2.4	Implement and apply different optimization techniques on various forms of software optimization problems using different SBSE Tools	Apply Level (Level 3)
C434-2.5	Analyze the behavior of different optimization techniques corresponding to different forms of software optimization problems.	Analyze Level (Level 4)
C434-2.6	Evaluate the performance of different single and multi-objective optimization techniques using different quality indicators	Evaluate Level (Level 5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**# Lectures**
1.	Introduction	Search-based Software Engineering (SBSE), why SBSE, architecture of SBSE,commonly used search techniques, Optimization Problems, Metaheuristic Algorithms, software engineering problem as a search-based optimization problem	4
2.	Optimization	Various types of optimization problems (e.g., linear and non-linear, convex and non-convex, single and multi-objective, etc.) in the context of software engineering	3
3	Problem Formulation	Define and formulate various software engineering activities/tasks e.g., requirement analysis, software design and software restructuring as search-based optimization problem	6
4.	Meta-heuristics	Tailoring various optimization methods and algorithms used in search-based software engineering., according to their suitability with respect to various classes of software engineering problems	6
5.	Application to software engineering problem	Apply and Implement different optimization techniques on various forms of software optimization problems e.g., Requirement analysis,	6

		software design software architecture recovery, software refactoring, and software remodularization	
6.	Statistical Analysis	Statistical hypothesis testing, parametric and nonparametric statistical tests for the analysis of the search-based software engineering solutions	6
7.	Evaluation	Evaluate the performance of different single and multi and many-objective search-based optimization techniques using different quality indicators such as Generational Distance (GD), Inverted Generational Distance (IGD), hyper-volume (HV), Error Ratio, Set Coverage Metric, Spacing and Spread	7
8.	SBSE Tools	Tools for SBSE include OpenPAT, JMetal, EvoSuite and Coverage a code coverage measurement tool for Python, etc.	4
		Total number of Lectures	42

Evaluation Criteria

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

Project based learning: Each student in a group of 3-4 have to work on a mini-project, in which they will identify a real-life problem and develop the solution by applying their knowledge of search-based software engineering approach. The project implementation can be in any programming language preferably along with well documentation on different aspects of the software. This enhances the understanding of students towards different concepts of search-based software engineering approach and also help them during their employability.

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

Text Book

1	Nature-Inspired Optimization Algorithms, by Xin-She Yang Publisher: Elsevier *Release Date: February 2014,* ISBN: 9780124167438

Reference Books

2	Practical Optimization, Book by Philip E. Gill
3	Practical Methods of Optimization, Book by R. Fletcher
4	Object-Oriented Modeling and Design with UML (2nd Edition) Michael R. Blaha; James R Rumbaugh
5	Head First Object-Oriented Analysis and Design A Brain Friendly Guide to OOA&D By Brett McLaughlin, Gary Pollice, David West
6	OBJECT-ORIENTED ANALYSIS AND DESIGN With applications Third EDITION Grady Booch Rational Santa Clara, California

Detailed Syllabus
Lecture-wise Breakup

Subject Code	18B12CS419	**Semester (Even)**	**Semester** Even **Session** 2020 - 21 **Month from** January **to** May
Subject Name	Distributed Computing		
Credits	**3+1**	**Contact Hours**	**3 Lectures +1 Tutorial**

Faculty (Names)	**Coordinator(s)**	Parmeet Kaur, Rashmi Kushwaha
	Teacher(s) (Alphabetically)	1. Parmeet Kaur 2. Rashmi Kushwaha

COURSE OUTCOMES		**COGNITIVE LEVELS**
C433-2.1	Identify and solve event ordering related problems occurring due to various synchronization related issues in distributed systems (e.g., using Lamport, Vector, Matrix clock implementations).	Apply Level 3
C433-2.2	Compare and explain the solutions for mutual exclusion and deadlock related issues for various application specific scenarios that may occur in distributed environments (e.g., using token and non-token based techniques). [Level 2]	Understand Level 2
C433-2.3	Examine and distinguish data consistency and replication related issues for various distributed scenarios.	Analyze Level 4
C433-2.4	Evaluate and assess fault tolerance related issues for perceiving reliable systems in distributed environments.	Evaluate Level 5
C433-2.5	Show how the concepts of distributed computing have been applied in existing distributed database systems, distributed file systems and cloud based systems.	Remember Level 1

