GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Computing Science and Engineering

Program: M.Tech Computer Science and Engineering

Scheme: 2019 – 2021

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	CENG5001	Professional Communication Skills	0	0	2	1	50	-	50
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	20	50	100
3	MCSE1110	Advanced Design and Analysis of Algorithms	3	0	0	3	20	50	100
4	MCSE1120	Advanced Computer Networks	3	0	0	3	20	50	100
5	MCSE1130	Advanced Operating Systems	3	0	0	3	20	50	100
6	MCSE1150	Advanced Software Engineering	3	0	0	3	20	50	100
7	MCSE1111	Advanced Design and Analysis of Algorithms Lab	0	0	2	1	50	-	50
8	MCSE1121	Advanced Computer Networks Lab	0	0	2	1	50	-	50
9	MCSE1151	Technical Seminar	0	0	2	1	50	-	50
		Total	**15**	**1**	**8**	**20**			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCSE1240	Artificial Intelligence & Machine Learning	3	0	0	3	20	50	100
2	MCSE9100	Data Mining & Analytics using R	3	0	0	3	20	50	100
3	MCSE1260	Research Methodology	3	0	0	3	20	50	100
4	MCSE9260	Elective-1	3	0	0	3	20	50	100
5	MCSE1241	AI & ML using Python Lab	0	0	4	2	50	-	50
6	MCSE9101	Data Mining & Analytics using R Lab	0	0	4	2	50	-	50
7	MCSE1250	Python Programming	0	0	4	2	50	-	50
8	MCSE1251	Advanced Java Programming Lab	0	0	4	2	50	-	50
9	SLMC5012	English Proficiency and Aptitude Building - 2	0	0	2	1	50	-	50
10	MCSE1261	Certification Course/Term Paper	0	0	2	1	50	-	50
		Total	**12**	**0**	**20**	**22**			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCSE2320	Software Project Management	3	0	0	3	20	50	100
2		Elective-2	3	0	0	3	20	50	100
3		Elective-3	3	0	0	3	20	50	100
4	SLMT5001	Quantitative and Communication Proficiency	0	0	2	1	50	-	50

5	MCSE2321	Software Development Lab	0	0	4	2	50	-	50
6	MCSE2381	M. Tech Dissertation Part-1	0	0	0	5	50	-	50
		Total	**9**	**0**	**6**	**17**			

Semester IV

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MCSE2481	M. Tech Dissertation-Final	0	0	30	15	**50**	**-**	**50**
		Total	**0**	**0**	**30**	**15**			

List of Electives

Basket-1

Sl No		**Course Code**	**Name of the Electives**				
				L	**T**	**P**	**C**
1	**Elective-1**	MCSE9110	IoT Technology and Applications	3	0	0	3
2		MCSE9120	IoT on Cloud	3	0	0	3
3		MCSE9130	Big Data Mining and Analytics	3	0	0	3
4		MCSE9260	Foundations of Information Security	3	0	0	3

Basket-2

Sl No		**Course Code**	**Name of the Electives**				
				L	**T**	**P**	**C**
1	**Elective-2**	MCSE9310	Formal models of software systems	3	0	0	3
2		MCSE9320	Embedded Software Development	3	0	0	3
3		MCSE9330	Social Network Analysis	3	0	0	3
4		MCSE9340	Bio-inspired Computing	3	0	0	3

Basket-3

Sl No		**Course Code**	**Name of the Electives**				
				L	**T**	**P**	**C**
1	**Elective-3**	MCSE9410	Data Visualization Techniques	3	0	0	3
2		MCSE9420	Reconfigurable Computing	3	0	0	3
3		MCSE9430	Mobile Application Development	3	0	0	3
4		MCSE9440	Information Storage Management	3	0	0	3

Detailed Syllabus

Name of The Course	Professional and Communication Skills			
Course Code	CENG 5001			
Prerequisite				
Corequisite				
Antirequisite				
L	T	P	C	
0	0	2	1	

Course Objective:

1. To develop the professional and communicational skills of learners in a technical environment.
2. To enable students acquire functional and technical writing skills.
3. To enable students acquire presentation skills to technical and non-technical audience.

Course Outcomes:

CO1	Improve their reading fluency skills through extensive reading
CO2	Use and assess information from academic sources, distinguishing between main ideas and details
CO3	Compare and use a range official support through formal and informal writings
CO4	The students will be able to exhibit language proficiency in comprehending, describing, and investigating.

Text Books

1. Rajendra Pal and J.S.Korlahalli. Essentials of Business Communication. Sultan Chand & Sons. New Delhi.

Reference Books

1. Kaul. Asha. Effective Business Communication.PHI Learning Pvt. Ltd. New Delhi.2011.
2. Murphy, Essential English Grammar, CUP.
3. J S Nesfield, English Grammar: Composition and Usage
4. Muralikrishna and S. Mishra, Communication Skills for Engineers.

UNIT 1:
Aspects of Communication; Sounds of syllables; Past tense and plural endings; Organizational techniques in Technical Writing; Paragraph Writing, Note taking, Techniques of presentation
UNIT 2:
Tense, Voice, conditionals, Techno-words; Basic concepts of pronunciation; word stress; Business letters, email, Techniques for Power Point Presentations; Dos and don'ts of Group Discussion
UNIT 3:
An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills

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Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
50	-	50	100

Name of The Course	Advanced Numerical and Statistical Methods			
Course Code	MATH5001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objective:

With ever growing demand of computational techniques, scope of numerical methods is penetrating aggressively into major and important fields including Science, Engineering &Technology, Medical, Space Science, Economics, Business and Environment. The objective is to achieve knowledge and understanding of numerical methods and to apply appropriate methods to model and solve problems where ordinary analytical methods fail. Statistical methods are used in manufacturing, development of food product, computer software, energy sources, pharmaceuticals and many other areas. The objective of statistics and probability is to analyze data to make scientific judgments in the face of uncertainty and variation for the improvement of the desired quality.

Course Outcomes:
At the end of the course, students will be able to:

CO1	Apply various numerical methods to solve system of linear and non-linear equations.
CO2	Apply standard interpolation methods to interpolate required/ missing value.
CO3	Apply appropriate methods of numerical differentiation /integration to solve related problems.
CO4	Solve ordinary differential equations and partial differential equations using appropriate numerical methods.
CO5	Identify the type of distributions and apply a suitable test to draw the conclusion.

Text Books:

1. Numerical Methods for Scientific and Engineering Computation (6^{th} edition) by Jain, Iyengar & Jain, New Age International publishers.
2. Probability & Statistics for Engineers & Scientists (9^{th} edition) by R.E.Walpole, R,H,Myers & K.Ye.

