DELHI TECHNOLOGICAL UNIVERSITY
SCHEME OF TEACHING AND EVALUATION
MASTER OF TECHNOLOGY IN INFORMATION TECHNOLOGY(ISY)

The following alphanumeric coding scheme has been adopted
Core Courses XXXYMN
Elective Courses XXXYCMN

XXX abbreviates a particular M. Tech. program, Y – (5 for M. Tech. 1 st year, 6 for M. Tech. 2 nd year),
C – credit of the course (4/3/2),
MN – Subject code (Odd number for odd semester and even number for even semester courses

Semester-I

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	Total Credits
Group A	1	ISY501	Linear Algebra and Probability	Core	4	3	0	2	15	25	20	40	-	**17**
Group A	2	ISY503	Data Structure and Algorithm	Core	4	3	0	2	15	25	20	40	-	
Group B	3	ISY5401/5403/……………	Elective 1	Elective	4	3	0	2	15	25	20	40	-	
Group B	4	ISY5301/5303/……………	Elective 2	Elective	3	3/2	0	0/2	20/15	0/25	30/20	50/40	-	
Group B	5	ISY5201/5203/…………………/ UEC5201/5203/……………	Elective 3/University Elective I	Elective	2	2	0	0	20	-	30	50	-	

Semester-II

	S.No.	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	Total Credits
Group	1	ISY502	High Performance Computing system	Core	4	3	0	2	15	25	20	40	-	**17**

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	Total Credits
	2	ISY504	Computer Network and Application	Core	4	3	0	2	15	25	20	40	-	
Group D	3	ISY5402/5404 /…………	Elective 4	Elective	4	3	0	2	15	25	20	40	-	
	4	ISY5302/5304 /…………	Elective 5	Elective	3	3/2	0	0/2	20/15	0/25	30/20	50/40	-	
	5	ISY5202/5204 /…………/ UEC5202/5204/…………	Elective6/ University Elective II	Elective	2	2/0	0	0/4	20/0	0/30	30/0	50/0	0/70	

Semester-III

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	Total Credits
	Track 1													
	1	ISY651	Research Project	Core	12	0	0	12	0	-	0	100	0	
	Track 2													
Group E	1	ISY601	Major Project I	Core	3						40	60		
	2	ISY6401/6403/……………	Elective 7	Elective	4	3	0	2	15	25	20	40	-	
	3	ISY6301/6303/……………	Elective 8	Elective	3	3/2	0	0/2	20/15	0/25	30/20	50/40	-	
	4	ISY6201/6203/……………	Elective 9	Elective	2	0	0	2	0	100	0	0	-	

Semester-IV

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	Total Credits
	Track 1													12
Group F	1	ISY652	Research Project	Core	12	0	0	12	0	-	0	100	0	
	Track 2													
	1	ISY602	Major Project II	Core	12						40	60		

List of Elective Courses

LIST OF ELECTIVES :

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE
Elective 1	1	ISY5401	Advanced Computer Graphics	Elective	4	3	0	2	15	25	20	40	-
	2	ISY5403	Artificial Neural network		4	3	0	2	15	25	20	40	-
	3	ISY5405	Big Data Analytics		4	3	0	2	15	25	20	40	-
	4	ISY5407	Data System Implementation		4	3	0	2	15	25	20	40	-
	5	ISY5409	Image Analysis		4	3	0	2	15	25	20	40	-
	6	ISY5411	Privacy and Security in Online Social Media		4	3	0	2	15	25	20	40	-
	7	ISY5413	Embedded System		4	3	0	2	15	25	20	40	-
	8	ISY5415	Digital and Cyber Forensics		4	3	0	2	15	25	20	40	-

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE
Elective 2	1	ISY5301	Artificial Intelligence	Elective	3	3	0	0	20	0	30	50	-
	2	ISY5303	Pattern analysis		3	2	0	2	15	25	20	40	-
	3	ISY5305	Business Intelligence and data warehousing		3	3	0	0	20	0	30	50	-
	4	ISY5307	Edge computing		3	3	0	0	20	0	30	50	-
	5	ISY5309	Financial data analytics		3	3	0	0	20	0	30	50	-
	6	ISY5311	Foundation to computer security		3	3	0	0	20	0	30	50	-
	7	ISY5313	Information Audit		3	3	0	0	20	0	30	50	-
	8	ISY5315	Information Integration and Data Analytics		3	2	0	2	15	25	20	40	-
	9	ISY5317	Linear Optimization		3	3	0	0	20	0	30	50	-
	10	ISY5319	Management Information System		3	3	0	0	20	0	30	50	-

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE
	11	ISY5321	Multi agent system		3	3	0	0	20	0	30	50	-
	12	ISY5323	Privacy in location based services		3	3	0	0	20	0	30	50	-
	13	ISY5325	Probabilistic Graphical Models		3	2	0	2	15	25	20	40	-
	14	ISY5327	Software Engineering		3	2	0	2	15	25	20	40	-
	15	ISY5329	Theory of modern cryptography		3	2	0	2	15	25	20	40	-
	S.No	**Course Code**	**Course Name**	**Type/Area**	**Cr**	**L**	**T**	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
Elective 3	1	ISY5201	SEMINAR	Elective	2	0	0	2	-	100	-	-	-
	2	ISY5203	Latest Research in information technology		2	2	0	0	20	0	30	50	-
	3	ISY5205	Optimization tools		2	2	0	0	20	0	30	50	-
	S.No	**Course Code**	**Course Name**	**Type/Area**	**Cr**	**L**	**T**	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
Elective 4	1	ISY5402	Advanced operating system	Elective	4	3	0	2	15	25	20	40	-
	2	ISY5404	Cloud computing and virtualization		4	3	0	2	15	25	20	40	-
	3	ISY5406	Foundation of information theory and coding		4	3	0	2	15	25	20	40	-
	4	ISY5408	Internet security and privacy		4	3	0	2	15	25	20	40	-
	5	ISY5410	Machine learning		4	3	0	2	15	25	20	40	-
	6	ISY5412	Mobile application		4	3	0	2	15	25	20	40	-
	7	ISY5414	Semantic web		4	3	0	2	15	25	20	40	-
	8	ISY5416	Smart sensing for internet of things		4	3	0	2	15	25	20	40	-
	S.No	**Course Code**	**Course Name**	**Type/Area**	**Cr**	**L**	**T**	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**
Elective 5	1	ISY5302	MINOR PROJECT	Elective	3	0	0	-	-	40	-	-	60
	2	ISY5304	Advanced computer vision		3	3	0	0	20	0	30	50	-
	3	ISY5306	ADhoc wireless network		3	3	0	0	20	0	30	50	-

	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	
	4	ISY5308	Advanced topic in mobile computing		3	3	0	0	20	0	30	50	-	
	5	ISY5310	Applied cryptography		3	3	0	0	20	0	30	50	-	
	6	ISY5312	Collaborative filtering		3	3	0	0	20	0	30	50	-	
	7	ISY5314	Cyber security and law		3	3	0	0	20	0	30	50	-	
	8	ISY5316	Deep learning		3	2	0	2	15	25	20	40	-	
	9	ISY5318	Digital watermarking and Steganalysis		3	3	0	0	20	0	30	50	-	
	10	ISY5320	Distributed Data Mining		3	3	0	0	20	0	30	50	-	
	11	ISY5322	Graph Theory		3	3	0	0	20	0	30	50	-	
	12	ISY5324	Network anonymity and privacy		3	3	0	0	20	0	30	50	-	
	13	ISY5326	Topics in computer security		3	3	0	0	20	0	30	50	-	
	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	
Elective 6	1	ISY5202	Research problem formulation	Elective	2	0	0	4	-	30	-	-	70	
	2	ISY5204	Laboratory on advanced topics		2	0	0	4	-	30	-	-	70	
	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	
Elective 7	1	ISY6401	Biometrics Systems	Elective	4	3	0	2	15	25	20	40	-	
	2	ISY6403	Natural Language Processing		4	3	0	2	15	25	20	40	-	
	3	ISY6405	Network security		4	3	0	2	15	25	20	40	-	
	4	ISY6407	Robotics		4	3	0	2	15	25	20	40	-	
	5	ISY6409	Ethical Hacking		4	3	0	2	15	25	20	40	-	
	6	ISY6411	Secure Coding		4	3	0	2	15	25	20	40	-	
	7	ISY6413	Mobile Computing.		4	3	0	2	15	25	20	40	-	
	S.No	Course Code	Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	
E 1	1	ISY6301	Bioinformatics	Elective	3	3	0	0	20	0	30	50	-	

	S.No		Course Name	Type/Area	Cr	L	T	P	CWS	PRS	MTE	ETE	PRE	
	2	ISY6303	Data Mining		3	3	0	0	20	0	30	50	-	
	3	ISY6305	Data Warehousing		3	3	0	0	20	0	30	50	-	
	4	ISY6307	Dev-Ops		3	3	0	0	20	0	30	50	-	
	5	ISY6309	Evolutionary computing		3	3	0	0	20	0	30	50	-	
	6	ISY6311	GPU computing		3	3	0	0	20	0	30	50	-	
	7	ISY6313	Information Retrieval		3	2	0	2	15	25	20	40	-	
	8	ISY6315	Intelligent system and interface		3	2	0	2	15	25	20	40	-	
	9	ISY6317	Introduction to cognitive science		3	3	0	0	15	25	20	40	-	
	10	ISY6319	Introduction to spatial computing		3	2	0	2	15	25	20	40	-	
	11	ISY6321	Malware Analysis		3	2	0	2	15	25	20	40	-	
	12	ISY6323	Real time operating system		3	2	0	2	15	25	20	40	-	
	13	ISY6325	Soft computing		3	3	0	0	20	0	30	50	-	
	14	ISY6327	Statistical machine learning		3	2	0	2	15	25	20	40	-	
	15	ISY6329	Web intelligence and big data analytics		3	3	0	0	20	0	30	50	-	
	16	ISY6331	Quantum computing		3	3	0	0	20	0	30	50	-	
	17	ISY6333	Intrusion detection and prevention		3	3	0	0	20	0	30	50	-	
	S.No		**Course Name**	**Type/Area**	**Cr**	**L**	**T**	**P**	**CWS**	**PRS**	**MTE**	**ETE**	**PRE**	
Elective 9	18	ISY6201	Open Area Research Seminar	Elective	2	0	0	2	-	100	-	-	-	

SEMESTER I
Courses
ISY501 Linear Algebra and Probability Introduction to Linear Algebra and Matrices: Matrices and Linear Transformations, Rank, Determinant, trace of a matrix. Solving simultaneous equations using matrices,Gaussian Elimination, Overdetermined and underdetermine systems, Inverse, pseudo inverse. Condition number of a matrix, eigenvalues, eigenvectors, singular values, singular vectors. Orthogonality: Inner Product, Orthogonality, Gram-Schmidt Orthogonalization, Vector and Matrix Norms - Applications to optimization problems and graph theory, machine learning.

Introduction to Random Variables and Random Vectors: Discrete and continuous random variables, random vectors. Transformation of continuous random variables and vectors by deterministic functions. Density functions of transformed continuous random variables.

Introduction to Random Processes: Statistical averages, ensemble and time averages. Random process, Bernoulli random process, binomial process. Weak and strict sense stationarity of a random process.

Estimation of parameters from data: method of moments, method of maximum likelihood. Tests of fit: Chi-Squared, Student-t test. Cramer-Rao bound on estimators. Comparison of two different distributions of the same random variable/vector..

Suggested Books:

1. Gilbert Strang , Linear Algebra and Its Applications - Fourth Edition- Cengage Learning, 2006
2. Papoulis and Unnikrishnan Probability, Random Variables and Stochastic Processes, Fourth Edition, 2002, available in paperback
3. W B Davenport, Probability and Random Processes - an introduction for application scientists and engineers, McGraw HilL,1970
4. Probability and Statistics with Reliability, Queuing, and Computer Science Applications - Kishore S Trivedi, PHI, July 2016
5. Kenneth Hoffman and Ray Kunze Linear Algebra (second edition), Prentice Hall India, 2013
6. Cheney and Kincaid Linear Algebra (Second Edition) , Jones and Bartlett learning, 2014"

ISY503 Data Structure and Algorithm
Introduction: Introduction to Algorithmic, Complexity- Time-Space Trade off. Introduction to C programming through Arrays, Stacks, Queues and Linked lists.
Trees: Basic Terminology, Traversals, Binary search trees, optimal and average BST's. 2-4 trees, Applications of Binary Search Trees, Complete Binary trees, Extended binary trees.
Introduction to algorithms: Concept of algorithmic efficiency, run time analysis of algorithms, Asymptotic Notations. Growth of Functions, Master's Theorem,
Searching and Searching: Linear Search, Binary search, Insertion Sort, Quick sort, Merge sort, Heap sort, Radix Sort.
Graphs: Terminology and Representations, Graphs & Multi-graphs, Directed Graphs, Representation of graphs, Breadth first search and connected components. Depth first search in directed and undirected graphs and strongly connected components.
Spanning trees: Prim's and Kruskal's algorithm, union-find data structure. Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path. Dynamic programming: Principles of dynamic programming. Applications: Matrix multiplication, Travelling salesman problem.
Suggested Books:

1. Aaron M. Tenenbaum, Data Structures Using C, Pearson Education India, 1990.
2. T .H .Cormen, C .E .Leiserson, R .L . Rivest "Introduction to Algorithms", 3rd Ed., PHI, 1956
3. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication R.L. Kruse, B.P. Leary, C.L. Tondo, 2011

Elective 1

ISY5401 Advanced Computer graphics
Discrete models. Visibility: zBuffer, Binary Space Partitioning, Volume rendering: Global Illumination and Rendering Equation ,ray-tracing, splatting, texture based, Bidirectional Ray Tracing, Monte-carlo Ray Tracing.