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Review of principles, concepts foundation to Distributed Systems.	Review of Operating Systems principles, Introduction to Distributed Systems.	2
2.	Consistency and Replication Issues	Data-centric consistencies, Client-centric consistencies. Epidemic Protocols and Implementation Issues, Distributed Hash Tables and Distributed Lookup Services	8
3.	Fault Tolerance and Reliability	Fault Tolerance, Reliability in Distributed Systems, group communications, and Distributed commit. Two Phase commit and Three Phase commit. Failure Recovery.	7

4.	Synchronization mechanisms	Resource models. Clock synchronization, Inherent limitations of distributed operating systems. Event ordering. Timestamps. Global state collection mechanisms. Termination Detection, Bully Algorithm. Ring Algorithm.	6
5.	Mutual Exclusion and Deadlock handling	Process deadlocks in DS. Distributed mutual exclusion. Token and non-token based algorithms. Comparative performance analysis.	9
6.	Agreement Protocols	System Model, Classification, Byzantine Problems and solutions.	3
7.	Distributed Computing Vs Cloud Computing.	Introduction, Challenges, Cloud Computing architectures, Virtualization in Cloud Computing, Building applications and Infrastructures in the cloud, Security Issues.	2
8.	Self Stabilizing Systems	System model, Self-Stabilization design issues and methodologies, Theoretical Foundations, Stabilizing DMEs, Stabilizing protocols, and Stabilizing Synchronization, Limitations etc.	3
9.	Case Studies	Distributed File Systems and Distributed Databases	2
			42

Evaluation Criteria

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

Project based learning: Each student in a group of 4-5 will study a practical problem in distributed computing in detail along with its real-world applications. They will present it as a Case study or give a practical demonstration of the problem and its solution. This detailed study on distributed environment will help their employability into IT sector.

Recommended Reading material:

Text Books

1	Sukumar Ghosh,. *Distributed systems: an algorithmic approach*. Chapman and Hall/CRC, 2014.
2.	M. van Steen and A.S. Tanenbaum, Distributed Systems, 3rd ed., distributed-systems.net, 2017.

Reference Books

1.	Ajay Kshemkalyani and Mukesh Singhal. *Distributed computing: principles, algorithms, and systems*. Cambridge University Press, 2011.
2	M. Singhal, N. G. Shivaratri, Advanced Concepts in Operating Systems, 1st Ed., Tata McGraw-Hill, 1994.
3.	"Introduction to Cloud Computing Architecture" Sun's White Paper, 1st Edition, June, 2009.
4.	IEEE, ACM Transactions, Journals and Conference papers on "Distributed and Cloud

	Computing."
5.	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'REILLY publication.
6.	"Virtualization Overview", White paper, VM Ware.
7.	"Implementing Virtualization" White paper, Intel virtualization Technology
8.	Tulloch, Mitch, Understanding Microsoft virtualization solutions: From the Desktop to Data Center, Microsoft Press.

Detailed Syllabus

Lecture-wise Breakup

Course Code	18B12CS428	**Semester** Even	**Semester** VIII **Session** 2020-21 **Month from** Jan,2020
Course Name	**Introduction to Deep Learning**		
Credits	4	**Contact Hours**	4 (L+T)

Faculty (Names)	**Coordinator(s)**	Dr. Satish Chandra (62), Dr. Swati Gupta(128)
	Teacher(s) (Alphabetically)	Dr. Satish Chandra, Dr. Swati Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C434-3.1	Identify and express the motivation behind and need of Deep Learning.	Understanding (Level-2)
C434-3.2	Comprehend the basic theory of learning, probability in learning, error minimization and regularization techniques.	Understanding (Level-2)
C434-3.3	Design and Model Convolution Neural Networks for Image recognition and Computer Vision.	Apply (Level-3)
C434-3.4	Apply Recurrent Neural Networks and LSTM for temporal data	Apply (Level-3)
C434-3.5	Assess the Deep Learning techniques on the basis of performance measures such as training speed, classification error, kappa coefficient, precision, recall and F-Measure.	Evaluate(Level-5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	What is deep learning? DL successes; DL versus Shallow Networks	02
2.	Math review	Gradient descent, logistic regression. Probability, continuous and discrete distributions; maximum likelihood. MSE cost	03
3.	Neural networks	Cost functions, hypotheses and tasks; training data; maximum likelihood based cost, cross entropy,; feed-forward networks; MLP, sigmoid units.	03
4.	Learning in neural networks	Output vs hidden layers; linear vs nonlinear networks;	03
5.	Backpropagation learning	Gradient descent; recursive chain rule, bias-variance tradeoff, Regularization; output units: linear, softmax; hidden units: tanh	06
6.	Convolutional neural networks	Convolutional neural networks, different CNN-based models and their architectures	06
7.	Deep learning	GPU training, regularization, RELU, dropouts etc.	06