Reference Books:

1. Numerical Methods by E Balagurusamy, Tata McGraw Hill
2. Curtis F. Gerald and Patrick O Wheatley, Applied Numerical Analysis, Pearson Education Ltd.
3. Introductory Methods of Numerical Analysis by S.S. Sastry, PHI learning Pvt Ltd.
4. Numerical methods for Engineers (6^{th} edition), Steven C. Chapra and Raymond P. Caynale.
5. Numerical Methods in Engineering & Science (9^{th} edition), by B.S.Grewal
6. Statistical Methods by S.P. Gupta, Sultan Chand and Sons
7. Probability and Statistics by Schaum's series (3^{rd} edition)

Unit –I **8 Hours**

System of Linear Equations: Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss- Seidel and Jacobi method, ill conditioned matrix System of Non-linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods

Unit -II **8 Hours**

Interpolation and Approximation: Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, Least square approximation.

Unit -III **8 Hours**

Numerical Integration: Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration An introduction to Modal and Phrasal verbs; Expansion; Word formation; Technical Resume; Company Profile Presentation; Interview Skills

Unit -IV **9 Hours**

Numerical Solution of Differential Equations: Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor-Corrector method, Solution of Laplace's and Poisson's equations by Liebman's method, Solution of one dimensional time dependent heat flow.

Unit -V **9 Hours**

Probability and statistics: Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced Design and Analysis of Algorithms				
Course Code	MCSE1110				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To know the importance of the complexity of a given algorithm.
2. To study various algorithmic design techniques.
3. To utilize data structures and/or algorithmic design techniques in solving new problems.
4. To know and understand basic computability concepts and the complexity classes P, NP, and NP-Complete.

Course Outcomes

At the end of the course, students will be able to:

CO1	Analyze the complexity of the algorithms and use technique divide and conquer to solve the problems
CO2	Identify feasible solutions for different problems through greedy method and minimize the solutions space and to solve the problems through dynamic programming.
CO3	Solve the problems through graph algorithms.
CO4	Justify that a certain problem is NP-Complete
CO5	Understand and apply linear programming concepts to real time applications.

Text Books

1. Cormen, Leiserson, Rivest and Stein, "Introduction to Algorithms", 2nd Edition, by, McGraw-Hill, 2000.
2. E. Horowitz, and S. Sahni, "Fundamentals of Computer Algorithms", Computer Science Press (1978).

Reference Books

1. Jon Kleinberg and Eva Tardos. Algorithm Design. Pearson Education, 2007.
2. Sanjoy Das Gupta, Christos Papadimitriou, Umesh Vazirani, Algorithms 1st Edition, Mcgraw Higher Ed, 2006.
3. Alfred V. Aho, John E. Hopcroft, Jeffery D.Ulman, Data Structures and Algorithms, Pearson; 1st edition, 2001.

Course Content

Unit I: Introduction **9 Hours**

Overview of algorithmic design, asymptotic notation and its properties, Growth of Functions, Time complexity and Analysis of algorithms, Recurrence Relations.

Unit II: Sorting and Searching Algorithms **9 Hours**

Brute Force Method - Sorting in Quadratic time, insertion , selection and Bubble sort; Divide and conquer method- Sorting in Logarithmic time – Quick Sort , merge Sort , Shell Sort , Heap sort; Non-comparison sorts - Sorting in Linear Time - Counting Sort , Radix Sort , Bucket Sort; Worst Case and best case analysis of all sorting algorithms; Linear Search, Binary Search, Hashing, Randomized select , randomized quick sort.

Unit III: Algorithms for Trees **9 hours**

Binary Tree - Binary Tree traversals, Binary Search Tree, heap, priority Queues, Red Black Trees, B-Trees.

Unit IV : Graph Algorithms **8 hours**

Graph Searching- Breadth-First Search, Depth-First Search, DAGs and topological sorting, minimum spanning tree, shortest path, backtracking, Network flow algorithms.

Unit V: Greedy Algorithms, Amortized Analysis and Dynamic Programming 10 hours

Longest common subsequence, Greedy Algorithms - Knapsack problem; Huffman codes, Algorithms for String Matching, Theory of NP-completeness; Turing machines and the halting problem, Applications of Algorithms in Databases, Information Retrieval and Web Searching, Data Mining

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced Computer Networks				
Course Code	MCSE1120				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

The objective of this course is to:

1. An ability to understand the basic concept of data communications and computer networks (e.g., different network types, applications, protocols, OSI layered architecture model, switching methodologies)
2. Provide the skills needed for algorithms in computer networks for various situations that one may encounter in a career in Computer Science.
3. Learn different algorithmic methodologies to design efficient algorithms and protocols in network field.

Course Outcomes

At the end of the course, students will be able to:

CO1	To develop knowledge about physical structure of computer network
CO2	To understand the fundamental concepts in routing and addressing
CO3	To analysis the problem in different layer during the communication in network
CO4	To understand the congestion control and transport protocols
CO5	To became expert to use of Internet and public network
CO6	To able to understand the connection management in network at transport layer

Text Books

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, Third Edition, Tata McGraw-Hill, 2005.
2. W. Richard Stevens, TCP/IP Illustrated, The Protocols, Pearson Education, 2004.
3. D. E. Comer, Internetworking with TCP/IP Principles, Protocols and Architecture Vol - I, Pearson Education, 2001.

Reference Books

1. Internetworking with TCP/IP: Design, Implementation, and Internals by Douglas E. Comer, Stevens.Prentice Hall. Hardcover- 30 April, 2004.
2. Networks Fundamental Video 3 - the Transmission Control Protocol/internet Protocol (Tcp/ip) Stack by Delmar.Delmar. Unknown Binding- 1 December, 2002.
3. Advanced IP Routing in Cisco Networks (McGraw-Hill Technical Expert) by Terry Slattery, Bill Burton. Osborne McGraw-Hill. Paperback- 1 October, 2000.

Course Content

Unit I: Networking Standards and Specification **8 hours** Networking standards and specifications, Need for standardization, ISO and the IEEE standards, The IEEE 802 Project
Unit II: Addressing and Routing **8 hours** Network names and addresses, Physical layer addressing: the MAC address, Network layer addressing: The IP address, Network layer address: The IPX address.
Unit III: Overview of OSI and TCP/IP Protocol Suite **8 hours** Converting network names to IP addresses, Resolving IP addresses to physical addresses, Addressing and routing.

Unit IV : TCP/IP Protocol Suite **8 hours** TCP/IP Protocol Suite, TCP/IP Protocol Suite advantages, Internet Protocol (IP), Transport Layer Protocols -TCP and UDP, File Transfer protocols - FTP and TFTP, Mail and news protocols - SMTP, POP3, NNTP and IMAP, Other Protocols Suite – ICMP and ARP.
Unit V: Other Networking Protocols **8 hours** The IPX/SPX Protocol Suite, NetBEUI, AppleTalk Protocol, File sharing protocols - SMB, NCP, and NFS, Routing protocols - RIP, OSPF and BGP, Network Management Protocol – SNMP and CIMP, Convergent Protocols – H.323 and SIP

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Advanced Operating Systems				
Course Code	MCSE1130				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To learn the fundamentals of Operating Systems.
2. To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols.
3. To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols.
4. To know the components and management aspects of Real time, Mobile operating systems.