Iso surface reconstruction. Transformation of discrete volume data to polygonal representations. Radiosity: Full Matrix Representation, Faster Methods Mesh topologies and mesh simplification.

Point Based Representation, Global Illumination for Point Based Representations, Image Based Rendering, Environmental Matting, GPU programming, Modelling curves and surfaces.

Visualization techniques: Visual aspects based on perception. Particle rendering. Algorithms for programmable graphics hardware), Applied visualization.

Suggested Books:

1. Edward Angel.,Interactive Computer Graphics - A Top-Down Approach Using OpenGL (5/e), Pearson; 6 edition (31 March 2011)
2. F. S. Hill Jr. and S. M. Kelley, Computer Graphics using OpenGL (3/e), Pearson; 3 edition (20 December 2006).
3. D. D. Hearn and M. P. Baker, Computer Graphics with OpenGL (3/e)) ,Hearn, Baker & Carithers 2013.

ISY5403Artificial Neural network

Introduction, history, structure and function of single neuron, neural net architectures, neural learning, use of neural networks.Supervised learning, single layer networks, perceptions, linear separability, perceptions training algorithm, guarantees of success, modifications.

Multiclass networks-I, multilevel discrimination, preliminaries, back propagation, setting parameter values, theoretical results.Accelerating learning process. Accelerating learning process, application, mandaline, adaptive multilayer networks.

Prediction networks, radial basis functions, polynomial networks, regularization, unsupervised learning, winner take all networks,Learning vector quantizing Learning vector quantizing, counter propagation networks, adaptive resonance theorem, toplogically organized networks, distance based learning, neo-cognition.

Associative models, hop field networks, brain state networks, Boltzmann machines, hetero associations.Optimization using hop filed networks, simulated annealing, random search, evolutionary computation.

Suggested Books:

1. S.Russel, P.Norvig,,Artificial Intelligence – A Modern Approach. Second Edition, PHI/ Pearson Education, November 5, 2011.
2. B. Yagna Narayana, Artificial Neural Networks, PHI (30 August 2004)
3. E.Rich and K.Knight. Artificial Intelligence , 2nd Edition,McGraw-Hill Education,2009.

ISY5405Big Data Analytics

Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce.

Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands , Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper

Data Analytics with R:- Machine Learning : Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

Suggested Books:

1. C. J. Date Addison-Wesley , Introduction to Database Systems (Links to an external site.)Links to an external site.. 8th Ed. Publisher: Addison-Wesley; 8 edition (August 1, 2003) ISBN-10: 0321197844/ ISBN-13: 978-0321197849.
2. R. A. Mata-Toledo and P. Cushman ,Fundamentals of SQL Programming (Links to an external site.)Links to an external site.. Schaum's Outline Series. McGraw-Hill (2000).
3. H. Garcia-Molina and et al. Prentice Hall , Database Systems the Complete Book (Links to an external site.)Links to an external site; 2ndEdition (June 15, 2008). ISBN-10: 0131873253 / ISBN-13: 978- 013187325 (Links to an external site.)Links to an external site.
4. R. Elmasri and S. Navathe . Addison-Wesley ,Fundamentals of Database Systems (Links to an external site.)Links to an external site. Addison-Wesley; 6 edition (April 9, 2010) ISBN-10: 0136086209 / ISBN-13: 978-0136086208

ISY5407 Data System Implementation
Relational Databases Overview: Relational data model concepts, integrity constraints, Keys domain constraints, referential integrity, assertions, triggers, foreign key relational algebra, relational calculus, domain and tuple calculus, SQL data definition queries and updates in SQL
Data Base Design: Functional dependencies, normal forms, 1NF, 2NF, 3NF and BCNF, multi-valued dependencies fourth normal form, join dependencies and fifth normal form. Inclusion dependencies, lossless join decompositions, normalization ,
File Organization: Indexing and Hashing Overview of file organization techniques, Indexing and Hashing- Basic concepts, Static Hashing, Dynamic Hashing, Ordered indices, Multi-level indexes, B-Tree index files, B+- Tree index files, Buffer management
Transaction processing concepts: Transaction processing system, schedule and recoverability, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recovery from transaction failures, deadlock handling. Concurrency Control Techniques.
Query Evaluation: SQL queries, Relational Algebra and Equivalence Rules, Tuple-based Evaluation
Cost-based Query Optimisation: Join Algorithms, Cost of an Evaluation Plan, Search Space Exploration, Selection of Evaluation Plan.
Suggested Books:

1. C. J. Date Addison , Introduction to Database Systems (Links to an external site.)Links to an external site, Wesley. 8th Ed. Publisher: Addison-Wesley; 8 edition (August 1, 2003) ISBN-10: 0321197844/ ISBN-13: 978-0321197849.
2. R. A. Mata-Toledo and P. Cushman , Fundamentals of SQL Programming (Links to an external site.)Links to an external site. Schaum's Outline Series. McGraw-Hill (2000).
3. H. Garcia-Molina and et al , Database Systems the Complete Book (Links to an external site.)Links to an external site. Prentice Hall; 2ndEdition (June 15, 2008). ISBN-10: 0131873253 / ISBN-13: 978- 013187325 (Links to an external site.)Links to an external site.
4. Fundamentals of Database Systems (Links to an external site.)Links to an external site. by R. Elmasri and S. Navathe . Addison-Wesley; 6 edition (April 9, 2010) ISBN-10: 0136086209 / ISBN-13: 978-0136086208

ISY5409 Image Analysis

Fundamental steps in DIP, concept of visual information, image formation model, image sampling and quantization, digital image representation, spatial and gray level resolution, relationship between pixels, application of image processing system.

Introduction to Multidimensional signals and systems, 2D-Signals, 2D systems, classification of 2D system, 2D convolution, 2D Z-transform, Image Transform: 2DDFT, discrete cosine, discrete sine, Haar, Walsh, Hadamard, Slant, KL, SVD, Hough, Radon, Ridgelet.

Image enhancement; Spatial domain: linear transformation, image negative, grey level shifting, non-linear transformation, logarithmic transformation, exponential transformation, grey level slicing, bit plane slicing, image averaging, mask processing, histogram manipulations.

Image Restoration :Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Image Segmentation :Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation.

Suggested Books:

1. Rafael C. Gonzalez, Richard Eugene Woods "Digital Image Processing" 3rd Edition, 2008
2. Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002
3. Kenneth R. Castleman,Digital Image Processing Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.

ISY5411Privacy and Security in Online Social Media

Privacy and Security in Online Social Media, Online Social Networks, security services(authentication, availability, integrity, confidentiality), Recognizing Your Digital Friends, Encryption for Peer-to-Peer Social Networks, Understanding User Privacy Perceptions, Cybercrime, Privacy Usable security, Trust Management and Issues
Data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs, Collecting data from Online Social Media.
Trust, credibility, and reputations in social systems, Online social Media and Policing, Information privacy disclosure, revelation and its effects in OSM and online social networks
Spam, Phishing and identity theft in OSM & Identifying fraudulent entities in online social networks, Crowdsourcing and Ethics, Interdisciplinary Impact Analysis of Privacy in Social Networks, Legal and policy issues in privacy and security, Anonymity in a networked world, e crime, identity resolution.
Web portal, Credibility scoring Social network graph, bitcoin system, android security.

Suggested Books:

1. Gavin Bell ,Building Social Web Applications, Publisher: Shroff/O'Reilly; First edition, 26 September 2009
2. Toby Segaran ,Programming Collective Intelligence: Building Smart Web 2.0 Applications,(Author), Publisher: O'Reilly Media, 16 August 2007.
3. Altshuler, Y. and Elovici, Security and Privacy in Social Networks, Publisher: Springer,2013.

ISY5413 Embedded System

Introduction: fundamentals of embedded systems, embedded system architecture, classifications of embedded systems, fundamentals of embedded processor and microcontrollers, embedded software in a system, examples of embedded systems. CISC vs. RISC.

The 8051 Architecture: 8051 microcontrollers, I/O Ports and Circuits, Timers Counters, Serial Interface, Interrupts. 8051 Assembly Language Programming: Registers in the 8051, 8051 Assembly Assembling and Running an 8051 Programs.

Programming in C: Fundamental concepts of C programming, Examples on different concepts, Control structure, Functions, Storage classes, Pointers, structure, union, object-oriented programming, Assembly language intro, memory organization.

Assembly language programming: Instruction set and Programming, Immediate Addressing, Register Addressing Direct Addressing, Indirect Addressing, Indexed Addressing.

I/O Programming: PIC I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and waveform generation, I/O programming.

PIC Microcontrollers: Introduction PIC Microcontroller, PIC16F877A Architecture and Instruction Set, I/O Ports and SFRs, Interrupts, Timers.

Serial Communication Protocols ,Introduction to Timers & Counters, Difference between Timer and Counter.

Suggested Books
1. Shibu K. V. (TMH),Introduction to Embedded Systems, McGraw Hill Education (15 June 2009)
2. F. Vahid (John Wiley),Embedded System Design – A unified hardware and software introduction, John Wiley & Sons; ISBN: 0471386782. Copyright (c) 2002.
3. chuck helebuyck ,Programming PIC microcontrollers with PIC basic; 1st Edition (later printing) edition (December 6, 2002).

ISY5415DIGITAL AND CYBER FORENSICS

Introduction to digitalforensics, Digital evidence and investigations, Real life examples of digital crime, Challenging aspects of digital forensics, introduction to intellectual property rights and professional ethics. Computer crime investigation process: The Investigation process, preparing a computer investigation..

Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations). Digital forensics of image, audio etc files.

Live Data collection and investigating windows environment: windows Registry analysis, Gathering Tools to create a response toolkit (Built in tools like netstat , cmd.exe , nbtstat , arp , md5sum ,regdmpetc and tools available as freeware like Fport , Pslistetc) ,

Live Data collection and investigating UNIX environment Forensic tools and report generation: Recovery of Deleted files in windows, Analyzing network traffic, sniffers, Ethical Hacking, Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap ,Netscanetc .Password recovery, Mobile forensic tools

Suggested Books:

1 Mandia, Kevin, Prosise, Chris, and Pepe, Matt," Incident Response &Computer Forensics", McGraw-Hill, July 17, 2003
2. Beebe, Nicole Lang, and Jan Guynes Clark, "A Hierarchical, Objectives-Based Framework for the Digital Investigations Process June 2005.
3. Nelson, Bill, Amelia Phillips, Frank Enfinger, and Christopher Steuart," Guide to Computer Forensics and Investigations", Thompson Course Technology, Boston, 2006

Elective 2

ISY5301Artificial Intelligence

Introduction: AI Problems, Task Domains of AI, AI Techniques: search knowledge, abstraction. Introduction to Intelligent program and Intelligent agents.
Problem Solving: Basic Problem-solving Method: state space search, problem characteristics, Production systems characteristics, issues in design of Intelligent search algorithm.
Heuristic search Techniques: Hill climbing techniques, Best First search, A* Search, Problem Reduction: AO* Search, Constraint Satisfaction, Means-End Analysis.
Game Playing: Game Tree, Searching procedure Minimax, alpha-beta pruning
Knowledge Representation: Knowledge Representation issues. Knowledge Representation using Predicate Logic: Unification, resolution.
Rule based Systems: Forward versus backward reasoning, conflict resolution. Structured Knowledge Representation: Semantic Nets, Frames, conceptual dependency, scripts.
Programming Languages: Fundamental and concepts of Programming languages like Prolog or Lisp. Reasoning: Handling uncertainty Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. Learning Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.
Applications: Expert Systems: Architecture, Domain Knowledge, Knowledge Acquisition, Case Studies: MYCIN, RI, Natural language Processing: Syntactic, Semantic and Pragmatic Analysis, Robotics etc.
Suggested Books:

1. E. Rich and K. Knig, Artificial Intelligence, E. Rich and K. Knight, TMH, 2nd ed.(ISBN- 978-0070522633), February 28, 1991
2. N.J. Nilsson, Principles of AI, Narosa Publ. House, (ISBN: 978-81-85198-29-3), 17 April 1998
3. KM Fu ,Neural Networks in Computer Intelligence", McGraw Hill (ISBN- 978-0136042594), 1 February 1994.
4. George F. Luger , Artificial Intelligence: Structures and Strategies for Complex Problem Solving (5th Edition), 2005. Addison-Wesley. (ISBN: 978-8131723272)

ISY5303 Pattern analysis

Introduction to Pattern Analysis, Types of patterns, Feature, feature vectors, feature space and classifiers. Pattern recognition systems and its applications such as web based patterns.
Object Representation: Chain codes, Polygon Approximations, Signatures, Boundary segments, skeletons. Boundary Descriptors: Fourier Descriptor and Statistical Moments. Regional Descriptors: Topological descriptor, texture, moments of 2-D functions.
Maximum-likelihood and Bayesian parameter estimation: Maximum Likelihood estimation: Gaussian case, Maximum a Posteriori estimation, Bayesian estimation.
Bayesian decision theory: Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and Discriminant functions, Discrete features, Missing and noisy features.
Clustering, fundamentals of clustering, similarity/ dissimilarity, measures, clustering criteria, different distance functions: Bhattacharya Distance, scatter matrices, minimum cluster distance criteria, K-mean algorithm, K-medoids, DBSCAN, dataset visualization, unique clustering, no existence of clusters.
Neural networks as a feature extractor and classifier, single layer perceptron, multi-layer perceptron, training set, test set, generalization, normalization, and evaluation, evaluation Parameters-Accuracy, confusion matrix, Precision, Recall, ROC, F-measure, specificity, sensitivity.