	strategies		
8.	Recurrent neural networks	Recurrent neural networks, different RNN models and applications	07
9.	Unsupervised deep learning	Unsupervised deep learning models, different types of autoencoders	06
		Total number of Lectures	**42**

Evaluation Criteria

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

Project based learning: Each student in a group of 3-4 have to work on a mini-project, in which they will design and implement different deep learning models for problems computer vison, speech, computer aided diagnosis , financial decision making etc. The results will be compared with the state of art models and reported. To increase the employability, real datasets will be used in the projects from various online repositeris.

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.	Ian Goodfellow, Yoshua Bengio, Aaron Courville , "Deep Learning", MIT Press book.
2.	Francois Chollet, "Deep Learning with Python ", Manning.
3.	Adam Gibson and Josh Patterson, "Deep Learning: A Practitioners Approach",O' Reilly.

Detailed Syllabus

Lecture-wise Breakup

Course Code **NBA Code**	**18B12CS434** **CS434**	**Semester (Even)**	**Semester** VIII **Session** 2020 -2021 **Month from** January - June
Course Name	Ethical Hacking		
Credits	04	**Contact Hours**	(L+T) (3+1)

Faculty (Names)	**Coordinator(s)**	Shariq Murtuza
	Teacher(s) (Alphabetically)	Shariq Murtuza

COURSE OUTCOMES		**COGNITIVE LEVELS**
C431-3.1	Define what is ethical hacking and penetration testing, and when and why penetration testing is required along with testing phases.	Remember Level (Level 1)
C431-3.2	Classify and outline the penetration testing phases and relate the phases to the specified context.	Understand Level (Level 2)
C431-3.3	Identify and analyse the stages a penetration tester requires to take in order to compromise a target system.	Apply Level (Level 3)
C431-3.4	Examine and implement tools and techniques to carry out a penetration testing.	Analyze Level (Level 4)
C431-3.5	Critically evaluate security techniques used to protect system and user data to suggest countermeasures.	Evaluate Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1	Introduction	Key issues plaguing the information security world, incident management process, and penetration testing	3
2	Footprinting	Various types of footprinting, footprinting tools, and countermeasures.	3
3	Scanning and Enumeration	Network scanning techniques and scanning countermeasures. Enumeration techniques and enumeration countermeasures	3
4	System Hacking	System hacking methodology, steganography, steganalysis attacks, and covering tracks	3
5	Malware and Virus	Different types of Trojans, Trojan analysis, and Trojan countermeasures. Working of viruses, virus analysis, computer worms, malware analysis procedure, and countermeasures	3
6	Sniffing	Packet sniffing techniques and how to defend against sniffing	3
7	Social Engineering	Social Engineering techniques, identify theft, and social engineering countermeasures	3
8	DoS Attacks	DoS/DDoS attack techniques, botnets, DDoS attack tools, and DoS/DDoS countermeasures	3
9	Session Hijacking	Session hijacking techniques and countermeasures	3
10	Web Servers and Apps	Dierent types of webserver attacks, attack methodology, and countermeasures. Dierent types of web application attacks, web application hacking methodology, and	3

		countermeasures	
11	SQL Injection	SQL injection attacks and injection detection tools	3
12	Hacking WiFi and Bluetooth	Wireless Encryption, wireless hacking methodology, wireless hacking tools, and wi-fi security tools	3
13	Mobile Hacking and Security	Mobile platform attack vector, android vulnerabilities, jailbreaking iOS, windows phone 8 vulnerabilities, mobile security guidelines, and tools	3
14	IT Act 2008	Indian Information Technology Act 2000 and IT Amendment Act 2008	3
15	Pentesting Report	Various types of penetration testing, security audit, vulnerability assessment, and penetration testing roadmap	3
		Total number of Lectures	**45**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 Attendance (05 Marks), Assignment/Quiz/Mini-project (20 Marks)
Total	**100**