Course Outcomes

At the end of the course, students will be able to:

CO1	Discuss the various synchronization, scheduling and memory management issues.
CO2	Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
CO3	Discuss the various resource management techniques for distributed systems.
CO4	Identify the different features of real time and mobile operating systems.
CO5	Install and use available open source kernel.
CO6	Modify existing open source kernels in terms of functionality or features used.

Text Books

1. Mukesh Singhal and Niranjan, "Advanced Concepts in Operating Systems", TMH, 1st Edition, 2001
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, 2nd Edition, 2006
3. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education, 2nd Edition, 2001.
4. Pradeep K. Sinha, "Distributed Operating Systems and concepts", PHI, First Edition, 2002

Reference Books

1. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
3. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.

Course Content

Unit I: Introduction **8 hours** Operating system concept - processes and threads, process model, process creation, process termination, process hierarchies, and process states, Implementation of processes, Threads- Thread model, thread usage, Implementation of threads in user space and kernel, Hybrid implementations.
Unit II: Inter Process Communication **8 hours**

Race conditions, critical regions, Mutual Exclusion with busy waiting, sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing; Scheduling- scheduling in batch systems, Interactive systems, Real time systems, Thread scheduling.
Unit III: Deadlocks **8 hours** Deadlocks-Introduction, Deadlock Detection and Recovery – Deadlock Detection with one resource of each type, with multiple resource of each type, recovery from deadlock; Deadlock Avoidance, Deadlock Prevention
Unit IV : Memory and Device Management **8 hours** Introduction, Swapping, Paging, Virtual memory – Demand paging, page replacement Algorithms; File System Management- Organization of File System, File Permissions, MS DOS and UNIX file system case studies, NTFS; Device Management- I/O Channels, Interrupts and Interrupt Handling, Types of device allocation.
Unit V: Distributed Operating Systems **8 hours** Distributed operating system concept – Architectures of Distributed Systems, Distributed Mutual Exclusion, Distributed Deadlock detection, Agreement protocols, Threads, processor Allocation, Allocation algorithms, Distributed File system design; Real Time Operating Systems: Introduction to Real Time Operating Systems, Concepts of scheduling , Real time Memory Management.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Advanced Software Engineering				
Course Code	MCSE1150				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand Software Engineering Lifecycle Models
2. To do project management and cost estimation
3. To gain knowledge of the System Analysis and Design concepts.
4. To understand software testing approaches
5. To be familiar with DevOps practices

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand the advantages of various Software Development Lifecycle Models
CO2	Gain knowledge on project management approaches as well as cost and schedule estimation strategies
CO3	Use UML diagrams for analysis and design
CO4	Architect and design using architectural styles and design patterns
CO5	Understand software testing approaches
CO6	Understand the advantages of DevOps practices

Text Books

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.

Reference Books

1. Len Bass, Ingo Weber and Liming Zhu, ―DevOps: A Software Architect‘s Perspective‖, Pearson Education, 2016
2. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009. 6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

Course Content

Unit I: INTRODUCTION **9 hours**

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

Unit II: SOFTWARE REQUIREMENT SPECIFICATION **9 hours**

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

Unit III: ARCHITECTURE AND DESIGN **9 hours**

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design

Unit IV : TESTING **9 hours**

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

Unit V: DevOps **9 hours**

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture Building and Testing-Deployment- Case study: Migrating to Micro services.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Technical Seminar**				
Course Code	**MCSE1151**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

Progressive Assessment:

The progressive assessment would be carried out based on following criteria**.**

i. Innovativeness of the topic
ii. Initiative and efforts taken in searching the topic
iii. Amount and quality of material collected related to topic by searching library/internet/automobile companies etc.
iv. Creativity and innovativeness in preparing models/charts etc.
v. Planning the activities and then pursuing that plan.
vi. Persistence in the efforts and resourcefulness.
vii. Communication skills.
viii. Timely achievement of the targets.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Exam (ETE)**	**Total Marks**
50	50	100

Name of The Course	**Artificial Intelligence & Machine Learning**				
Course Code	**MCSE1240**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

1. Understand the Concept of artificial intelligence &machine learning.
2. Understand the Concept of Neural Network.
3. Learn essentials of R language.
4. Decision making through Inference Technique.
5. Make students understand the knowledge discoveries in AI & ML.
6. Learn AI & ML tools.

Course Outcomes

At the end of the course student will be able to:

CO1	Students should know about artificial intelligence and machine learning
CO2	Students should know about artificial intelligence and machine learning
CO3	Students should learn machine learning tools.
CO4	Students should know about neural networks.
CO5	Students use prediction of AI techniques.
CO6	Students can use classification of machine learning algorithm
CO7	Further take the R&D interest and try to contribute some new methods to the area.

Text Books

1. Artificial Intelligence - A Modern Approach ; Stuart J. Russell, Peter Narvig.

Reference Books

1. Super Intelligence - Paths,Danger,Strategies ; Nick Bostrom
2. How to Create a Mind ; Ray Kirzweil.
3. Artificial Intelligence-A Modern Approach ; Stuart J. Russell,PeterNarvig
4. Deep Learning with R ; Francois Chollet, J.J. Allaire.
5. Deep Learning (Adaptive Computation and Machine Learning series) ; Ian Goodfellow.

Course Content:

UNIT 1 Introduction to data science and AI & ML + Foundation of AI & ML 9 Hours Data Science, AI & ML, Use cases in business and scope, Scientific method, Modeling concept, CRISP-DM method, ML techniques overview, Validation techniques(Cross-validation), Feature reduction/ Dimensionality reduction, Principle component analysis(Eigen value, Eigen vector, Orthogonality), AI application areas, AI basics(divide & conquer, greedy, branch and bound,Gradient descent), NN basics(perceptron and MLP, FFN, Back propagation).
UNIT 2 Reinforced Learning 8 Hours

Data exploration(histograms, bar chart, box plot, line graph, scatter plot), Qualitative and quantitative data, Measure of central tendencies(mean,median,mode), Measure of positions(quartiles, deciles, percentiles and quantiles), Measure of dispersion(range, median, absolute deviation about median, variance and standard deviation), Anscombe's quartet, Other measures - quartile and percentile, interquartile range

UNIT 3 Principles of Big Data and Frameworks(Hadoop,Spark,NoSQL) 8 Hours

Introduction to big data, Challenges of processing big data(volume, velocity, variety perspective), Use cases, Processing, storage and programming framework, Hadoop ecosystem components and functions, Essential algorithms (word count, page rank, IT-IDF), Spark: RDDs, streaming and spark ml, NoSQl concepts(CAP, ACID, NoSQL types)

UNIT 4 Neural Networks 8 Hours

Convolution NN, Image classification, Text classification, Image classification and hyper parameter tuning, Emerging NN architecture,Recurrent NN,Building recurrent NN, Long short-term memory, Time series forecasting

UNIT 5 Classification 9 Hours

Naive Bayes Classifiers-Model Assumptions, Probability estimation, Required data processing, M-estimates. Feature selection Mutual information, Classifiers,K-Nearest Neighbors-Computational geometry; Wilson editing and triangulation, Aspects to consider while designing K-Nearest Neighbour,Support Vector Machines-Linear learning machines and Kernel space, making Kernels and working in feature space, SVM for classification and regression problems,Decision Trees,ID4, C4.5, CART,Ensembles Trees ,Bagging & boosting and its impact on bias and variance, C5.0 boosting, Random forest, Gradient Boosting Machines and XGBoost

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Data Mining & Analytics using R				
Course Code	MCSE9100				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To learn data analysis techniques.
2. To understand Data mining techniques and algorithms.
3. Comprehend the data mining environments and application.