Suggested Books:

1. Rafael C. Gonzalez, Richard Eugene Woods "Digital Image Processing" 3rd Edition, 2008
2. S.Theodoridis, K. Koutroumbas, "Pattern Recognition", IInd Edition, Elsevier, 2008
3. Richard O. Duda, Peter E. Hart, David G. Stork , "Pattern Classification", IInd edition, Wiley, 1973.

ISY5305 Business Intelligence and data warehousing

Introduction: Business Intelligence, Data Warehouses, Data mining, Pivot Tables, Relational Database review, Database Normalization, normal forms, DE normalization of tables, SQL, Data Warehousing fundamentals
Modelling the data warehouse: Data sources, operational data store, data marts, Characteristics and key figures , Creating InfoObjects, Building InfoCubes
Data Mining : Statistical techniques in data mining , Preparing data for mining, Association analysis, market basket analysis, Clustering , Classification, Regression, Decisions Trees, Building analytics applications, Mobile analytics.
Data Extraction, Transformation and Loading (ETL) in SAP BW Extraction from data sources such as SAP ERP, Flat file extraction, Defining and using Persistent staging areas PSA.
Introduction to Business Intelligence with Business Objects Analysis: Navigating in reports, Designing queries in the Query Designer, Using InfoProviders and InfoObjects for queries, Calculated and restricted key,
Query properties and navigation , Exceptions and Conditions.Front end visualization of business intelligence, Designing Dashboards, Designing reports, Business Objects Web Intelligence, Crystal Reports.

Suggested Books:

1. R. and Ross ,The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling Kimball, M.Second Edition. John Wiley & Sons, 2006.
2. Richard O. Duda, Peter E. Hart, David G. Stork , "Pattern Classification", IInd edition, Wiley, 1973
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning", 15 February 2010

ISY5307 Edge computing

Introduction: What is IoT, Fog computing, Edge computing, Key techniques of edge computing, Importance of edge computing, Edge computing systems, Edge architecture.

Environment and Application: Cloud edge environment, Distributed Collaborative Execution on the Edges and Application on AMBER alert: Application design, Implementation details.

Challenges and Opportunities in Edge Computing: Programmability, Naming,Data abstraction, Service management, Privacy, Security, Application Distribution, Scheduling strategies,Business models, optimization metrics.

Existing Edge Computing Tools:Role of edge computing, virtualization, virtual machine, resourcemanagement, developing platforms for edge computing, edge analytics, development tools and platforms.

Suggested Books:

1. Jie Cao, Quan Zhang, Weisong Shi ,Edge Computing: A Primer, SpringerBriefs in Computer Science, 2018.
2. Gerardus Blokdyk , Edge Computing: Complete Self-assessment Guide, 2017.
3. Fadi Al-Turjman ,Edge computing: From Hype to Reality, Springer,2018.
4. Shijun Liu, BedirTekinerdogan, Mikio Aoyama, Liang-Jie Zhang, Edge Computing – EDGE 2018: Second International Conference, Held as Part of the Services Conference Federation, SCF 2018,

ISY5309 Financial data analytics

Introduction: The study of Language, Introduction to NLP, Regular Expression, Finite State Automata, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Linguistic Background.

Financial reporting & Analysis: slicing & dicing, queries, reports, financial statement analysis, Banking analytics.

Data Visualization: Charts, Dashboards & Advanced Visualization Techniques in Accounting & Finance

Introduction to Audit Analytics, data mining and fraud, Computational Intelligence techniques such as logistic regression, neural networks, fuzzy logic and genetic algorithm for Credit Scoring, Cash flows & Fraud Detection

Descriptive Models for Accounting Decision Making, Predictive Accounting Models including Predictive Models with Non-Discrete Variables and Outcomes, Monte Carlo simulations and other stochastic modeling for budgeting, credit scoring, other accounting metrics with non-discrete inputs and outputs

Interpretation & Evaluation of results for Internal & External Reporting and Audit, Problem solving for complex accounting and business-related problems using appropriate data modeling tools.

Suggested Books:
1. Tsay, Ruey S. An introduction to analysis of financial data with R. John Wiley & Sons, 2014.
2. Alexander, Carol. Market models: A guide to financial data analysis. John Wiley & Sons, 2001.
3. Campbell, John Y., Andrew W. Lo, and Archie Craig MacKinlay. The econometrics of financial markets. Vol. 2. Princeton, NJ: princeton University press, 1997.

ISY5311 Foundation to computer security

Introduction: Basic concepts: threats, vulnerabilities, controls; risk; confidentiality, integrity, availability; security policies, security mechanisms; assurance; prevention, detection, deterrence.

Basic cryptography: Basic cryptographic terms, Historical background, Symmetric crypto primitives, Modes of operation, Cryptographic hash functions, Asymmetric crypto primitives.

Program security: Malicious code: viruses, Trojan horses, worms.Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation Software development controls, Testing techniques.

Trusted operating systems: Assurance; trust, Design principles, Evaluation criteria, Evaluation process

Database management systems security: Database integrity, Database secrecy, Inference control, Multilevel databases.

Network security: Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks.

Suggested Books:
1. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall, 6 March 2013
2. Charles P. Pfleeger, "Security in Computing", Prentice Hall, February 5, 2015.
3. William R. Cheswick and Steven M. Bellovin, "Firewalls and Internet Security: Repelling the Wily Hacker", Addison-Wesley, March 6, 2003.

ISY5313 Information Audit

Types of Audit - general audits and specific audits; types of general audits and types of specific audits; continuous, periodical and balance sheet audits, concept and objectives of internal audit.

The Internal Auditor - qualifications for an internal auditor; need for independent functioning; relationship with the external auditor; code of ethics; qualities required in internal audit personnel; role of internal auditor as a management member.

Internal Controls on the Accounting Function -Internal control considerations, cash functions like Cash and bank; Salaries and employee benefits; Purchases and creditors; Sales and debtors; Inventories; Fixed assets and investments and other accounting activity.

Evaluation of Internal Control Systems - objectives of evaluation; steps in evaluation; techniques of evaluation; flowcharts and internal control questionnaires; internal control schemes.

Information Audit in an EDP Environment - audit planning in computerised environment; challenges for the auditor in an IT environment, internal audit practices in computerised systems, Computer assisted audit techniques (CAATs).

Suggested Books:
1. Gallegos, F., Manson D. P., Gonzales, C., Senft, S., Information Technology Control and Audit, Auerbach, 2004.
2. CISA Review Manual, ISACA publications. 2. Hunton, J.E., Bryant, S.M., and Bagranoff, N.A., Core Concepts of Information Technology Auditing, John Wiley & Sons, 2004.Champlain, J.J., Auditing Information Systems, John Wiley, 2003.

ISY5315 Information Integration and Data Analytics

Introduction to data analytics, Probability distributions, Model fitting, Descriptive statistics, Inferential Statistics through hypothesis tests

Supervised learning: Linear and logistic Regression, Lasso regression, ANNOVA, Linear and quadratic discriminant analysis, K-nearest neighbors, neural networks, deep learning, support vector machines, decision trees, random forest

Unsupervised learning: Introduction to Clustering mechanisms, K-means clustering, Hierarchical clustering, Unsupervised model fitting, Associative rule mining, Anomaly detection

Overview of information integration, integrated views and schema mapping, impact of increasing the number of data sources, data compression, record linking, data exchange, data fusion, data cleaning, source modeling, and information extraction

Retrieving data from Big data management systems, processing on Hadoop and Spark, Integration for Multi-channel customer analytics, Case studies, Data integration tools-Splunk and Datameer, Semantic web (RDF, OWL, SPARQL), linked data and services, mash-ups

Prescriptive Analytics: Creating data for analytics through designed experiments, creating data for analytics through Active learning, Creating data for analytics through Reinforcement learning.

Suggested Books:

1. Hastie, Trevor, et al. The elements of statistical learning. Vol. 2. No. 1. New York: springer, 2009.
2. Doan, AnHai, Alon Halevy, and Zachary Ives. Principles of data integration. Elsevier, 2012 Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010.

ISY5317 Linear Optimization

Introduction and Modeling with Linear Programming: Variants of the linear programming problem, Examples of linear programming problems, Piecewise linear convex objective functions, Graphical representation and solution, Linear algebra background and notation, Algorithms and operation counts.

Geometry of linear programming: Polyhedra and convex sets, Extreme points, vertices, and basic feasible solutions, Polyhedra in standard form, Degeneracy, Existence of extreme points, Optimality of extreme points, Representation of bounded polyhedral, Projections of polyhedral: Fourier-Motzkin elimination.

The Simplex Method: Optimality conditions, Development of the simplex method, Implementations of the simplex method, Anti-cycling: lexicography and Bland's rule, Finding an initial basic feasible solution, Column geometry and the simplex method, Computational efficiency of the simplex method.

Duality theory: The dual problem, The duality theorem, Optimal dual variables as marginal costs, Standard form problems and the dual simplex method, Farkas' lemma and linear inequalities, From separating hyperplanes to duality, Cones and extreme rays, Representation of polyhedral, General linear programming duality.

Sensitivity Analysis: Local sensitivity analysis, Global dependence on the right-hand side vector, The set of all dual optimal solutions, Global dependence on the cost vector, Parametric programming.

The art in linear optimization: Modelling languages for linear optimization, Linear optimization libraries and general observations, The fleet assignment problem, The air traffic flow management problem, The job shop scheduling problem.

Suggested Books:

1. Dimitris Bertsimas and John N. Tsitsiklis ,"Introduction to Linear Optimization", Athena Scientific (1 February 1997).
2. R. Fletcher, Practical Methods of Optimization, 2nd Edn., John Wiley, 1987.
3. D. G. Luenberger, Linear and Nonlinear Programming, 2nd Edn., Kluwer, 2003.
4. N. S. Kambo, Mathematical Programming Techniques, East West Press, 1997.
5. M. S. Bazarra, J.J. Jarvis, and H.D. Sherali, Linear Programming and Network Flows, 2nd Edn., John Wiley, 1990. (also available as WSE (2003) edition).

ISY5319 Management Information System

Introduction to Management Information Systems, History of MIS, Impact of MIS, Role and Importance, MIS Categories, Managers and Activities in IS, Types of Computers Used by Organizations in Setting up MIS, Hardware support for MIS, The Decision-Making Process, System Approach to Problem Solving, The Structure of Management Information System

Types of Management Systems, Concepts of Management Organization, Differences between planning and control information, Systems Analysis, Systems Design

MIS Planning and Development, Planning, development, Business Process Re – Engineering, Improving a process in BPR, Object Oriented methodology, Strategic Level Planning, Operational Level Planning, Economic and Behavior Theories.

Enterprise Resource Planning: Basics of ERP, Evolution of ERP, Enterprise Systems in Large Organizations, Benefits and Challenges of Enterprise Systems, Managing the E-enterprise, Organisation of Business in an E-enterprise, E-business, E-commerce, E-communication, E-collaboration

Trends in MIS: Introduction, Decision Support Systems (DSS), Artificial Intelligence (AI), Market Research Methods, Ratio Analysis for Financial Assessment, Management Science Models, Procedural Models, Project Planning and Control Models.

Suggested Books:

1. D.P. Goyal, "Management information systems", Macmillan India Ltd, 2014
2. Robert G. Murdick& Joel E. Ross & James R. Claggett, "Information Systems for Modern Management" PHI,2010
3. Gordon B. Davis & M.H. Olson, "Management Information Systems: Conceptual Foundation, structure & Development".2010

ISY5321 Multi agent system

Introduction to intelligent agents. Definition, Architectures interface agents, information agents, heterogeneous Multi-Agent Systems,distributed-intelligent-systems, Communication, Standards, Coordination, Negotiation, Distributed planning. Voting. Auctions. Coalition formation. Application of multi-agent systems to industrial problems.

Agent Design: Reasoning in Agents Definition of Reasoning. Automated Reasoning. Reasoning Paradigms. Symbolic Reasoning Agents. Deductive Reasoning Agents. Agent-Oriented Programming, Practical Reasoning. BDI Agents. BDI Agent Control Loop

Agent-Oriented-Methodologies Current trends in Software engineering. Agent-Oriented Software Engineering. Agent-Oriented Methodologies. The GAIA Methodology. The Prometheus Methodology

Social Design: Coordination and Social Models Coordination in MAS. Coordination Structures. Social Models for Coordination. Trust and Reputation Models. Organizational Models. Institutional Models.

Applications of Agent-Oriented Design. Agent-Oriented Design for 1) Electronic Negotiation Support, 2) Flexible Dynamic Web services, 3) Multi-robotic environments. Case studies for the practical assignments.

Suggested Books:

1. Michael Wooldridge (John Wiley and Sons), An Introduction to Multiagent Systems,first edition 2002, or second edition, 2009.
2. Luck, M., McBurney, P., Shehory, O., Willmott, S , Agent Technology: Computing as interaction. A Roadmap to Agent Based Computing, Willmott, S., 2005.

ISY5323 Privacy in location based services

Introduction – Evolution of Location Based Services – Application Areas of Location Based Services (LBS) – Application Taxonomy – LBS Privacy – LBS Markets and Customer Segments

Vehicle Tracking: Tracking Concepts, Components of Vehicle Tracking, Online and Offline Tracking. Alarms Used In Vehicle Tracking, Fleet Management – Vehicle Navigation: Navigation Concepts For Road, Waterways And Airways – Components Of Vehicle Navigation, File Formats Used For Navigation – Distress Call Management.

Mobile Device Eco-System: Mobile Applications, Business Model, and Privacy, Threats, Legal Protection of Location Data, user Perception of LBS: Overview on User Studies, User Attitude Towards LBS, Privacy Preferences of Users.