Project based learning: Student shall be a part of a group of 5-6 students and will be require to model and simulate real life enterprise system that will be under attack and the student will be supposed to detect, stop and mitigate the attack. The students are supposed to use advance network protect methods and analyze networks to mitigate attacks. Understanding how attacks work and mitigating them will enable their employability in information security 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)

Text Books

1.	Sean-Philip Oriyano, "Certified Ethical Hacker Version 9 - Study Guide", EXAM 312-50, SybexWiely, 2016.
2.	Georgia Weidman, "Penetration testing A Hands-On Introduction to Hacking", No Scratch Press, 2014.

Reference Books

3.	Raphaël Hertzog, Jim O'Gorman, and Mati AharoniKali, "Linux Revealed Mastering the Penetration Testing Distribution", OFFSEC Press, 2017
4.	Corey P. Schultz, Bob Percianccante, "Kali Linux Cook Book", Second edition, Packet Publishing, 2017.
5.	Lee Allen, TediHeriyanto, Shakeel Ali, "Kali Linux – Assuring Security by Penetration Testing, Packet Publishing, 2014.
6.	Dejey, Murugan, "Cyber Forensics", Oxford University Press, 2018.

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 and System Implementation	Codification Tools and Procedures, The knowledge Developer's Skill set, Quality assurance, Approaches to Logical testing and Acceptance testing, Issues related to deployment	6
6.	Knowledge	Transfer strategies, Inhibitors of Knowledge transfer, Role	5

	Transfer and Knowledge Sharing	of Internet in Knowledge Transfer	
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

Course Code	19B12CS412	**Semester** Even **(specify Odd/Even)**	**Semester** VIII **Session** 2020 -2021 **Month from** January to June
Course Name	Advanced Java Programming		
Credits	3	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr. Raju Pal (J28) andPrantik Biswas (J62)
	Teacher(s)	Dr. Raju Pal and Prantik Biswas
Prerequisites	1. Basic Knowledge of Programming & Data Structure. 2. Experience in object-oriented programming and knowledge of core Java concepts. 3. Experience of Programming Projects would help but is not mandatory.	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C434-1.1	Explain threads, synchronization and need of handling concurrency issues in applications.	Understand Level (Level 2)
C434-1.2	Apply synchronization utilities to solve concurrency issues in given problem.	Apply Level (Level 3)
C434-1.3	Build Java Programs using JDBC Connectivity with SQL Database.	Create Level (Level 6)
C434-1.4	Demonstrate and implementweb application using Java Servlets.	Understand Level (Level 2)
C434-1.5	Build Java Programs using Java Server Pages technology.	Create Level (Level 6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Course description and course outcome discussion, Overview of Java as a language.JVM internals, Java modules- J2SE, J2EE and J2ME.	6
2.	Concurrency in Java	Multithreading basic concepts- Threads, Java Thread Model,Thread Priorities, Thread Synchronization-I (synchronized, wait, notify) Producer/Consumer, Concurrency Thread Synchronization (Lock, Condition) Producer/Consumer problem, Thread Synchronization Utilities- Semaphore, Countdownlatch, CyclicBarrier, Thread Exceutors, Concurrent collection.	11
3.	Learning JDBC (Java Database Connectivity)	Introduction to JDBC- What is JDBC, Components of JDBC, JDBC Specification., JDBC Architecture, JDBC API-java.sql Package, JDBC API- javax.sql Package, JDBC Drivers & its Types, Type-1 Driver, Type-2 Driver, Type-3 Driver, Type-4 Driver, Comparison of all JDBC Drivers, Driver Interface , DriverManager Class, Connection Interface, Statement Interface, PreparedStatement Interface, ResultSet Interface, Implementing JDBC Processes with java.sql Package - Basic JDBC Steps, Prepare, send and execute SQL Query, basic CRUD operations with some examples.	9