Course Outcomes

Students who complete this course will be able to

CO1	To Compare various conceptions of data mining as evidenced in both research and application
CO2	To Characterize the various kinds of patterns that can be discovered by association rule mining
CO3	To Evaluate mathematical methods underlying the effective application of data mining.

Text Books:

1. Adelchi Azzalini, Bruno Scapa, "Data Analysis and Data mining", 2nd Edition, Oxford University Press Inc., 2012.

Reference Books

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2011.
2. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", 10th Edition, TataMc Graw Hill Edition, 2007.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", 1st Edition, Easter Economy Edition, PHI, 2006.

Course Content:

UNIT- I INTRODUCTION TO DATA MINING 9 Hours Data mining - KDD versus data mining - Stages of the Data Mining Process- Data Mining Techniques – KDD Process - knowledge representation – Data mining query languages- Integration of a Data Mining System with a Data Warehouse – Data pre-processing – Data cleaning- Data transformation- Feature selection- Dimensionality reduction
UNIT-II ASSOCIATION AND CLASSIFICATION 9 Hours Association Rules- Association rule Mining -Mining frequent patterns association- Apriori Algorithm -correlation – Classification - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Associative - Classification – Lazy Learners – Other Classification Methods
UNIT-III CLUSTERING 9 Hours

Clustering techniques – Partitioning methods- k-means Clustering - Hierarchical Methods – Distance based agglomerative and divisible clustering - Density-Based Methods – Expectation maximization -Grid Based Methods – Model-Based Clustering Methods – Constraint – Based Cluster Analysis – Outlier Analysis.
UNIT-IV DATA MINING SOFTWARE AND APPLICATIONS 9 Hours Mining complex data objects - Spatial databases - temporal databases - Multimedia databases- Time series and Sequence data - Text Mining - Graph mining - Web mining - Application and trends in data mining.
UNIT-V METHODS OF INTERNAL ANALYSIS & DATA ANALYTICS USING R 8 Hours Methods of Internal analysis – Cluster analysis – Association among variables – Web mining analysis -Data Analytics – Simulated data – Mathematical statistic analysis – Applications of probability theory – Linear models – Case study.

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Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Research Methodology				
Course Code	MCSE1260				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Identify an appropriate research problem in their interesting domain.
2. Understand ethical issues Understand the Preparation of a research project thesis report.
3. Understand the Preparation of a research project thesis report
4. Understand the law of patent and copyrights.
5. Understand the Adequate knowledge on IPR

COURSE OUTCOMES (COs):

CO1	Understand the research problem and research process.
CO2	Understand research ethics.
CO3	Prepare a well-structured research paper and scientific presentations
CO4	Explore on various IPR components and process of filing.
CO5	Understand the adequate knowledge on patent and rights

Text Books:

1. Stuart Melville and Wayne Goddard, " Research methodology: an introduction for science & engineering students"

Reference Books:

1. Ranjit Kumar, 2nd Edition, " Research Methodology: A Step by Step Guide for beginners

Course Content:

UNIT-I	MEANING OF RESEARCH PROBLEM	9 Hours
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.		
UNIT-II	**LITERATURE STUDIES**	**9 Hours**
Effective literature studies approaches, analysis Plagiarism, and Research ethics.		
UNIT-III	**TECHNICAL WRITING**	**9 Hours**
Effective technical writing, how to write report, Paper Developing a Research Proposal. Format of research proposal, a presentation and assessment by a review committee.		
UNIT-IV	**RESEARCH PROPOSAL**	**9 Hours**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.		

UNIT-V	PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR	9 Hours
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**AI & ML using Python Lab**				
Course Code	**MCSE1241**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objectives:

1. Understand the concept of Artificial Intelligence & Machine Learning.
2. Understand the multi-dimensions of Artificial Intelligence.
3. Learn the tools for AI & Ml.
4. Make students understand the knowledge discoveries in AI & ML.
5. Learn machine learning techniques. Introduction to Neural networks.

Course Outcomes

At the end of the course student will be able to:

CO1	Students should know about artificial intelligence and machine learning
CO2	Students should learn machine learning tools.
CO3	Students should know about neural networks.
CO4	Students use prediction of AI techniques.
CO5	Students can use classification of machine learning algorithm.
CO6	Further take the R&D interest and try to contribute some new methods to the area.

Module I	**Introduction to Artificial Intelligence and Machine Learning tools.**	
1. PyTorch - Download and Install Anaconda (https://www.anaconda.com/distribution/) then install pyTorch repository. 2. Weka - Install Weks (https://sourceforge.net/projects/weka/) then install JDK. 3. Tableau - Download and Install Tableau Public (https://public.tableau.com/en-us/s/download). 4. Knime - Download and Install Knime (https://www.knime.com/downloads/download-knime) . 5. Google ML - Download and Install (https://developers.google.com/ml-kit) 6. Apache Mahout - Download and Install (https://mahout.apache.org/) 7. Scikit Learn - Download and Install Anaconda (https://www.anaconda.com/distribution/) or pyCharm (https://www.jetbrains.com/pycharm/) and then use Scikit learn. 8. Tensor Flow - Download and Install (https://www.tensorflow.org/install) 9. Shogun - Download and Install 10. Colab - Download and Install		
Module II	**Programs based on the respective tools .**	
1. PyTorch - MNIST classification, Image Super-Resolution, Image Colorization, Text-Classification, CUB dataset, COCO dataset, 2. Weka - 3. Tableau - Data Connection, Organizing and Simplifying Data, Mapping, Analytics, Data Visualization. 4. Knime - Data Analyze, Data Pre-processing, Data Visualization, Data Manipulation, Data Wrangling. 5. Google ML - 6. Apache Mahout - 7. Scikit Learn - 8. Tensor Flow - 9. Shogun - 10. Colab -		
Module III	**Artificial Intelligence and Machine Learning programs using Python**	
1. Use Tensor Flow library to perform AI & ML program. 2. Use Scikit-Learn library to perform AI & ML program. 3. Use NumPy library to perform AI & ML program. 4. Use Theano library to perform AI & ML program. 5. Use Keras library to perform AI & ML program. 6. Use NLTK library to perform AI & ML program. 7. Use Mahout library to perform AI & ML program. 8. Use PyTorch library to perform AI & ML program. 9. Implementing KNN - classification clustering algorithm using python.		