Design of Private Location-Based Services, Geo-Social Networks, Friend-Nearby Notification, POI Finder, Traffic Monitoring.

Quantification of Location Privacy, Obfuscation-based Protection Schemes: Hiding Events, Reducing Precision, Perturbation, Dummies.

Case Study: Develop A Real Time Case Study on Location Based Services Using the Above Concepts Learned and Submit A Working Application Along With the Presentation.

Suggested Books:

1. Jochen Schiller & Agnes Voisard" Location – Based Services" Morgan Kaufmann Publishers, 2004.
2. Syed A. Ahson& Mohammad Ilyas "Location-Based Services Handbook: Applications, Technologies, And Security – CRC Press, 2010

ISY5325 Probabilistic Graphical Models

Introduction, Graph theory, Probability Theory, Probability distributions, Bayes theorem, Bayesian Networks.
Learning Bayes nets, Undirected models, undirected graphical models and their temporal extensions.
Exact inference, MAP inference, message passing, sampling, Exponential families, Variational inference, Exact and approximate inference methods.
Parameter learning, Bayesian learning, Structured learning, estimation of parameters and the structure of graphical models.
Applications to computer vision, natural language processing, data mining, machine learning fields, decision-making under uncertainty.

Suggested Books:

1. Koller, Daphne, Nir Friedman, and Francis Bach. Probabilistic graphical models: principles and techniques. MIT press, 2009.
2. Andrew, Alex M. "INFORMATION THEORY, INFERENCE, AND LEARNING ALGORITHMS, by David JC MacKay, Cambridge University Press, Cambridge, 2003, hardback, xii+ 628 pp., ISBN 0-521-64298-1 (£ 30.00)-." Robotica 22, no. 3 (2004): 348-349.
3. Barber, David. Bayesian reasoning and machine learning. Cambridge University Press, 2012.

ISY5327Software Engineering

Measurement in software engineering, scope of software metrics, Basics of Measurement: Models, Measurement Scales and Scale Types, Meaningfulness in Measurement.
Measuring External Product Attributes: Modeling Software Quality, Measuring aspects of quality, Goal Framework for Software Measurement. Classifying software measures, determining what to measure, applying the framework

Empirical Investigation & Data Collection: Four Principles of Investigation, planning formal experiments, defining data, collecting data.
Measuring Internal Product Attributes, Size and Structure: Aspects of Software Size, Length, Reuse, Functionality, Complexity, Types of Structural Measures, Modularity and information flow attributes, Object Oriented Metrics
Analyzing Software Measurement Data: Analyzing the results of experiments, Analysis Techniques, Overview of statistical tests.
Measurement and Management: Planning a measurement program, Measurement in practice, empirical research in software engineering
Suggested Books:

1. Roland Petrasch, "The Definition of, Software Quality': A Practical Approach", ISSRE, 1999.
2. J.D. Musa, A. Iannino, and K. Okumoto, Engineering and Managing Software with Reliability Measures, McGraw-Hill,1963.
3. Pressman, Scott , Software Engineering: A Practitioner's Approach (Sixth, International ed.), McGraw-Hill Education .2005

ISY5329Theory of modern cryptography

Introduction: Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques.
Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, Fiestal structure, data encryption standard(DES), strength of DES, crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.
Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, RSA algorithm,key management, Diffle-Hellman key exchange algorithm,
Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code (MAC), hash functions, security of hash functions message digest algorithm, Public Key Infrastructure(PKI).
Authentication Applications: Kerberos and X.509, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.
IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure Socket Layer(SSL) and transport layer security.

Suggested Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.2002.
2. AtulKahate, "Cryptography and Network Security", TMH, 2017
3. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag,2004.
4. Behrouz A. Forouzan, "Cryptography and Network Security", TMH,2007.

Elective 3

ISY5201 SEMINAR

ISY5203 Latest Research in information technology

ISY5205 Optimization tools

Linear Programming Models, Prototype, Examples, Assumptions of Linear Programming, Additional Examples, Some Classic Case Studies. Graphical method, The Simplex Method: The Essence of the Simplex Method, Setting up the Simplex Method, The Algebra of the Simplex Method, The Simplex Method in Tabular Form, Tie Breaking in the Simplex Method, Adapting to Other Model Forms, Post optimality Analysis.

Dynamic programming, prototype example for Dynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming, Probabilistic Dynamic Programming

Nonlinear Programming and Sample Applications, Graphical Illustration of Nonlinear Programming Problems, Types of Nonlinear Programming Problems, One-Variable Unconstrained Optimization, Multivariable Unconstrained Optimization.

Introduction to Evolutionary Computing Global Optimization, Components of an evolutionary algorithm, Evolution strategies, Fitness Functions, Learning Classifier systems, Parameter Control, Multi-modal Problems

Application to real world optimization problems Optimization examples from Machine Learning, Robotics, Image Processing and Computer Vision, Web and data mining, network traffic routing.

Suggested Books:

1. H.A.Taha – Operations Research, 8/e , Pearson Education , New Delhi, 2007.
2. Andries P. Engelbrech, John , Computational Intelligence", Second Edition, John Wiley & Sons, ISBN: 978-0-470-03561-0,2008
3. A.E Eiben and J.E. Smith , "Introduction to Evolutionary Computing", Springer, second edition,2007.
4. S. Hiller & G.J. Lieberman – Operations Research, 8th Edn, TMH, New Delhi – 2006,
5. David Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning". Addison-Wesley,1989

SEMESTER II

ISY502 High Performance Computing System

Cluster Computing:

Introduction to Cluster computing, Scalable Parallel Computer Architectures, Cluster Computer and its Architecture, Classifications, Components for clusters. Representative Cluster systems, Heterogeneous Clusters, Security, Resource Sharing, Locality, Dependability, Cluster Architectures, Detecting and Masking Faults, Recovering from Faults.

Load Sharing and Balancing: Evolution, Job and Resource Management Systems, State-of-the-Art in RMS and Job, Rigid Jobs with Process Migration, Fault Tolerance, Scheduling Problem for Network Computing, Algorithm-ISH, MCP and ETF, Task Granularity and Partitioning, Static and Dynamic Scheduling.

Cloud Computing:

Introduction to Cloud Computing, Types: Deployment and Service Models, Characteristics, Applications, Service-Level Agreement, Virtualization, High-Throughput Computing: Task Computing and Task-based Application Models, Market-Based Management of Clouds, Resource Allocation, Leases, Task Scheduling : RR, CLS and CMMS,Montage, Cloudlet, Virtual Machine and its Provisioning, Time and Space-shared Provisioning.

Data Access Optimization:

Balance Analysis and Light Speed Estimates, Storage Order, Case study: Jacobi Series and Dense Matrix Transpose, Algorithm Classifications and Optimizations, Sparse Matrix Vector Multiply

Suggested Books

1. Raj Kamal, Embedded System, TMH, 2004
2. Kennth J. Ayala, The 8051 Microcontroller, Thomson DelMar Learning, 2006
. 3 Deshmukh, Microcontrollers, TMH, 2006

4. Wayne Wolf, Computer as components, Harcourt India Pvt. Ltd, 2002
5. Philip A. Laplante,Real time System and Analysis, Wiley, 2006

ISY504Computer Networks and Application

Introduction to Computer Networking Concepts: Layered Network Protocol Architectures; Personal, Local, Metropolitan and Wide Area Network

Data Link Layer and Logical Link Control (LLC) sub-layer: Framing; Error control including Bit-parity, CRC and Hamming Codes; Reliable transmission and Automatic Repeat Request (ARQ) protocols including Stop-and-Wait, Go-back-N, Selective Repeat.

Medium Access Control (MAC) sub-layer: Shared media systems; Bus, Star and Ring topologies; TDMA, FDMA, CSMA, CSMA/CD, Ethernet and IEEE 802.3; IEEE 802.11 including CSMA/CA protocols;

Network Layer: Internet Protocol (IP) suite; Hierarchical network architectures; IPv4 and IPv6 addressing and headers; Routing protocols including distance-vector and link-state approaches; Interior and Exterior Gateway Protocol concepts; Routing Algorithms including Dijkstra's algorithm and distributed Bellman-Ford algorithm; Example protocols: OSPF, RIP, BGP.

Transport Layer: Reliable end-to-end transmission protocols; UDP header; Details of TCP header and operation including options headers and congestion control; TCP variants such as Reno, Tahoe, Vegas, Compound and CUBIC.

Application Layer: Socket Interface and Socket programming.

Suggested Books

1. Kurose and Ross, "Computer Networking - A top-down approach", Seventh Edition, Pearson, 2017.
2. Andrew S. Tanenbaum, "Computer Networks", Fifth Edition, Pearson Education India, 2013.
3. Ying-Dar Liu, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill, 2011.
4. W. Richard Stevens, Bill Fenner and Andrew Rudoff, "Unix Network Programming", Volumes 1 and 2, Third Edition, Addison-Wesley Professional, 2003.

Elective 4

ISY5402 Advanced operating system

Types of Advanced Operating Systems. Architectures and design issues of Network operating system, DOS, Middleware, RTS, DBOS. Introduction to process, Concurrent processes, Critical Section problems, other synchronization problems

Scheduling: Issues in load distributing, Components of load distributing algorithms, Stability, Load distributing algorithms, Performance Comparison, Selecting a suitable load sharing Algorithm. Synchronization: Physical and logical clocks. Distributed Mutual Exclusion: Introduction, Classification of Mutual Exclusion algorithms, Mutual Exclusion Algorithms. Distributed Deadlock.

Agreement Protocol: System Model, Classification, Solution to Byzantine Agreement Problem. Fault Recovery: Concepts, Classification of failures, Backward error recovery, Recovery in concurrent Systems, Consistent Check Points, Synchronous and Asynchronous check pointing and recovery.

Types of Real time tasks, Timing Constraints, Modeling Timing Constraints. Task Scheduling: Types of tasks and their characteristics, Task Scheduling, Clock driven Scheduling, Hybrid Schedulers.

Concurrency control: Database systems, Concurrency control model of database systems, Problem of Concurrency Control, serializability theory, Distributed Database Systems.Concurrency Control Algorithms Basic synchronization Algorithms, Lock based, Concurrency Control Algorithms

Suggested Books:

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems" MC Graw Hill education,2011.
2. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson education,2006.
3. Andrew S.Tanenbaum, "Modern Systems Principles and Paradigms". PHI.
4. Pradeep K.Sinha, "Distributed Operating System-Concepts and design", PHI,2003.
5. Andrew S.Tanenbaum, "Distributed Operating System", Pearson Education. 4. Jane W. S. Liu, "Real Time Systems", Pearson education,2006.

ISY5404Cloud computing and virtualization

Overview: – A short history Client – Server Computing, Peer-to-Peer Computing, Distributed Computing, Collaborative Computing, Cluster Computing, Grid Computing, Cloud Computing, Functioning of Cloud Computing, Cloud Architecture, Cloud Storage, Cloud Services.

Cloud Computing Service Models and Development Models:- Objectives, Service Modelling, Infrastructure Services, Platform Services, Software Services - Software as service modes-Private Cloud, Community Cloud, Public Cloud, Hybrid Cloud.

Migrating to the Cloud and Virtualization: - Objectives, Cloud Services for individuals- Available Services - Skytap Solution, Cloud Services Aimed at the mid – market, Enterprise Class Cloud Offerings- Migration- Applications needed for migration - Moving existing data to cloud- Using the Wave approach.

Data Management and Information Storage in Cloud Computing:- Introduction- Objectives, Data Security- Data Location- Data Control- Securing data for transport, Scalability and Cloud Services- Large Scale Data Processing.

Cloud Security:- Security issues associated with the cloud, Cloud security controls, Dimensions of cloud security, Security and privacy, Cloud Vulnerability and Penetration Testing, Data security, Confidentiality, Encryption.
Suggested Books:

1. Rajkumar Buyya ,Cloud Computing: Principles and Paradigms, Wiley; 1 edition (2013).
2. Kai Hwang Professor, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann (22 November 2011).
3. Thomas Erl. "Cloud Computing: Concepts, Technology & Architecture", PHI; 1 edition (10 May 2013)

ISY5406 Foundation of information theory and coding
Introduction to Probability, Sample space and events, The axioms of probability,Conditional Probability and Independence, Baye's theorem. Random variables, discrete probability distribution, discrete functions for random and discrete random variables.
Uncertainty and Information, Shannon Entropy, Joint and conditional Entropies, Mutual Information, Uniquely decipherable and Instantaneous codes, Noiseless coding problem. Source coding Theorem, Block coding, construction of Optimal codes,
Discrete memoryless channel, channel capacity BSC and other channels, the channel coding theorem, application to BSC.

Information measure for continuous ensembles capacity of AWGN channel. Error control coding. Types of codes, error and error control strategies, Linear block codes, syndrome and error detection, Minimum distance, Error detecting and correcting capabilities of a block code, Syndrome decoding, Hamming codes

Cyclic codes, Generator and parity, encoding, syndrome computation, error detection and decoding. BCH codes, decoding of the BCH codes Introduction to RS codes.

Blind Deconvolution Using Convex Programming, Asynchronous code division random access using convex optimization.

Suggested Books:

1. R Ash , Information Theory, Dover Science Publications,1990.
2. Cover and Thomas , Element of Information Theory , John Wiley & Sons,2006.
3. Shulin& Daniel J. Costello Jr , Error Control coding: Fundamental & Applicatio, Prentice Hall, 1948
4. C. E. SHANNON, A Mathematical Theory of Communication, 1948 The Bell System Technical Journal,1948.