4.	Knowing Java Servlets	Introduction to Servlet, Web App Architecture: high-level overview, Mini MVC Tutorial: hands-on MVC, Servlet: request and response, Web Application: attributes and listeners, Session management	9
5.	Java Server Pages	Introduction to JSP, Scriptless JSP, Custom tags library – JSTL, Custom tag development, Web app deployment, Web app security, Wrappers and Filters, Examples	8
6.	Applications	Building a complete Database Web Application using JDBC, JSP and Servlet.	3
		Total number of Lectures	**46**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Mini Project(6), Attendance(7),Internal assessment (5), Quiz(7))
Total	**100**

Project-based learning: In this course students learns various advanced concept in JAVA programming languages. Students select a problem statement of any real-world problem and create groups of 2 or 3 members and develop a web-based or window-based application. This enhances their problem-solving skills as well as programming skills which definitely impact on their employability.

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	Schildt, Herbert. Java: *The Complete Reference, Ninth Edition*. US: McGraw-Hill Osborne Media, 2017.
2	Goetz, B., Peierls, T., Lea, D., Bloch, J., Bowbeer, J., & Holmes, D. *Java concurrency in practice*. Pearson Education. 2017.
3	Basham, Bryan, Kathy Sierra, and Bert Bates. *Head First Servlets and JSP*. " O'Reilly Media, Inc.", 2016 re-print.
4	*Core and Advanced Java, Black Book, Ninth Edition*.Dreamtech press, 2018.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	16B1NHS832	Semester:**EVEN** (specify Odd/Even)	Semester 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	Developing and positioning a service in the market Applying the 4 Ps of Marketing to	8

	and service promotion	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

Course Code	18B12PH811	**Semester Even (specify Odd/Even)**	**Semester VIII Session** 2020 -2021 **Month from** January to June
Course Name	Photonics and Applications		
Credits	3	**Contact Hours**	3

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: VIII Session :**2020 -2021 **Month from: January to June**
Course Name	**Astrophysics**		
Credits	3	**Contact Hours**	3

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

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.	**6**

		Different models of universe. Specific attention to the ideas 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**VIII Sem	**Session :2020-21** **Month:** January **to** June
Subject Name	Integrated Optics and Applications (IOA)		
Credits	**03**	**Contact Hours**	**03**

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	Lithography. Etching, Metallization, Packaging, Nanoscale waveguide, micro-ring resonator, micro-disk resonator and applications.	4
6.	Photonic integrated	Integrated optical Devices; Design and Processing TechnologyPhotonic switches, PIC (Photonic Integrated	8

	circuits	Circuits), Photonic crystal cavity, plasmonic waveguide based devices, NRI (negative refractive index) Optics, perfect lens, near-field scanning optical microscope (NSOM) and Applications.	
			Total number of Lectures **40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (7 M), attendance (7 M), a mini-project in PBL mode (6 M) and internal assessment (5 M)]
Total	**100**

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

1.	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	18B12PH814	**Semester: EVEN**	**Semester:8th Session:**2020 -2021 Month from: January to June
CourseSubje	**Plasma Physics**		
Credits	3	**Contact Hours**	3
Faculty (Names)	***Coordinator (s)***	***Dr Anuraj Panwar***	
	Teacher (s)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
C402-34.1	Define terminology and concepts of plasma physics with various natural phenomena and engineering applications.	Remembering Level (C1)
C402-34.2	Summarize plasma and explain its electric, magnetic, dielectric and thermal properties.	Understand Level (C2)
C402-34.3	Develop magneto-hydrodynamic fluid and kinetic models to explain various phenomena taking place in homogeneous, isotropic and anisotropic plasma conditions.	Apply Level (C3)
C402-34.4	Analyze and formulate mathematical / analytical expressions for various nonlinear processes in plasmas.	Analyze Level (C4)
C402-34.5	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 (Plasma supported against gravity by magnetic field).	04
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 (10 M) and Cass performance (5 M)]
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 [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	8

		interpretation (Gene ontology and microarray 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 evaluation)	25 (Assignment, Quiz, Case study, Project based
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

Optimization Techniques (16B1NMA831)

Course Description

Course Code	16B1NMA831	**Semester** Even	**Semester** VIII **Session** 2020-21 **Month from** Jan - Jun 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 - Jun 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 - Jun 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.