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Exam (ETE)	Total Marks
50	50	100

Name of The Course	Data Mining & Analytics using R Lab				
Course Code	MCSE9101				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	4	2

List of Projects

1. Box office prediction using twitter reaction.
2. Tweet emotion analysis.
3. Prediction of the weather forecast.
4. Detecting fraud apps using sentimental analysis.
5. Movie success prediction.
6. Crime rate using k means.
7. Cancer prediction using data mining.
8. Topic detection using keyword clustering.
9. Smart Health Disease Prediction using Naive Bayes
10. Diabetes Prediction using data mining
11. TV show popularity analysis using data Mining
12. Secure E-learning using data mining techniques
13. E-banking Log system
14. Data Mining for Sales Prediction in the tourism industry
15. Cancer Prediction Using Data Mining
16. Financial status analysis using credit score rating
17. Opinion Mining for restaurant reviews
18. Personality Prediction System using CV Analysis.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Exam (ETE)	Total Marks
50	50	100

Name of The Course	Python Programming				
Course Code	MCSE1250				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	4	2

List of Experiments

1. Write a python program to print all prime numbers among the interval given by user.
2. Write a python program to double the values in a list using map()
3. Write a python program to show the importance of operator precedence and associativity of different operators
4. Write a python program to do the following operations
    a. Reversing a given integer number.
    b. Find the sum of digits of given integer number.
5. Write a python program to implement Dice game for 2 players using random()
6. Write a python program to utilize all in-built mathematical functions.
7. Write a python program to check the given string is palindrome or not, without using In-built functions.
8. Write a python program to find a character and number of occurrence of a given character in a string.
9. Write a python program to manage student's details using dictionary.
10. Write a python program to design groceries billing system using dictionary.
11. Write a python program to get a date from user and give the day as output
12. Write a python program to find the number of days between two dates given by user.(Age Calculator)
13. Write a python program tofind Factorial of a given number without using Recursion Concept.
14. Write a python program tofind sum of N given numbers using Recursion by using Function.
15. Write a python program using the module, maintain students data and retrieve it accordingly.
16. Write a python program to implement a user defined math function using module.
17. Write a python program to copy the content of one file to another file.
18. Write a python program to search the give character or string is present in a file.
19. Write a python program which defines a function f. f takes two arguments a and b and do (a+b) / (a-b) computation. Implement exception handling with try, catch and else.
20. Write a python program to take input from the user again and again until correct value is given by user. Three user defined exceptions can be created i.e:
    a. NegativeValueError(if value entered is negative),
    b. ValueTooLarge(if value entered is more than stored value), and
    c. ValueTooSmall(if the value stored is less than stored value).

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Exam (ETE)	Total Marks
50	50	100

Name of The Course	Advanced Java Programming Lab(PBL)				
Course Code	MCSE1251				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn advanced Java programming concepts like interface, threads, Swings etc.
- To develop network programs in Java
- To understand Concepts needed for distributed and multi-tier application
- To understand issues in enterprise applications development.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO1	Develop Swing-based GUI
CO2	Develop client/server applications using socket programming
CO3	Design, Update and retrieve the data from the databases using SQL
CO4	Develop distributed applications using RMI and component-based Java software using JavaBeans
CO5	Develop server-side programs in the form of Servlets and enterprise applications.

Text Books:

1. Elliotte Rusty Harold, "Java Network Programming", O'Reilly publishers, 2004
2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc., 2004.

Reference Books:

1. Hortsmann& Cornell, "CORE JAVA 2 ADVANCED FEATURES, VOL II", Pearson Education, 2002.
2. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", Tata McGraw-Hill, 2003.

Online resources

1. www.cs.rit.edu/~jmk/java707/lecnotes/lecnotes.html
2. http://www.inf.ed.ac.uk/teaching/courses/cs2/LectureNotes/CS2Bh/APJ/apj5.pdf
3. http://ebookmaterials.blogspot.in/2011/07/advanced-programming-in-java-lecturer.html
4. http://java.sun.com.

ROLES OF CO-ORDINATOR:

- Give PBL orientation and motivation to students
- Clarify the doubts in the PBL process
- Monitor and record the progress of each individuals
- Evaluating and measuring the course outcome attainment
- Collect the feedback from the students and keep track of records

ROLES OF STUDENTS:

- Identify the suitable projects for Advanced Java Programming
- Individual student should develop the projects
- Must follow the deadline given for the review
- Equally contribute to the development of projects
- Project should be unique for MTE, ETE (2 different project problem)

BASIC LAB EXERCISES:

LIST OF EXPERIMENTS: CYCLE – I

S.No.	Experiment Name
1.	Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings
2.	Apply Event Handling on AWT and Swing components
3.	Develop java swing program to accept two numbers from user and output the sum, difference in the respective text boxes.
4.	Develop a website using HTML and validating the form fields by using Java script
5.	Servlet program to implement and demonstrate get () and post() methods (using HTTP Servlet class).
6.	Session tracking for a hit count using Java Servlet.

LIST OF EXPERIMENTS: CYCLE – II

S.No.	Experiment Name
1.	Create three tier application using Servlet by incorporating Java Database Connectivity inside Servlet to save data in a table.
2.	Creating JSP program to implement attributes of directive tags
3.	Cookies and session management using JSP
4.	Create MVC application with Struts framework: using Servlet /JSP
5.	Creating Stateless and Stateful Session Beans
6.	EJB Application that demonstrates Entity Bean, Session Bean

LIST OF PBL PROJECTS:

1. Students Assessment system in Java
2. Flight Reservation System in Java
3. Hotel Management System in Java
4. Gas Booking system in Java
5. Weather Forecasting system in Java
6. Candidate Management system in Java
7. University Management System in Java
8. Simple Car Sales System in JAVA
9. Bus Management System in Java
10. Hospital Management in JAVA
11. Library Management System in Java

12. Online Medical Diagnostic System in JAVA
13. Student Information System in JAVA
14. Vehicle Management System in JAVA
15. College Library Management in JAVA
16. Group of Hotels Management in J2EE
17. Human Resource Database Management System in Java
18. Design of Shopping Mall Management System
19. Online Course Registration System in JAVA
20. Simple Search Engine in JAVA Servlets
21. Simple Railway Reservation in JAVA
22. Simple Chat Program in JAVA
23. Weather Report Application in JAVA
24. Online Address Book in JAVA
25. Mini Orkut Using JAVA
26. Web Auction in EJB
27. Telephone Billing System
28. Vehicle Investigation System in JSP
29. JAVA Based Online Shopping
30. Stock Market Trading

REQUIRED SOFTWARE:

1. Microsoft Windows (Version 7 or later)
2. Web server (WebLogic/ Glassfish Server/ Xampp Server)
3. Java Development Kit (JDK 1.8 or later)
4. Eclipse IDE

RUBRICS FOR EVALUATION:

1) IA Rubric:

IA Components	Marks Awarded
Quiz- Moodle/LMS	10
Activity based mini model	10
Co-curricular activities	10
Extra curricular Actitvities	10
Design of Mini Application –GUI & Implementation	10
Total	50(scale to 20)

2) MTE - Rubric:

IA Components	Complete App Development (Marks)
Project Specification & Detailed Design	10
GUI / Website design	10
Data base Connectivity	5
Project Implementation	20
Viva-Voce	5

TOTAL	50(Scale to 30)

3) ETE - Rubric:

IA Components	Complete App Development (Marks)
Quiz	20
Detailed Design	20
GUI / Website design	10
Data base Connectivity	10
Project Implementation	30
Viva-Voce	10
TOTAL	100

SCHEDULE OF PBL IMPLEMENTATION

Modules	Title
Module 1	**Swings, Html , Javascript, CSS**
Module 2	**Servlets**
Module 3	**JSP**
Module 4	**EJB**
Module 5	**Implementation of real Time Project**

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Exam (ETE)	Total Marks
50	50	100

Name of The Course	Software Project Management				
Course Code	MCSE2320				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The course should enable the students to:

1. Understand overall software development life cycle and adopt suitable processes.
2. Analyze, prioritize, and manage both functional and quality requirements.
3. Estimate efforts required, plan, and track the plans.
4. Understand and apply configuration and quality management techniques.

COURSE OUTCOMES (COs):

CO1	Understand overall software development life cycle and adopt suitable processes.
CO2	Analyze, prioritize, and manage both functional and quality requirements.
CO3	Estimate efforts required, plan, and track the plans
CO4	Understand and apply configuration and quality management techniques.

Text Books:

1. Pankaj Jalote, "Software Process Management in Practice"‖, Pearson, Illustrated, 2002.
2. Walker Royce, "Software Project Management – A Unified Framework",Pearson Education, 1st Edition, 2002

Reference Books:

1. Watts S.Humphrey, "PSP: A Self Improvement Process for Software Engineers", Addison Wesley, 1st Edition, 2005.
2. Chris F. Kemerer, "Software Project Management- Readings and Cases", McGraw-Hill, Illustrated Edition, 1997.

Watts S. Humphrey, "Introduction to the Team Software Process", Addison-Wesley, Illustrated Reprint, 2000

Course Content

UNIT -I	**DEVELOPMENT LIFE CYCLE PROCESSES:**	**10 hours**
Overview of Software Development Life Cycle, introduction to processes, Personal Software Process (PSP), Team Software Process (TSP), unified processes, agile processes, choosing the right process.		
UNIT -II	**REQUIREMENTS MANAGEMENT:**	**10 hours**
Functional requirements and quality attributes, elicitation techniques, Quality Attribute Workshop (QAW), analysis, prioritization, and trade off, Architecture Centric Development Method (ACDM), requirements, documentation, and specification, change management, traceability of requirements.		
UNIT -III	**ESTIMATION, PLANNING, AND TRACKING:**	**9 hours**

Identifying and prioritizing risks, risk mitigation plans, estimation techniques, use case points, function points, COCOMO II, top down estimation, bottom up estimation. Work break down structure, macro and micro plans, planning poker, wideband Delphi, documenting the plan, tracking the plan, Earned Value Method (EVM).		
UNIT -IV	**CONFIGURATION AND QUALITY MANAGEMENT:**	**8 hours**
Identifying articrafts to be configured, naming conventions and version control, configuration control, quality assurance techniques, peer reviews, Fagan inspection, unit, registration, system, and acceptance testing, test data and test cases, bug tracking, casual analysis		
UNIT -V	**SOFTWARE PROCESS DEFINITION AND MANAGEMENT:**	**8 hours**
Process elements, process architecture, relationship between elements, process modeling, process definition techniques, ETVX (Entry-Task-Validation-exit), process base lining, process assessment and improvement, CMMI, six sigma.		

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	**Software Development Lab**				
Course Code	MCSE2321				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

List of Mini Projects

1. Library Management System
2. Student Mark Analyzing System
3. Creation of Text Editor
4. Dictionary
5. Telephone dictionary
6. Banking System
7. Payroll System
8. Inventory System

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Exam (ETE)	Total Marks
50	**50**	**100**

List of Electives

Name of The Course	IoT Technology and Applications				
Course Code	MCSE9110				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the fundamentals of Internet of Things.
2. To learn about the basics of IOT protocols.
3. To build a small low cost embedded system using Raspberry Pi.
4. To apply the concept of Internet of Things in the real world scenario.

Course Outcomes

At the end of the course, students will be able to:

CO1	Analyze various protocols for IoT Develop web services to access/control IoT devices.
CO2	Design a portable IoT using Rasperry Pi.
CO3	Deploy an IoT application and connect to the cloud.
CO4	Analyze applications of IoT in real time scenario.

Text Books

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Course Content

Unit I: INTRODUCTION TO IoT **9 hours**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

Unit II: IoT ARCHITECTURE **9 hours**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

Unit III: IoT PROTOCOLS **9 hours**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

Unit IV : BUILDING IoT WITH RASPBERRY PI & ARDUINO 9 hours Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.
Unit V: CASE STUDIES AND REAL-WORLD APPLICATIONS 9 hours Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	IoT on Cloud				
Course Code	MCSE9120				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the basics of Internet of Things.
2. To get an idea of some of the application areas where Internet of Things can be applied.
3. To understand the middleware for Internet of Things.
4. To understand the concepts of Web of Things.
5. To understand the concepts of Cloud of Things with emphasis on Mobile cloud computing.
6. To understand the IOT protocols.

Course Outcomes

At the end of the course, students will be able to:

CO1	Identify and design the new models for market strategic interaction.
CO2	Design business intelligence and information security for WoB
CO3	Analyze various protocols for IoT.
CO4	Design a middleware for IoT.
CO5	Analyze and design different models for network dynamics.

Text Books

1. The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou – CRC Press – 2012.
2. Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles(Eds.) – Springer – 2011
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press - 2010
4. The Internet of Things: Applications to the Smart Grid and Building Automation by -Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley -2012
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Course Content

Unit I: INTRODUCTION **10 hours**
Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security
Unit II: IOT PROTOCOLS **8 hours**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security

Unit III: WEB OF THINGS **10 hours**

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

Unit IV : INTEGRATED **9 hours**

Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small-World Phenomenon.

Unit V: APPLICATIONS **8 hours**

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Big Data Mining and Analytics				
Course Code	MCSE9130				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the computational approaches to Modeling, Feature Extraction.
2. To understand the need and application of Map Reduce.
3. To understand the various search algorithms applicable to Big Data.
4. To analyse and interpret streaming data.
5. To learn how to handle large data sets in main memory.
6. To learn the various clustering techniques applicable to Big Data.

Course Outcomes

At the end of the course, students will be able to:

CO1	Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO2	Design algorithms for Big Data by deciding on the apt Features set.
CO3	Design algorithms for handling petabytes of datasets.
CO4	Design algorithms and propose solutions for Big Data by optimizing main memory consumption
CO5	Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

Text Books

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Course Content

Unit I: DATA MINING AND LARGE SCALE FILES **9 hours**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques

Unit II: SIMILAR ITEMS **9 hours** M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.
Unit III: MINING DATA STREAMS **9 hours** Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.
Unit IV : LINK ANALYSIS AND FREQUENT ITEMSETS **9 hours** Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.
Unit V: CLUSTERING **9 hours** Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Foundations of Information Security				
Course Code	MCSE9260				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To provide an understanding of principal concepts, major issues, technologies, and basic approaches in information security.
2. Master the key concepts of information security and how they "work."
3. Develop a "security mindset:" learn how to critically analyze situations of computer and network usage from a security perspective, identifying the salient issues, viewpoints, and trade-offs.
4. To provide the ability to examine and analyze real-life security cases.