ISY5408 Internet security and privacy
Introduction: Basic concepts: threats, vulnerabilities, controls; risk; confidentiality, integrity, availability; security policies, security mechanisms; assurance; prevention, detection, deterrence.
Basic cryptography: Basic cryptographic terms, Historical background, Symmetric crypto primitives, Modes of operation, Cryptographic hash functions, Asymmetric crypto primitives.
Program security: Malicious code: viruses, Trojan horses, worms.Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation, Software development controls , Testing techniques
Trusted operating systems: Assurance; trust, Design principles, Evaluation criteria, Evaluation process.
Database management systems security: Database integrity, Database secrecy, Inference control, Multilevel databases.
Network security: Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks, intrusion detection.

Suggested Books:
1. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall,2006.
2. Charles P. Pfleeger, "Security in Computing", Prentice Hall,2019.
3. William R. Cheswick and Steven M. Bellovin, "Firewalls and Internet Security: Repelling the Wily Hacker", Addison-Wesley,2003.
4. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network Security: Private Communication in a Public World", Prentice Hall, March 6, 2003.

ISY5410 Machine learning
Introduction: Linear Algebra, Probability Theory, Introduction to Bayesian Methods, Parametric Methods, Discriminant Functions.
Supervised Learning: Linear Regression models, classification, Linear discriminant analysis, Probably Approximately Correct (PAC) Learning, Learning Multiple Classes, Model Selection and Generalization, Support vector machine, Decision trees, Nearest neighbors, neural networks.
Unsupervised Learning: Clustering, Mixture Models, Latent Variables, Expectation-Maximization, Feature selection, Dimensionality Reduction, Factor/Component Analysis, Linear Discriminant Analysis.
Genetic Algorithms: Motivation, Genetic operators, Fitness function, Models of Evolution and Learning, Fuzzy Logic: Fuzzy sets and operations, Membership function, Classical sets, angular fuzzy sets.
Reinforcement Learning: Introduction, The learning task, Q learning, Non-deterministic rewards and actions, Relationship to dynamic programming, Model-Based Learning.

Recent applications: Speech recognition, computer vision, natural language processing, face recognition.

Suggested Books:
1. Alpaydin, E, Introduction to Machine Learning, MIT Press, 2004
2. Tom Mitchell , Machine Learning, McGraw Hill, 1997
3. David Barber , Machine Learning: A probabilistic approach, 2006.
4. Charlie Kaufman, Radia Perlman and Mike Spencer, "Network Security: Private Communication in a Public World", Prentice Hall,2008.

ISY5412 Mobile application

Introduction to Android: Native Android Application; SDK Features; Introduction to Open Handset Alliance; Development Framework; Application Fundamentals; Device Compatibility; System permissions.

User Interface and Application Components: Basic UI Design; Fragments; Widget Toolbox; Creating New View; Introduction to Intents; Intent Filters and broadcast Receivers; Activities; Services; Content Providers; Application Widgets; Processes and Threads.

Files and Database Handling: Saving Application Data; Shared Preferences; Preference Framework and Activity; Static File as Resource; File System; Introduction to SQLite Database; Querying SQLite; Storage options; Data backup

User Experience Enhancement: Action Bar; Menus and Action Bar Items; Settings; Dialogs; Customizing Toast; Notifications; Search; Drag and Drop

Multimedia, Wireless Connectivity and Telephony: Audio and Video Handling; Manipulating Raw Audio; Sound Effects; Camera Programming; Video Recording;
Managing Wireless Connectivity : Wi-Fi, Bluetooth, Near Field Communication; Hardware Support for Telephony; Telephony Management; SMS and MMS.

Suggested Books:
1. Reto Meier, "Professional Android 4 Application Development", Wrox, 2012
2. Matt Gifford, "PhoneGap Mobile Application Development Cookbook", PACKT, 2012
3. Adrian Kosmaczewski, "Mobile JavaScript Application Development", O'RELLY, 2012

ISY5414 Semantic web

Semantic Web Introduction: fundamental of semantic web, Examples of semantic web, Semantic web technologies, layered approach Web Intelligence Thinking and Intelligent Web Applications, The World Wide Web, Limitations of Today's Web.
Structured web documents in XML: The XML language, Structuring, Namespaces, Querying and Addressing XML documents. Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the web, UML, XML/XML Schema
Web Ontology Engineering: Introduction, OWL language, Examples, OWL in OWL, Future extensions, Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods.
Applications: Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.
Describing Web Resources: Introduction, RDF, RDF Schema, RDF: XML-Based Syntax, RDF serialization, syntax and language, Direct Inference System, Querying RQL, A query language for RDF: SPARQL

Suggested Books:
1. Berners Lee, Godel and Turing ,Thinking on the Web , Wiley inter science, 2008.

2. Grigoris Antoniou and Frank Van Hermelen , A Semantic web Primer, MIT Press,2008.
3. John Davies (Editor), Rudi Studer (Co-Editor), Paul Warren (Co-Editor) ,Semantic Web Technologies, Trends and Research in Ontology Based Systems,2006.

ISY5416 Smart sensing for internet of things

INTRODUCTION& CONCEPTS: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT, Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols.

IoT and M2M, Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization, IoT Platform Design Methodology, Introduction, IoT Design Methodology.

IoT System Logocal Design Using Python, Introduction, Installing Python, Python Data Types and Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date Time applications, Classes, Python Packages of Interest for IoT.IoT Physical Devices and End Points.

Data Analytics for IoT; Introduction AppacheHadoop, using HadoopMapReduce for Batch Data Analysis, Apache oozie, Apache Spark, Apache Storm, using Apache Storm for Real-time Data Analysis.

Ethics: Characterizing the IoT, Privacy, Control , Distributing Control and Crowd Sourcing.

Suggested Books:
1. Raj Kamal ,"INTERNET OF THINGS" , McGraw-Hill,2017.
2. Timothy Chou ,"Precision - Internet Of Things", McGraw-Hill,2017.
3. Rajkumar Buyya,Amir Vahid Dastjerdi **,** "Internet of Things Principles and Paradigms, Morgan Kaufmann (10 May 2016)".

Elective 5

ISY5302 MINOR PROJECT

ISY5304 Advanced computer vision

Image Formation Models: Monocular imaging system, Orthographic & Perspective Projection, Camera models and Camera calibration, Sources, shadows and shading

Image Processing: Image representation, feature extraction and matching, Image filters, Edge detection, Image texture analysis, Clustering, Model Fitting
 Motion Estimation: Regularization theory, Optical computation, Multi-view scene processing, depth recovery from Stereo Vision, Motion estimation, Structure from motion

Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multiresolution analysis

Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Tracking with linear dynamical models

Object detection and tracking: Tracking with linear dynamical models, Optical flow estimation, Object tracking using deep neural networks.

Suggested Books:
1. D. Forsyth and J. Ponce ,Computer Vision - A modern approach, Prentice Hall,2012.
2. Linda Shapiro and George Stockman ,Computer Vision, Prentice-Hall, 2001.
3. Szeliski, Richard. Computer vision: algorithms and applications. Springer Science & Business Media, 2010.
4. E. Trucco and A. Verri , Introductory Techniques for 3D Computer Vision, Publisher: PHI 4. COMPUTER SECURITY.

ISY5306ADhoc wireless network

Ad-hoc Wireless Networks Introduction and Issues, Mobile Ad-Hoc Networking with a View of 4G Wireless: Imperatives and Challenges, IEEE 802.11 in Ad Hoc Networks: Protocols, Performance and Open Issues; MAC Protocols for Ad-hoc Wireless Networks: Introduction,Contention-Based Protocols.
Routing Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols; On-Demand Routing Protocols, Hybrid Routing Protocols.
Multicast Routing in Ad-hoc Wireless Networks Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols.
Transport Layer and Security Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions.
Quality of Service and Energy Management in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions and Network Layer Solutions.
Suggested Books:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
2. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
3. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
4. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002

ISY5308Advance Topic in Mobile Computing

MOBILE COMMUNICATIONS: AN OVERVIEW

Mobile communication-Mobile Computing-Mobile Computing Architecture-Mobile devices-Mobile System Networks – Data dissemination – Mobile management- security. MOBILE DEVICES AND SYSTEMS.

GSM AND SIMILAR ARCHITECTURES:

GSM – services and architectures – Radio interfaces – Protocols – Localization – Calling – Handover – Security – New data services – General packet radio service- High speed circuit switched data – DECT. WIRELESS MEDIUM ACCESS CONTROL BASED COMMUNICATION-Medium Access Control

MOBILE IP NETWORK LAYER AND MOBILE TRANSPORT LAYER:

 IP and mobile Network layers – Packet Delivery and Handover Management – Location management – Registration – Tunnelling and Encapsulation - Route Optimization - Dynamic Host Configuration Protocol. Conventional TCP/IP Transport Layer Protocols – Indirect TCP – Snooping TCP – Mobile TCP – Other methods of mobile TCP – layer transmission – TCP over 2.5G/3G Mobile networks.

SERVER AND MANAGEMENT:

Mobile agent – Application server – Gateways – Portals -Service Discovery – Device management – Mobile file systems-Security.

MOBILE AD HOC AND WIRELESS SENSOR NETWORKS-Introduction to mobile Ad hoc network – MANET –Wireless Sensor Networks – Applications.

Suggested Books:

1. Raj Kamal, "Mobile Computing",Oxford Higher education, Second Edition, 2007
2. Jochen Schiller, "Mobile Communications", Addison-Wesley, 2nd Edition. 2004
3. LotherMerk, Martin.S.Nicklaus and Thomas Stober, "Principle of Mobile Computing",Second Edition, Springer, 2003.
4. William C.Y.Lee, "Mobile Communication Design Fundamentals", John Wiley,1993.

ISY5310 Applied cryptography

Number Theory Basics: Modular arithmetic, primes, GCD and Chinese reminder theorems.

Block Ciphers: DES, AES; ECB, CBC, OFB,CFB, CTR and GCM modes, Double and triple encryptions.

Public Key Cryptography: RSA, ElGamal, Diffe-Hellman Key exchange, practical digital signatures. ECC.

Hash Functions: oneway, collision resistant, preimage resistant HASH functions, Real-world examples.

Message Authentication Codes: MAC from Hash functions, MAC from block ciphers.

Side Channel Analysis: Power / timing analysis of crypto-implementations

Applications: Key Establishment Protocols, Blockchains, etc.

Suggested Books:
1. William Stallings ,CNS: "Cryptography and Network Security: Principles and Practice" (6th Edition),2014.
2. Menezes, van Oorschot, and Vanstone , HAC: "The Handbook of Applied Cryptography",1996.
3. IdCrypto: C. Youngblood, "An Introduction to Identity-Based Cryptography," CSEP 590TU, 2005.
4. AnCom: Ren J and Wu J. Survey on Anonymous Communications in Computer Networks.Computer Communications. 2010, 33(4): 420–431.

ISY5312 Collaborative filtering

Introduction to collaborative filtering: Collaborative Filtering-Based Recommendations, Measuring Similarity, Cosine Similarity, Types of filtering: Model-based Collaborative Filtering, Memory based, hybrid Context-aware collaborative filtering, Neighbourhood-based approach: selecting neighbourhood, the sparsity problem. User-Based Collaborative Filtering, Item-Based Collaborative Filtering

Application on social web: Problems, Challenges: Data sparsity, Scalability, Synonyms, Gray sheep, Shilling attacks, Diversity and the long tail. Evaluation of recommendation system, case study.

Suggested Books:
1. Jun Wang ,Collaborative Filtering and Recommender Systems, Wiley, 2017, ISBN 0470547987, 9780470547984,2017.
2. SuXiaoyuan , Collaborative Filtering , LAP Lambert Academic Publishing, ISBN: 9783659429095, 3659429090, 2013.
3. Ekstrand Michael D ,Collaborative Filtering Recommender Systems, now publishers Inc, ISBN: 9781601984425, 1601984421, 2011.

ISY5314 Cyber security and law

The World Wide Web, Web Centric Business, E Business Architecture, Models of E Business, E Commerce, Threats to virtual world. Cyber Crimes& social media, Cyber Squatting, Cyber Espionage, Cyber Warfare, Cyber Terrorism
Computer ethics, moral and legal issues, descriptive and normative claims, Professional Ethics, code of ethics and professional conduct. Privacy, Computers and privacy issue.
Web Servers and Browsers, HTTP, Cookies, Caching, Plug-in, ActiveX, Java, JavaScript, Secure Socket Layer (SSL), Secure Electronic Transaction (SET). E-mail Risks, Spam, E-mail Protocols, Simple Mail Transfer Protocol (SMTP), Post office Protocol (POP), Internet Access Message protocol (ICMP). Secured Mail Protocols.

Copyrights, Jurisdiction Issues and Copyright Infringement, Multimedia and Copyright issues, WIPO, Intellectual Property Rights, Understanding Patents, Understanding Trademarks, Trademarks in Internet, Domain name registration, Software Piracy, Legal Issues in Cyber Contracts, Authorship, Document Forgery.

Indian IT ACT, Adjudication under Indian IT ACT, IT Service Management Concept, IT Audit standards, System audit, Information security audit, ISMS, SoA (Statement of Applicability), BCP (Business Continuity Plan), DR (Disaster Recovery), RA (Risk Analysis/Assessment).

Suggested Books:

1. RaefMeeuwisse , Cyber security for Beginners, Cyber Simplicity Ltd; 2nd Revised edition edition (14 March 2017).
2. Advocat Prashant Mali ,Cyber Law & Cyber Crimes; Snow White publications, Mumbai,2012.
3. Yuri by Yuri Diogenes, Cyber security - Attack and Defence Strategies, Packt Publishing; 1 edition (30 January 2018).

ISY5316   Deep learning

Introduction: Basics of deep learning, Importance of deep learning, Feature engineering, Overview of deep learning framework.

Machine Learning Basics: Supervised learning algorithms, Hyper parameters and validation sets, overfitting, under fitting, Unsupervised learning algorithms, Stochastic Gradient Descent, Challenges motivating Deep Learning.

Deep feed forward network: Artificial Neural Network, activation function, multi-layer neural network, Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization, Data Augmentation, Dropout.

Convolutional Networks (CNN): Motivation, The Convolution Operation, Pooling, Structured outputs, Kernels.

Recurrent and Recursive Nets: Recurrent Neural Networks (RNN) , Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, Long-Term Dependencies, Long-Short Term Memory, Gated RNNs.

Applications: Large scale deep learning, Computer vision, Speech Recognition, Natural Language Processing, Other applications, Deep Learning Tools and Libraries: Caffe, Theano, Keras..

Suggested Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Python Deep Learning, by Valentino Zocca, GianmarioSpacagna, Daniel Slater, and Peter Roelants, Packt Publishing Ltd, 2017.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

ISY5318Digital watermarking and Steganalysis

Introduction: Information Hiding, Steganography, and Watermarking, Importance of Digital Watermarking, Theoretic Foundations of Steganography

Applications and Properties: Applications of Watermarking, Applications of Steganography, Properties of Watermarking Systems, Evaluating Watermarking Systems, Properties of Steganographic and Steganalysis Systems, Evaluating and Testing Steganographic Systems.

Models of Watermarking: Communication-Based Models of Watermarking, Geometric Models of Watermarking, Modeling Watermark Detection by Correlation, Basic Message Coding: Mapping Messages into Message Vectors, Error Correction Coding, Detecting Multisymbol Watermarks.

Watermarking with Side Information: Informed Embedding, Watermarking Using Side Information, Dirty-Paper Codes, Robust Watermarking: Approaches, Robustness to Volumetric Distortions, Robustness to Temporal and Geometric Distortions.

Watermark Security: Security Requirements, Watermark Security and Cryptography, Some Significant Known Attacks, Content Authentication: Exact Authentication, Selective Authentication, Localization, Restoration

Steganalysis: Steganalysis Scenarios, Some Significant Steganalysis Algorithms, Case studies

Suggested Books:

1. Ingemar Cox Matthew Miller Jeffrey Bloom Jessica Fridrich Ton Kalker, "Digital Watermarking and Steganography, Morgan Kaufmann 13th November 2007

2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom , Digital Watermarking principles, Morgan Kaufmann (June 1, 2011)

3. Ingemar Cox Matthew Miller Jeffrey Bloom Mathew Miller , Digital Watermarking, Morgan Kaufmann (June 1, 2011)

ISY5320 Distributed Data Mining
Introduction and Incremental & Stream Data Mining:- Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining Incremental Algorithms for Data Mining, Characteristics of Streaming Data, Issues and Challenges, Streaming Data Mining Algorithms, Any time stream Mining.
Distributed computing solutions for data mining:-MapReduce/Hadoop and Spark, Cluster Computing
Mining Complex Structures:-Algorithmic Development Issues, Mining trees, Tree Model Guided Framework, TMG framework for mining ordered & unordered subtrees, Tree Mining Applications, Mining Graphs, Approaches to graph mining
Sequence Mining: - Characteristics of Sequence Data, Problem Modeling, Sequential Pattern Discovery, Timing Constraints, Applications in Bioinformatics.
Web Search: - Crawling & Indexing, Hyperlink Analysis, Page Rank algorithm, Web Search and Information Retrieval.
Suggested Books:
1. Hadzic F., Tan H. & Dillon T. S. "Mining data with Complex Structures" Springer, 2011
2. Yates R. B. and Neto B. R. "Modern Information Retrieval" Pearson Education, 2005
3. Tan P. N., Steinbach M & Kumar V. "Introduction to Data Mining" Pearson Education, 2006.
4. Han J. &Kamber M., "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Second Edition, 2006.

ISY5322 Graph Theory
Graphs, Konisberg-problem,isomorphism, subgraphs, matrix representations, degree, operations on graphs, degree sequences, Walks, trails, paths, connected graphs, distance, weighted graphs, connectivity
 Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm, graphs, Hamiltonian paths and circuits, operations on graphs.
Trees, number of trees, minimum spanning trees, distance and centers in a tree, rooted and binary trees, fundamental circuits, cut sets and cut vertices.
Connectivity and separability, edge connectivity, vertex connectivity, network flows, planar and dual graphs, geometric dual .
Matrix representation of graphs, incidence matrix, circuit matrix, cut-set matrix, path matrix, application to a switching network, applications of graphs
Suggested Books:
1. Nersing Deo ,Graph theory with applications to engineering and computer science", PHI,1979.
2. D.B. West. Introduction to Graph Theory. Prentice Hall of India, 2005.
3. R.B. Bapat ,"Introduction to Graph Theory (5th edition)" by Robin Wilson, Person Education Limited 2010.

ISY5324Network anonymity and privacy

Anonymity and Privacy, and why it matters, Networking basics, various network challenges, cryptography, firewalls, web authentication, user tracking Corporate Network Security Policies, threats and controls, Firewall: Technologies, Stateful and stateless firewall, Transparent Proxy and Protocol or Application Gateway, Linux-based Firewall: ip chains&ip tables, Internet Services against firewall.

Virtual Private Network (VPN): Concepts and technologies, IPSec and Free S/WAN, VPN with Firewall, Intrusion Detection System(IDS): Concepts, Network-based and Host based IDS, tripwire or Snort or Port Sentry setup and management, onion routing, anonymous browsing, P3P

Historical network anonymity and privacy protocols ndash; MIXes and MIXnets, various theoretical and practical attack strategies against high and low-latency anonymity networks, practical traffic analysis against modern anonymity systems like Tor, Freenet, GNUnet, JAP.

Side-channel attacks, covert channel communications, pseudonymity and privacy, Anonymous P2P communication systems (e.g. Oneswarm), traffic analysis against anonymous VoIP communications. Definition and value of privacy, Conceptual frameworks for reasoning about privacy.

Suggested Readings:
1. Matthew Bailey , Complete Guide to Internet Privacy, Anonymity & Security,2014.
2. Kun Peng , "Anonymous Communication Networks: Protecting Privacy on the Web,2014
3. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall,2002.

ISY5326Topics in computer security

Overview of Network Security, Security services, attacks, Security Issues in TCP/IP suite- Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, IP address spoofing, IP fragment attack, routing exploits, UDP exploits, TCP exploits.

Authentication requirements, Authentication functions - Message Authentication Codes - Hash Functions - Security of Hash Functions and MACs - MD5 message Digest algorithm - Secure Hash Algorithm - RIPEMD - HMAC Digital Signatures, Authentication Protocols-Kerberos, X.509.

IP Security-AH and ESP, SSL/TLS, SSH, Web Security-HTTPS, DNS Security, Electronic Mail Security (PGP, S/MIME).

Intruders, Viruses, Worms, Trojan horses, Distributed Denial-Of-Service (DDoS), Firewalls, IDS, Honey nets, Honey pots.

Introduction to wireless network security, Risks and Threats of Wireless networks, Wireless LAN Security (WEP, WPA).

Network security: Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks.

Suggested Books

1. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall,2006.
2. Charles P. Pfleeger, "Security in Computing", Prentice Hall,2015.
3. Matthew Bailey ,Complete Guide to Internet Privacy, Anonymity & Security,2014.

Elective 6

ISY5202Research problem formulation

Introduction, thinking skills: Problem solving, creativity, problem finding and formulation, Experimental and Modeling skills, Communication skills - oral and written, Management skills: Stress and time management, Interpersonal relations, professional ethics, Publishing and patenting.

Suggested Readings:
1. John W. Creswel ,Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (Paperback), 2013
2. Uwe Flick, Introducing Research Methodology: A Beginner′s Guide to Doing a Research Project Second Edition,2017.

3. Ranjit Kumar , Research Methodology: A Step-by-Step Guide for Beginners Fourth Edition ,2014.

ISY5204 Laboratory on advanced topics
I: Advanced Programming with Data Science:
Python 3.5, The NumPy package for scientific computing, The pandas data analysis library, including reading and writing of CSV files, The Jupyter and PyDev development environments, The Matplotlib 2D plotting library, Understanding the shell, Using Git and GitHub, Best-practice software engineering techniques.
Suggested Readings:
1. Wes McKinny, O'Reilly Media ,Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, 2012. ISBN 978-1-4493-1979-3.
2. William E. Shotts, The Linux Command Line: A Complete Introduction , Jr., No Starch Press, 2012. ISBN 978-1-5932-7389
3. Mark Lutz, O'Reilly Media , Learning Python, 5th Edition, 2013. ISBN 978-1-4493-5573-9.

SEMESTER III

Elective 7

ISY6401   Biometrics Systems

Introduction to Bio-Metric System: Development of biometric authentication. Basic terms, biometric data, biometric characteristics, biometric features, biometric templates and references. Expected properties of biometric identifiers.
Fingerprint recognition: Fingerprint capture, sensor types, latent fingerprints. Fingerprint image pre-processing, segmentation, binary and skeletal images. Fingerprint singularities.
Iris recognition: Eye and iris morphogenesis, genetic penetrance. Principles of iris image capture, iris sensors. Iris image preprocessing, segmentation, formatting and filtering.
Face recognition: Face detection in still images and sequences. Face features. Face space, principal component analysis and its application, Eigen faces, linear discriminant analysis and its application, Fisher faces. Face recognition methods.
Recognition of handwritten signatures: Signature capture, off-line (scanned) and on-line (captured by tablets) signatures. Signature as a multidimensional curve, two- and multi-dimensional analyses. Signature features, hidden and visible features.
Security of biometrics system: Secure transfer of biometric data. Merging biometrics and cryptography, template protection. Merging biometrics and steganography..

Suggested Books:
1. Jain, A.K., Ross, A., Nandakumar, K. Introduction to Biometrics. Edition 2011.
2. Maltoni, D., Maio, D., Jain, A.K., Prabhakar, S., Handbook of Fingerprint Recognition. Second edition 2009.
3. Marcel, S., Nixon, M.S., Li, S.Z., Handbook of Biometric Anti-Spoofing: Trusted Biometrics under Spoofing Attacks (Advances in Computer Vision and Pattern Recognition). Edition 2014.

ISY6403 Natural Language Processing
Introduction: The study of Language, Introduction to NLP, Regular Expression, Finite State Automata, Evaluating Language Understanding Systems, Different levels of Language Analysis,
Grammars and Parsing: Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold mechanisms in ATNs.

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of-Speech tagging, Obtaining Lexical Probabilities,Probabilistic Context-Free Grammars, Dependency Parsing, Best First Parsing, Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Advanced Features and Syntax, Features and Unification: Feature structures – Unification of feature structures – Features structures in the grammar – Implementing unification – Parsing with unification constraints – Types and Inheritance.

Application of NLP: Intelligent Work Processors, Machine Translation, User Interfaces, Man-Machine Interfaces, Natural language Querying Tutoring and Authoring Systems.

Suggested Books:

1. James Allen, Natural Language Understanding, 2/e, Pearson Education (ISBN 13: 9788131708958), 2003
2. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education,(ISBN-13: 978-8131716724), 2008.
3. Manning and Schutze ,Foundation of Statistical Natural Language Processing, (ISBN-13: 978-0262133609), 1998.

ISY6405 Network security

Introduction: Basic concepts: threats, vulnerabilities, controls; risk; confidentiality, integrity, availability; security policies, security mechanisms; assurance; prevention, detection, deterrence.

Basic cryptography: Basic cryptographic terms, Historical background, Symmetric crypto primitives, Modes of operation, Cryptographic hash functions, Asymmetric crypto primitives.

Program security: Malicious code: viruses, Trojan horses, worms. Program flaws: buffer overflows, time-of-check to time-of-use flaws, incomplete mediation Software development controls, Testing techniques

Trusted operating systems: Assurance; trust, Design principles, Evaluation criteria, Evaluation process.

Database management systems security: Database integrity, Database secrecy, Inference control, Multilevel databases.

Network security: Network threats: eavesdropping, spoofing, modification, denial of service attacks o Introduction to network security techniques: firewalls, virtual private networks, intrusion detection.

Suggested Books:

1. Bruce Schneier, "Applied Cryptography: Protocols, algorithms and source code in C", John Wiley & Sons Inc,2015.
2. William Stallings, "Cryptography and Network Security", Prentice Hall,2006.
3. Behrouz A. Forouzan , "Cryptography & Network Security", McGraw-Hill,2015.

ISY6407Robotics

Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

Kinematics of Robots: Transformation Matrices, Inverse transformation matrices, Forward and Inverse kinematic equation for position and orientation, Denavit-Hartenberg representation of robot, inverse kinematic solution for articulated robot, Numericals. Differential Motions and velocities: Jacobian, Differential motions of a frame, Differential motion between frames, Calculation of the Jacobian, Inverse Jacobian, Numericals.

Dynamic analysis of Force: Lagrangian and Newtonian mechanics, Dynamic equations for multiple –DOF Robots, Static force analysis of Robots, Transformation of forces and moments between coordinate frames, Numericals. Trajectory Planning: Basics of Trajectory planning, Joint space trajectory planning, Cartesian Space trajectories, Numericals.

Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages. Off-line programming systems: Introduction, central issues in on-line and off-line programming. Programming examples.