Course Outcomes

At the end of the course, students will be able to:

CO1	Evaluate vulnerability of an information system and establish a plan for risk management.
CO2	Demonstrate basic principles of Web application security.
CO3	Evaluate the authentication and encryption needs of an information system
CO4	Demonstrate how to secure a network.
CO5	Evaluate a company's security policies and procedures.

Text Books

1. Computer Security: Principles and Practice, William Stallings; Lawrie Brown.
2. Introduction to Computer Security, 2004 Matt Bishop, Addison-Wesley, ISBN 0-321-24744.

Reference Books

1. Buchmann J. A., Introduction to Cryptography, Springer Verlag (2001)..
2. Stallings William, Cryptography and Network Security, Pearson Education (2006)..
3. Schneier Bruce, Applied Cryptography, John Wiley and Sons (1996).
4. Britz M., Computer Forensic and cyber crime, Upper Saddle River, Prentice Hall (2003).

Course Content

Unit I:INTRODUCTION **9 hours**

Need for security, Computer Security Concepts (CIA) - Confidentiality, Integrity, Availability, Accountability and Assurance, Interdependencies. Information security history- Physical security and administrative security, Security current trends-Emergence of internet, digital information, financial losses and national defense, Terminology-Threats, Attacks and Assets. **Software Security -** Vulnerabilities and protections, malware, program analysis

Unit II: Practical Cryptography **9 hours**

Ciphers, Caser Cipher, Cryptanalysis, Encryption- Types of encryption, authentication-authentication factors, types of authentication methods, hashing-feature of hash function,

properties of hash functions, message Digest, Secure hash function, RIPEMD, symmetric and asymmetric cryptography, Digital Signatures and Certificates.

Unit III:**Network Security:** **9 hours**

Network security issues, Sniffing-types of sniffing, IP spoofing-DDoS attacks, application layer attacks, security research, Common threats, E-Mail security, IPSec- uses of IP security, components of IP security, SSL Protocol, PGP- Definition of PGP and uses of PGP, Intruders, Virus, Worms, Firewalls-need and features of firewall, Types of firewall, Intruder Detection Systems.

Unit IV :Cyber Security: **9 hours**

Cyber Crime and security- types of cyber crime, prevention of cyber crime, Security tools-metasploit, Nmap, wireshark, aircrack-ng, john the ripper and nessues, Introduction to Digital Forensic-characteristics of digital forensic, principle of digital forensic, challenges of digital forensic, OS fingerprinting, TCP/IPstack masking, Social Engineering-attack techniques, prevention.

Unit V: Applications and special topics **9 hours**

Web application Security-vulnerabilities- cross site scripting, sql injection, denial of services, memory corruption, buffer overflow, cross-site request forgery, data breach, Privacy and Anonymity- privacy, trust, anonymity, VPN services, public policy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Formal Models of Software Systems				
Course Code	MCSE9310				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
2. To understand the fundamentals of abstraction and formal systems.
3. To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
4. To understand formal specification models based on set theory, calculus and algebra and apply to a case study.
5. To learn Z, Object Z and B Specification languages with case studies.

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
CO2	Gain knowledge on fundamentals of abstraction and formal systems.
CO3	Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
CO4	Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study.
CO5	Have working knowledge on Z, Object Z and B Specification languages with case studies.

Text Books

1. Mathematical Logic for computer science, second edition, M.Ben-Ari, Springer,2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.
3. Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011.

Reference Books

1. The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.
2. Using Z-Specification Refinement and Proof,Jim Woodcock and Jim Devies Prentice Hall, 1996
3. Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994

Course Content

Unit I: SPECIFICATION FUNDAMENTALS **9 hours**

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities-

Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

Unit II: FORMAL METHODS **9 hours**

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

Unit III: **LOGIC** **9 hours**

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

Unit IV : SPECIFICATION MODELS **9 hours**

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

Unit V: FORMAL LANGUAGES **9hours**

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language-Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Embedded Software Development				
Course Code	MCSE9320				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the architecture of embedded processor, microcontroller and peripheral devices.
2. To interface memory and peripherals with embedded systems.
3. To study the embedded network environment.
4. To understand challenges in Real time operating systems.
5. To study, analyze and design applications on embedded systems.

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand different architectures of embedded processor, microcontroller and peripheral devices.
CO2	Interface memory and peripherals with embedded systems.
CO3	Work with embedded network environment.
CO4	Understand challenges in Real time operating systems.
CO5	Design and analyze applications on embedded systems.

Text Books

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013.
2. Andrew N Sloss, D. Symes, C. Wright, ‖ Arm system developers guide‖, Morgan Kauffman/Elsevier, 2006.
3. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014.
4. C. M. Krishna and K. G. Shin, ―Real-Time Systems‖ , McGraw-Hill, 1997.

Reference Books

1. Frank Vahid and Tony Givargis, ―Embedded System Design: A Unified Hardware/Software Introduction‖, John Wiley & Sons.
2. Jane.W.S. Liu, ―Real-Time systems‖, Pearson Education Asia.
3. Michael J. Pont, ―Embedded C‖, Pearson Education , 2007.
4. Muhammad Ali Mazidi , SarmadNaimi , SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" Pearson Education, First edition, 2014.
5. Steve Heath, ―Embedded SystemDesign‖ , Elsevier, 2005.
6. Wayne Wolf, ―Computers as Components:Principles of Embedded Computer System Design‖, Elsevier, 2006.

Course Content

Unit I: EMBEDDED PROCESSORS 9 hours Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.
Unit II: EMBEDDED COMPUTING PLATFORM 9 hours

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

Unit III: **EMBEDDED NETWORK ENIVIRONMENT** **9 hours**

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

Unit IV : REAL-TIME CHARACTERISTICS **9 hours**

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

Unit V: SYSTEM DESIGN TECHNIQUES **9 hours**

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Social Network Analysis				
Course Code	MCSE9330				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems.

Course Outcomes

At the end of the course, students will be able to:

CO1	Work on the internals components of the social network.
CO2	Model and visualize the social network.
CO3	Mine the behavior of the users in the social network
CO4	Predict the possible next outcome of the social network.
CO5	Apply social network in real time applications.

Text Books

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, ―Computational Social Network Analysis: Trends, Tools and Research Advances‖, Springer, 2012
2. Borko Furht, ―Handbook of Social Network Technologies and Applications‖, Springer, 1st edition, 2011.
3. Charu C. Aggarwal, ―Social Network Data Analytics‖, Springer; 2014.