Suggested Books:
1. Saha S K, "Introduction to Robotics", TMH Publication, 2008
2. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, "Robotics, control, sensing, Vision and Intelligence", McGraw Hill International, 1987
4. Saeed B. Niku, "Introduction to Robotics analysis, Systems & Applications", Pearson Education Singapore P. Ltd., 2002.
5. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
6. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, 2005.

ISY6409 Ethical Hacking

Introduction: Understanding the importance of security, Concept of ethical hacking and essential. Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking, Foot printing, Scanning, System Hacking, Session Hijacking. Buffer Overflows: Significance of Buffer Overflow Vulnerability, Why Programs/Applications are vulnerable. Reasons for Buffer Overflow Attacks. Methods of ensuring that buffer overflows are trapped,Sinffing.

SQL Injection: Attacking SQL Servers, Sniffing, Brute Forcing and finding Application, Configuration Files, Input validation attacks. Preventive Measures. Web Application Threats,

Web Application Hacking, Cross Site Scripting / XSS Flaws / Countermeasures Correct Web Application Set-up.

Web Application Security: Core Defence Mechanisms. Handling User Access, Authentication, Session Management, Access Control. Web Application Technologies: HTTP Protocol, Requests, Responses and Methods.

Attacking Authentication: Attacking Session Management, Design Flaws in Authentication, Mechanisms Attacking Forgotten Password Functionality, attacking Password change functions.

Attacking other users: Reflected XSS Vulnerabilities, Stored XSS Vulnerabilities, DOM-Based , XSS Vulnerabilities, HTTP Header Injection. Countermeasures to XSS.

Suggested Books:
1. Saha S K, "Introduction to Robotics", TMH Publication, 2008
2. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
3. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, "Robotics, control, sensing, Vision and Intelligence", McGraw Hill International, 1987

4. Saeed B. Niku, "Introduction to Robotics analysis, Systems & Applications", Pearson Education Singapore P. Ltd., 2002.
5. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
6. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, 2005.

ISY6411 Secure Coding

Introduction: Security, CIA Triad, Viruses, Trojans, and malware The need for secure system, proactive security development process, Threat modelling process and its benefits, Identifying the Threats by Using Attack Trees and rating threats using DREAD, cross-site scripting.

Access control, protecting secret data, Format String Problems, Integer Overflow, and Software Security Fundamentals, Buffer Overrun- Stack overrun, Heap Overrun, Array Indexing Errors.

Socket security, Avoiding Server Hijacking, Securing RPC, ActiveX and DCOM, secure .NET code, Command Injection, Failure to Handle Errors, and Security Touchpoints, Java Programming with Crypto API.

Proactive Security development process, Secure Software Development Cycle (S-SDLC), Security issues while writing SRS, Design phase security, Development Phase, Test Phase,

Database and Web-specific issues: SQL Injection Techniques and Remedies, Race conditions, Time of Check Versus Time of Use and its protection mechanisms.

Secure Coding Techniques: Protection against DoS attacks, Application Failure Attacks, CPU Starvation Attacks, Insecure Coding Practices In Java Technology. ARP Spoofing.

Suggested Books:

1. Michael Howard and David LeBlanc ,Writing Secure Code, Microsoft Press, 2nd Edition, 2004.
2. Jason Deckar,Syngress , Buffer Overflow Attacks: Detect, Exploit, Prevent,1st Edition, 2005.
3. Frank Swiderski and Window Snyder ,Threat Modeling, Microsoft Professional, 1st Edition, 2004.

ISY6413 Mobile Computing

Introduction: issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR, VLR, hierarchical, handoffs, channel allocation in cellular systems, Cellular telephone.

Wireless Networking, Wireless LAN Overview: MAC issues, PCF, DCF , Frame types, addressing, IEEE 802.11 standards, Blue Tooth: Architecture , Layers and protocols, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP.

Data management issues, data replication for mobile computers, Replication through data allocation, User profile replication scheme, optimistic replication and active replication, adaptive clustering for, mobile wireless networks, File system, Disconnected operations

Mobile Agents computing: Introduction, Advantages, Application Domains; security and fault tolerance: Protecting server, code signaling, Firewall approach; security techniques and algorithms: DES, 3DES, AES, Diffie-Hellman, RSA; transaction processing in mobile computing environment: Structure, properties, Data consistency.

Ad Hoc networks, localization, Routing protocols: Global state routing (GSR), Destination sequenced distance vector routing (DSDV), Fisheye state routing(FSR), Dynamic source routing (DSR), ABR, Route Discovery.

Suggested Books:

1. Yi-Bing Lin &Imrich Chlamtac, "Wireless and Mobile Networks Architectures", John Wiley & Sons, 2001.
2. Raj Pandya, "Mobile and Personal Communication systems and services", Prentice Hall of India, 2001.
3. Hansmann, "Principles of Mobile Computing", Wiley Dreamtech, 2004.
4. Mark Ciampa, "Guide to Designing and Implementing wireless LANs", Thomson learning, Vikas Publishing House, 2001

Elective 8

ISY6301 Bioinformatics
The Biologist & Internet: Internet basics, FTP, World Wide Web, and Introduction to Primary & Secondary database, GenBank, GCG, and ACDEB. Structure Databases: Introduction to structures, PDB, MMDB, Structure file formats, Visualizing structural information, Database structure viewers.
Information Retrieval from Biological Databases & submission of DNA Sequences to the Databases: Retrieving database entries, Integrated information retrieval: The ENTREZ system, sequence databases beyond NCBI, Medical Databases.
Sequence Alignment and Database Searching: Introduction, Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching.
 Multiple Sequence Alignment & Genome Mapping: Progressive alignment methods, Motifs and patterns, Probe, Presentation methods, Abscript; Different types of maps: physical, genetical, etc. Synteny, Human genome project, Application of genome mapping, Chromosome maps.
Predictive Methods Using Nucleotide & protein Sequences: Framework, marking repetitive DNA, Database search, Codon bias detection, detecting function sites in the DM, Protein identity based on composition.

Suggested Books:

1. A.D. Baxevanis and B.F.F. Ouellette , Bioinformatics: A practical guide to the analysis of genes and proteins, John Wiley and Sons. ISBN 0-471-38391-0,2004.
2. Rastogi, S.C., Mendiratta, N. and Rastogi , Bioinformatics: Concepts, Skills &Applications, CBS Publishers &Distributors, New Delhi. ISBN 13: 9788120330627, 2004.
3. Dix A., Finlay J.,Abowd G. D. and Beale R. Human Computer Interaction, 3rd edition, Pearson Education, 2005.

 ISY6303Data Mining

An Introduction to data ware housing, types of databases for data mining, functionalities of data mining, characteristics of data mining, classification of data mining systems, task primitives, integration of data mining with database, issues of data mining.

Data Objects and Attribute Types: Nominal Attributes, Big Data Preprocessing: reason for preprocessing, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

Data cube computation and data generalization: efficient methods of data cube computation, attribute oriented induction. Associations and correlations-basic concepts, efficient and scalable frequent item sets mining methods, mining various kinds of association rules, constrain- based association mining.

Classification and prediction: issues, classification by decision tree induction, Bayesian classification, rule based classification, SVM, classification by back propagation, associative classification, lazy learners; types of prediction methods: linear regression, non-linear regression.

Cluster analysis: types of data- interval scaled, binary, categorical, ordinal, ratio scaled.

Suggested Books

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann,2011
2. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education,2002.
3. Pieter Adriaans, DolfZantinge , "Data Mining", Pearson Education Asia,1997
4. Ralph Kimball, "The Data Warehouse Lifecycle toolkit", John Wiley, 2002.

ISY6305 Data Warehousing

The Building Blocks: Defining Features, Data Warehouses and Data Marts, Overview of the components, Metadata in the Data Warehouse.
Planning and Project Management: Planning Your Data Warehouse, The Data Warehouse Project, The Project Team, Project Management Considerations.
The Architectural Components: Understanding Data Warehouse Architecture, Distinguishing Characteristics,   Architectural Framework, Technical Architecture, Infrastructure Supporting Architecture, Collection of Tools
Data design and data preparation: From Requirements to Data Design, The STAR Schema, STAR Schema Keys, Advantages of the STAR Schema, Data Extraction, Data Transformation, Data Loading .
OLAP in the Data Warehouse: Demand for Online Analytical Processing, Major Features and Functions, OLAP Models.
Implementation and maintenance: physical design steps,   physical design considerations, physical storage, indexing the datawarehouse, performance enhancement techniques.
Suggested Books:

1. PaulrajPonniah, "Data Warehousing Fundamentals", John Wiley,2001
2. M.H. Dunham, "Data Mining Introductory and Advanced Topics", Pearson Education,2002.
3. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann,2011.
4. Pieter Adriaans, DolfZantinge , "Data Mining", Pearson Education Asia,2002.

ISY6307 Dev-Ops
Fundaments: Beginning DevOps for Developers, Definition of DevOps, Development and operationsin conflict, Views of DevOps, DevOps and Tool suites, Traditional Project Settings, Agile Project Settings, Development and operations in agile.
Metrics and Measurement view: Quality, Capacity, resilience, Key aspects of Quality, Degeneration, Faults and Failures,Testing, Quality gates, Hawthorne effect, Importance of Team,Facilitator and Caretakers, Shared Responsibilities.
Process view: The DevOps Area Matrix, Extend Development to   Operations, Value   Stream mapping, Nonfunctional Requirements, Conceptual Deficits, Principal-Agent Problem, Moral Hazard, Attributes of a Unified Approach.

Technical View: Environments and infrastructure, Patterns with Appropriate Tools, Baselines, Shared version number, Overview of Topology, Parameterizing Maven's Versions Plug-In, Apply Task-Based Development, Starting with Infrastructure as Code, Test Environments with Vagrant, Jenkins, Acceptance test driven development.

Aligning Engineering and Business Operations: Creating Symmetry for Engineering and Business, Understanding Developer Culture, Business Understands Technical Capabilities, Effectively Meeting Deadlines.

Suggested Books:

1. Michael Httermann , DevOps for Developers, Apress 2012.
2. Matthew Sacks , Website Development and Operations: Streamlining DevOps for Large-Scale Websites by Matthew Sacks, Apress, 2012.
3. Gene Kim, Jez Humble, and Patrick Debois , The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, 2016.
4. Michael Httermann, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, Jennifer Davis, 2016.DevOps for Developers, Apress 2012.

ISY6309   Evolutionary computing

Optimization background and terminology: Gradient optimization methods, sampling methods, linear programming, combinatorial optimization. **Evolutionary Biology background and terminology**: Genotype and phenotype, unit of selection, genes and traits, chromosomes, alleles, diploid and haploid, fitness, mutation and recombination.
Genetic Algorithms: Representation, operators, and standard algorithm. The building block hypothesis and the schema theorem.
Evolutionary strategies: Evolution in continuous variables.
Artificial landscapes and test functions: The Two-armed bandit problem. Multi-modal and deceptive functions. Royal roads. N-k landscapes. Hierarchical and fractal functions. Pareto evolution. **Co-evolution**: Multiple populations and single-population co-evolution, relative and absolute fitness, engagement and gradient loss, the red queen effect.
Symbiosis as a source of evolutionary innovation. Macro-mutations, Major transitions in evolution, symbiosis and symbiogenesis. How symbiosis can guide evolution.**Evolutionary algorithms as models**: Modeling sexual selection, modeling ecosystems, artificial life.
Modularity and regularity in evolution. The scaling problem and the curse of dimensionality. Evolvability. Module acquisition. Developmental models. Compositional and hierarchical approaches.

Suggested Books:
1. Eiben, A.E., Smith, James E, Introduction to Evolutionary Computing, Springer,2015.
2. Naruya Saitou, Introduction to Evolutionary Genomics, Springer,2013.
3. Ashish M. Gujarathi, Evolutionary Computation: Techniques and Applications, CRC Press,2016

VLS6311   Phase Locked Loop Design

Phase locked loops' requirements, Integer/ fraction-N PLLs, delay locked loops, injection locked loops, sub-sampled PLLs, Building Blocks- Phase/ frequency detectors, charge pumps, LC/ ring oscillators, multi modulus frequency dividers, Active/ passive loop filters.

Suggested Books:
1. Roland Best; Phase-Locked Loops, McGraw Hill.2007
2. Carlos Quemada, Guillermo Bistue, Inigo Adin; Design Methodology for RF CMOS Phase Locked Loops, Artech House,2019

ISY6311 GPU computing

Overview of GPUs: architecture, features, programming model.System issues: cache and data management, languages and compilers, stream processing, GPU-CPU load balancing.The Age of Parallel Processing, The Rise of GPU Computing, What Is the CUDA Architecture, Applications of CUDA.Parallel Programming in CUDA C, Thread Cooperation: splitting parallel blocks, shared memory and synchronization, Constant memory and events, texture memory, Graphics interoperability, atomics, advanced atomics, streams, CUDA C on multiple GPUs.

Suggested Books:
1. K R. Fernando and M. Kilgard, "The Cg Tutorial: The Definitive Guide to Programmable Real-Time,2009.
2. E. Kandrot and J. Sanders, Cuda by Example: an Introduction to General-Purpose Gpu Programming, Addison Wesley.2011
3. David B. Kirk, Wen-mei W. Hwu, Morgan Kaufmann, Programming Massively Parallel Processors: A Hands-on Approach, 22 Feb 2010.
4. Wen-Mei w. Hwu, Morgan Kaufmann , GPU Computing GEMS Emerald Edition, February 7, 2011

ISY6313 Information Retrieval

Information Retrieval Models: Boolean Model, Vector Space Model, Relational DBMS, Probabilistic Models, Language Models.

Web Information Retrieval: citation network analysis, social collaboration (PageRank and HITS algorithms), Term Indexing: Zipf's Law, term weighting

Searching and Data Structures: Inverted files to support Boolean and Vector Models, Clustering: non-hierarchical- single pass and reallocation; hierarchical agglomerative; String Searching trees, binary trees, binary digital trees, suffix trees, etc.

Retrieval Effectiveness Evaluation: Recall, Precision, Fallout, comparing systems using average precision.

User Search Techniques: Search statements and binding, Similarity measures and ranking, Relevance feedback, Selective dissemination of information search, Weighted searches of Boolean systems, Searching the Internet and hypertext. Information Visualization: Introduction, Cognition and perception, Information visualization technologies.

Text Search Algorithms: Introduction, Software text search algorithms, Hardware text search systems. Information System Evaluation: Introduction, Measures used in system evaluation, Measurement example – TREC results.

Suggested Books:

1. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.

2. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992

3. Yates, "Modern Information Retrieval", Pearson Education,2003

4. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze," Introduction to Information Retrieval", Cambridge University Press,2008.

5. Carlos Quemada, Guillermo Bistue, Inigo Adin; Design Methodology for RF CMOS Phase Locked Loops, Artech House, February 1, 2009.

ISY6315 Intelligent system and interface

Introduction: The study of Language, Introduction to NLP, Regular Expression, Finite State Automata, Evaluating Language Understanding Systems, Different levels of Language Analysis.

Grammars and Parsing: Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top-Down Chart Parsing, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold mechanisms in ATNs, Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.

Introduction to Machine Learning: Overview of different tasks: Supervised classification, regression, control, Concept learning, information theory and decision tree, Neural networks, Deep learning

Unsupervised Learning: Clustering, Expectation Maximization, Dimensionality Reduction, Feature Selection, PCA, factor analysis, manifold learning, clustering

Case studies of Intelligent systems and interfaces, Intelligent Work Processors, Machine Translation, User Interfaces, Man-Machine Interfaces, Natural language Querying Tutoring and Authoring Systems, Speech Recognition Commercial use of NLP.

Suggested Books:

1. Duda, Richard O., Peter E. Hart, and David G. Stork. Pattern Classification. John Wiley & Sons, 2012.

2. D. Jurafsky, J. H. Martin, Speech and Language Processing, Pearson Education,(ISBN-13: 978-8131716724), 2008

3. Foundation of Statistical Natural Language Processing, Manning and Schutze, (ISBN-13: 978-0262133609), 1998.

4. Simon O. Haykin. Neural Networks and Learning Machines. Pearson Education India, 2009.

ISY6317Introduction to cognitive science

Basic concepts of cognitive science, Domains of cognitive psychology, Cognitive Neuroscience and Nervous system.

 Concept of Learning, Evaluate Classical Conditioning, Operant conditioning as well as Observational learning. Long Term Memory, Memory processes and related theories.

Illusions, Dimensions of Perception, Attention, Attention Model, Thinking, Decision making, Problem solving, intelligence, theories of intelligence.

Study of Human intelligence which will include Measurement of intelligence, Artificial Intelligence, Language, Structure of language, Comprehension of language, language acquisition and connection with brain

Cognitive process, Cognitive biases and Cognitive deficits. Emphasis on drug abuse and how drug affect cognitive abilities of a person, role of cognition in causation of various pathologies, Cognition oriented therapies.

Suggested Books:

1. Thagard, Paul. Mind: Introduction to cognitive science. Vol. 4. Cambridge, MA: MIT press, 1996.

2. Dawson, Michael RW. Mind, body, world: Foundations of cognitive science. Athabasca University Press, 2013
3. Simon O. Haykin. Neural Networks and Learning Machines. Pearson Education India, 2009.

ISY6319 Introduction to spatial computing

Introduction to Geographic Information Systems, techniques for working with geospatial Data-Collection, Analysis and Visualization of spatial data

High-performance and scalable CyberGIS, CloudGIS, exploiting spatial characteristics of data, analytical operations for geospatial scientific discoveries, Geospatial mashups.

Cloud services for spatial computing, combination of geographic data, application, software, or platform as open source solutions for spatial issues.

Spatial Data Mining techniques and problem solving, Python geospatial libraries and application to real-world problems

Volunteered Geographic Information, Big Geospatial Data and GIS design, ArcGIS Desktop, Google Map and Google Earth,SPARQL

Geo-coding of text data, Sematic web technology and GIS, Geospatial Sematic Web.

Suggested Books:

1. Duckham, Matt. Decentralized spatial computing: foundations of geosensor networks. Springer Science & Business Media, 2012.
2. Horst, Bunke, Peng Lam, and Caelli Terry Michael, eds. Spatial computing: issues in vision, multimedia and visualization technologies. Vol. 24. World Scientific, 1997.

ISY6321Malware Analysis

Introduction to malware, OS security concepts, malware threats, evolution of malware, malware typesviruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis.
X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets. Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, Reverse Engineering- x86 Architecture, recognizing c code constructs in assembly, c++ analysis, Analysing Windows programs, Anti-static analysis techniques-obfuscation, packing, metamorphism, polymorphism.
Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques-anti-vm, runtime-evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wire shark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching
Downloader, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.
Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences
 Malware Characterization, Case Studies – Plankton, DroidKungFu, AnserverBot, Smartphone (Apps) Security

Suggested Books:

1. Michael Sikorski and Andrew Honig "Practical malware analysis The Hands-On Guide to Dissecting Malicious Software.2013
2. Xuxian Jiang and Yajin Zhou, Android Malware, Springer, 2013.
3. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

ISY6323Real time operating system

Introduction: Concept of Real Time System, Issues in real time computing, Performance measures of Real Time System, Issues in Real Time Computing, Performance measures of Real time Systems, Real Time Application. Task Assignment and Scheduling: Different task model, Scheduling hierarchy, offline vs Online Scheduling, Clock Drives.

Model of Real Time System: Processor, resources, temporal parameter, Periodic Task Model, Sporadic Task Model, Precedence Constraints and Data Dependencies, Scheduling hierarchy. Scheduling of Periodic Task: Assumptions, fixed versus dynamic priority algorithms, schedulability test for fixed priority task with arbitrary deadlines.

Scheduling of Aperiodic and Sporadic Tasks: Assumptions and approaches, deferrable, sporadic servers, slack stealing in deadline driven and fixed priority systems. Two level schemes for integrated scheduling, Scheduling for applications having flexible constrains. Resources and Resource Access Control: Assumptions on resources and their usage, resource contention, resource access control (Priority Ceiling Protocol, Priority Inheritance protocol, Slack Based Priority Ceiling Protocol, Preemption Ceiling Protocol).

Real Time Operating Systems – 1: RTOS Overview, RTOS Components, Task Management & Memory Management, Scheduling Strategies, Commercial Real-time Operating Systems.

Real time Communication: Model of real time Communication, Priority base service for switched network, Weighted Round Robin Service, Medium access Control Protocol, Real Time Protocol.

Suggested Books:

1. Michael Sikorski and Andrew Honig Practical malware analysis The Hands-On Guide to Dissecting Malicious Software, 22 February 2013
2. Xuxian Jiang and Yajin Zhou, Android Malware, Springer, 2013.
3. Victor Marak, Packt ,Windows Malware Analysis Essentials , Publishing, 2015.

ISY6325Soft computing

Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms- Perceptrons, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Applications of Artificial Neural Networks, Radial Basis Function networks

Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Functions, Fuzzy rule generation and solving, Mamdani, Sugeno and Tsukamoto fuzzy rule systems, Graphical fuzzy inferencing

Operations on Fuzzy Sets: Complement, Intersection, Union, Combinations of Operations, Aggregation Operations, Nonspecificity of Fuzzy Sets, Fuzziness of Fuzzy Sets

Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.

Evolutionary Computing:. Introduction, Evolutionary Techniques, Swarm Intelligence, Bacterial Foraging, Ant Colony Optimization, and Genetic Algorithm.

Introduction of Neuro-Fuzzy Systems: Architecture of Neuro Fuzzy Networks-ANFIS, MANFIS, CANFIS and other neuro-fuzzy network architectures, Learning mechanisms.

Suggested Books:
1. Jang, Jyh-Shing Roger, Chuen-Tsai Sun, and EijiMizutani. "Neuro-fuzzy and soft computing; a computational approach to learning and machine intelligence." PHI, 1997.
2. "An Introduction to Neural Networks", Anderson J.A., PHI, 1995.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms", by S. Rajasekaran& G. A. Vijayalakshmi Pai,: Synthesis & Applications, PHI, 2003.
4. "An Introduction to Genetic Algorithm", Melanie Mitchell, PHI, 1997

ISY6327Statistical Machine Learning
Introduction: Overview of Statistical Learning, The Trade-Off Between Prediction Accuracy and Model Interpretability, Supervised versus Unsupervised Learning, Regression Versus Classification Problems.
Linear Regression: Estimating the Coefficients in simple Linear Regression, Estimating the Regression Coefficients in Multiple Linear Regression, Comparison of Linear Regression with K-Nearest Neighbors.
Classification: An Overview of Classification, Estimating the Regression Coefficients for Logistic Regression, Multiple Logistic Regression, Linear Discriminant Analysis, A Comparison of Classification Methods.
Resampling Methods: Cross-Validation, The Validation Set Approach, k-Fold Cross-Validation, Bias-Variance Trade-Off for k-Fold Cross-Validation, Cross-Validation on Classification Problems.
Unsupervised Learning: The Challenge of Unsupervised Learning, Principal Components Analysis, K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering.
Ensemble Learning: Introduction, Boosting and Regularization Paths, The "Bet on Sparsity" Principle, Regularization Paths, Over-fitting and Margins, Learning a Good Ensemble, Rule Ensembles
Suggested Books:
1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani ,An introduction to statistical learning with applications in R, New York, Springer, 2013.
2. T. Hastie, R. Tibshirani, and J. Friedman , The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd Edition, Springer, 2009.
3. David Barber, Machine Learning: A probabilistic approach, 2006.
4. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
5. Larry Wasserman, All of Statistics: A Concise Course in Statistical Inference, Springer Texts in Statistics, Springer-Verlag, New York, 2004.

ISY6329Web intelligence and big data analytics
Introduction – distributed file system – Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.
Big Data – Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.
Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features- NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Suggested Books**:**

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk derooset al. , "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide" , O Reilly 2012.

ISY6331 Quantum computing

Introduction and Overview: qubits and pieces, Bloch sphere, quantum mechanical probabilities, quantum behaviours.

Quantum Mechanics:History of quanta, base states and superposition, structural randomness, measurement: how long is a qubit,Heisenberg's Uncertainty Principle, waveform collapsein the macroscopic limit, basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation

Fundamentals of Quantumness and Quantum Circuits: Abramsky-Coecke semantics, no-cloning theorem, quantum entanglement('spooky action at a distance'), Bell states and Bell inequalities, Pauli, Hadamard, phase, CNOT, Toffoli gates, quantum teleportation, the universality of two-qubit gates, reversible computing.

Quantum Algorithms: Deutsch-Josza algorithm,problem, quantum Fourier transform,Shor's period-finding algorithm, quantum key distribution (BB84, E91).

Quantum error-correction:The Shor code, Theory of quantum error-correction, Classical Linear codes. Calderbank–Shor–Steane codes, Stabilizer codes, Fault-tolerant quantum computation.

Quantum information theory: Distinguishing quantum states and the accessible information, Data compression, Classical information over noisy quantum channels, Quantum information overnoisy quantum channels, Entanglement as a physical resource, Quantum cryptography.

Suggested Books:

1. Michael A. Nielsen and Issac L. Chuang, "Quantum Computation and Information", Cambridge (2002)
2. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing Ltd (2012)
3. Scott Aaronson, "Quantum Computing since Democritus", Cambridge (2013).
4. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge (2010)

ISY6333 Intrusion detection and prevention

Intrusion detection, Intrusion Prevention Analysis, Rule based detection, Profile based detection, Stealth Probes Heuristics.

OSI reference model – seven layers IP,TCP, UDP, ICMP, ARP, DNS.

ARP abuses, IP abuses, TCP abuses, UDP abuses.

Memory buffer overflow, Format string overflow, Encrypted communication. TCPSplice, TCPFlow, TCPJoin Command line options, expressions, bulk capture. Tiered architecture, Sensors, agents

Packet capture, filtering, packet decoding Storage, fragment reassembly, stream reassembly Stateful inspection. Configuring Real Secure Creating and Implementing Event Filters Reporting Signatures.

Collecting requirements Defense Event viewer Network IDS Assigning packet capture to signatures.SNORT Modes, sniffer Packet capture, detection File order Filters, Alerts.

NER Sentivist Sensor Signatures Alerts and forensics. Data correlation definitions Data fusion, alert fusion Using statistical correlation Correlation coefficient Statistical inference.

Response types Response process Risk analysis Response methodology UDS and IPS incident response phases. IDS/IPS policy Standard, Baselines and procedures.

Suggested Books:
1. William Stallings, "Cryptography and Network Security: Principles and Practice.", Prentice-Hall.
2. Charles P. Pfleeger, "Security in Computing", Prentice Hall, February 5, 2015
3. Hansmann, "Principles of Mobile Computing", Wiley Dreamtech, 2004.
4. Mark Ciampa, "Guide to Designing and Implementing wireless LANs", Thomson learning, Vikas Publishing House, 2001.
5. Ray Rischpater, "Wireless Web Development", Springer Publishing, 2000
6. P.Stavronlakis, "Third Generation Mobile Telecommunication systems", Springer Publishers, 2001.

Elective 9

ISY6201Open area research seminar
Open area research seminar
Content to be decided as per the latest development and research in the concerned filed.

Semester-IV

ISY652 Research Project

ISY602Major Project II