Reference Books

1. Giles, Mark Smith, John Yen, ―Advances in Social Network Mining and Analysis‖, Springer, 2010.
2. Guandong Xu , Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, Springer, 1st edition, 2012.
3. Peter Mika, ―Social Networks and the Semantic Web‖, Springer, 1st edition, 2007.
4. Przemyslaw Kazienko, Nitesh Chawla,‖Applications of Social Media and Social Network Analysis‖, Springer,2015.

Course Content

Unit I: INTRODUCTION **9 hours**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

Unit II: MODELING AND VISUALIZATION **9 hours**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

Unit III: **MINING COMMUNITIES** **9 hours**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

Unit IV : EVOLUTION **9 hours**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

Unit V: APPLICATIONS **9 hours**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Bio Inspired Computing				
Course Code	MCSE9340				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To Learn bio-inspired theorem and algorithms.
2. To Understand random walk and simulated annealing.
3. To Learn genetic algorithm and differential evolution.
4. To Learn swarm optimization and ant colony for feature selection.
5. To understand bio-inspired application in image processing.

Course Outcomes

At the end of the course, students will be able to:

CO1	Implement and apply bio-inspired algorithms.
CO2	Explain random walk and simulated annealing.
CO3	Implement and apply genetic algorithms.
CO4	Explain swarm intelligence and ant colony for feature selection.
CO5	Apply bio-inspired techniques in image processing.

Text Books

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016.

Reference Books

1. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014.
2. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

Course Content

Unit I: INTRODUCTION **9 hours**

Introduction to algorithm - Newton' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

Unit II: RANDOM WALK AND ANEALING **9 hours**

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

Unit III: **GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION** **9 hours**

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

Unit IV : SWARM OPTIMIZATION AND FIREFLY ALGORITHM **9 hours**

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varientsAnt colony optimization toward feature selection

Unit V: APPLICATION IN IMAGE PROCESSING **9 hours**

Bio-Inspired Computation and its Applications in Image Processing: An Overview – Fine Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

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Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Data Visualization Techniques				
Course Code	MCSE9410				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To develop skills to both design and critique visualizations.
2. To introduce visual perception and core skills for visual analysis.
3. To understand visualization for time-series analysis.
4. To understand visualization for ranking analysis.
5. To understand visualization for deviation analysis.
6. To understand visualization for distribution analysis.
7. To understand visualization for correlation analysis.
8. To understand visualization for multivariate analysis.
9. To understand issues and best practices in information dashboard design.

Course Outcomes

At the end of the course, students will be able to:

CO1	Explain principles of visual perception.
CO2	Apply core skills for visual analysis.
CO3	Apply visualization techniques for various data analysis tasks.
CO4	Design information dashboard.

Text Books

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Reference Books

1. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
2. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
3. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
4. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

Course Content

Unit I: CORE SKILLS FOR VISUAL ANALYSIS 9 hours

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

Unit II: TIME-SERIES, RANKING, AND DEVIATION ANALYSIS **9 hours**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

Unit III: **DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS** **9 hours**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

Unit IV : INFORMATION DASHBOARD DESIGN **9 hours**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

Unit V: INFORMATION DASHBOARD DESIGN **9 hours**

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together Unveiling the dashboard.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Reconfigurable Computing				
Course Code	MCSE9420				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the need for reconfigurable computing.
2. To expose the students to various device architectures.
3. To examine the various reconfigurable computing systems.
4. To understand the different types of compute models for programming reconfigurable architectures.
5. To expose the students to HDL programming and familiarize with the development environment.
6. To expose the students to the various placement and routing protocols.
7. To develop applications with FPGAs.

Course Outcomes

At the end of the course, students will be able to:

CO1	Identify the need for reconfigurable architectures.
CO2	Discuss the architecture of FPGAs.
CO3	Point out the salient features of different reconfigurable architectures
CO4	Build basic modules using any HDL.
CO5	Develop applications using any HDL and appropriate tools.
CO6	Design and build an SoPC for a particular application.

Text Books

1. Christophe Bobda, ―Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications‖, Springer, 2010.
2. Maya B. Gokhale and Paul S. Graham, ―Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays‖, Springer, 2005.
3. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform.

Reference Books

1. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer.
2. Scott Hauck and Andre Dehon (Eds.), ―Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation‖, Elsevier / Morgan Kaufmann, 2008.

Course Content

Unit I: DEVICE ARCHITECTURE 9 hours General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.
Unit II: RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS 9 hours Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.
Unit III: PROGRAMMING RECONFIGURABLE SYSTEMS 9 hours Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.
Unit IV : MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 9 hours The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.
Unit V: APPLICATION DEVELOPMENT WITH FPGAS 9 hours Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Mobile Application Development				
Course Code	MCSE9430				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. Understand system requirements for mobile applications.
2. Generate suitable design using specific mobile development frameworks.
3. Generate mobile application design.
4. Implement the design using specific mobile development frameworks.
5. Deploy the mobile applications in marketplace for distribution.

Course Outcomes

At the end of the course, students will be able to:

CO1	Describe the requirements for mobile applications.
CO2	Explain the challenges in mobile application design and development.
CO3	Develop design for mobile applications for specific requirements.
CO4	Implement the design using Android SDK.
CO5	Implement the design using Objective C and iOS.
CO6	Deploy mobile applications in Android and iPhone marketplace for distribution

Text Books

1. Charlie Collins, Michael Galpin and Matthias Kappler, ―Android in Practice‖, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, ―Beginning iOS 6 Development: Exploring the iOS SDK‖, Apress, 2013.
3. http://developer.android.com/develop/index.html.

Reference Books

1. James Dovey and Ash Furrow, ―Beginning Objective C‖, Apress, 2012.
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,2012.
3. Reto Meier, ―Professional android Development‖, Wiley-India Edition, 2012

Course Content

Unit I: INTRODUCTION **9 hours** Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.
Unit II: BASIC DESIGN **9 hours** Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.
Unit III: **ADVANCED DESIGN** **9 hours** Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.
Unit IV : ANDROID **9 hours** Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.
Unit V: IOS **9 hours** Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100

Name of The Course	Information Storage Management				
Course Code	MCSE9440				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives

1. To understand the storage architecture and available technologies.
2. To learn to establish & manage data center.
3. To learn security aspects of storage & data center.

Course Outcomes

At the end of the course, students will be able to:

CO1	Select from various storage technologies to suit for required application.
CO2	Apply security measures to safeguard storage & farm.
CO3	Analyse QoS on Storage.

Text Books

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001.

Reference Books

1. Robert Spalding, ―Storage Networks: The Complete Reference―, Tata McGraw Hill , Osborne, 2003.

Course Content

Unit I: STORAGE TECHNOLOGY **9 hours**

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

Unit II: STORAGE SYSTEMS ARCHITECTURE **9 hours**

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

Unit III: INTRODUCTION TO NETWORKED STORAGE **9 hours**

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

Unit IV: INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS

9 hours

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

Unit V: SECURING STORAGE AND STORAGE VIRTUALIZATION 9 hours

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks
20	30	50	100