JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech
CSE for COMPUTER NETWORKS Programme

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

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KAKINADA – 533 003, Andhra Pradesh, India

I-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTCN1101	**Program Core-1** Transport Control Protocol/Internet Protocol (TCP/IP)	PC	3	0	0	3
2	MTCN1102	**Program Core-2** Advanced Data Structures	PC	3	0	0	3
3	MTCN1103	**Program Elective-1** 1. Software Define Networks 2. Network Coding Theory 3. Adhoc & Sensor Networks	PE	3	0	0	3
4	MTCN1104	**Program Elective-2** 1. Distributed Systems 2. Grid and Cluster Computing 3. Wireless Networks	PE	3	0	0	3
5	MTCN1105	**Research Methodology and IPR**	CC	2	0	0	2
6	MTCN1106	**Laboratory-1** Transport Control Protocol/Internet Protocol (TCP/IP) Lab	LB	0	0	4	2
7	MTCN1107	**Laboartory-2** Advanced Data Structures Lab	LB	0	0	4	2
8	MTCN1108	**Audit Course-1***	AC	2	0	0	0
Total Credits							18

*Student has to choose any one audit course listed below.

II- SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTCN1201	**Program Core-3** Network Security	PC	3	0	0	3
2	MTCN1202	**Program Core-4** Wireless Sensor Networks	PC	3	0	0	3
3	MTCN1203	**Program Elective-3** 1. Web Security 2. Internet of Things 3. Intrusion Detection & Prevention Systems	PE	3	0	0	3
4	MTCN1204	**Program Elective-4** 1. Firewall & VPN Security 2. Machine Learning 3. Service Oriented Architecture	PE	3	0	0	3
5	MTCN1205	**Laboratory-3** Network Security Lab	LB	0	0	4	2
6	MTCN1206	**Laboartory-4** Advanced Network Programming Lab	LB	0	0	4	2
7	MTCN1207	**Mini Project with Seminar**	MP	0	0	0	2
8	MTCN1208	**Audit Course-2**	AC	2	0	0	0
Total Credits							18

*Student has to choose any one audit course listed below.

Audit Course 1 & 2:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

III-SEMESTER

S. No	Course Code	Courses	Category	L	T	P	C
1	MTCN2101	**Program Elective-5** 1. Trustworthy Computing 2. Advanced Storage Area Networks 3. Cloud Computing 4. MOOCs-1 (NPTEL/SWAYAM)-12 Week Program related to the programme which is not listed in the course structure	PE	3	0	0	3
2	MTCN2102	**Open Elective** 1. MOOCs-2 (NPTEL/SWAYAM)-Any 12 Week Course on Engineering /Management/ Mathematics offered by other than parent department 2. Course offered by other departments in the college	OE	3	0	0	3
3	MTCN2103	**Dissertation-I/Industrial Project #**		0	0	20	10
Total Credits							16

#Students going for Industrial Project/Thesis will complete these courses through MOOCs

IV-SEMESTER

S.No	Course Code	Courses	Category	L	T	P	C
1	MTCN2201	**Dissertation-II**		0	0	32	16
Total Credits							16

Open Electives offered by the Department of CSE for other Departments Students

01. Python Programming
02. Principles of Cyber Security
03. Internet of Things
04. Artificial Intelligence and Machine Learning

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I Year - I Semester		L	T	P	C
		3	0	0	3

Transport Control Protocol/Internet Protocol (MTCN1101)

Course Objectives:

- Student able to learn about the protocols which are using in the current scenario.
- To learn and understand client server relations and OSI programming Implementation of the socket and IPC.

Course Outcomes:

- Explain OSI Model and Standard Internet Protocols
- How to handle server process termination
- Acquire the knowledge of Elementary TCP sockets and I/O Multiplexing and socket
- Demonstrate the concepts of FIFOs streams messages and Remote logins.

UNIT-I: Introduction to Network Programming: OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application.

UNIT-II: TCP client server: Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.

UNIT-III: Sockets: Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.
I/O Multiplexing and socket options: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server, getsockopt and setsockopt functions. Socket states, Generic socket option IPV6 socket option ICMPV6 socket option IPV6 socket option and TCP socket options.

UNIT-IV: Elementary UDP sockets: Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP.
Elementary name and Address conversions: DNS, gethost by Name function, Resolver option, Function and IPV6 support, uname function, other networking information.

UNIT-V: IPC- Introduction, File and record locking, Pipes, FIFOs streams and messages, Name spaces, system IPC, Message queues, Semaphores. **Remote Login:** Terminal line disciplines, Pseudo-Terminals, Terminal modes, Control Terminals, rlogin Overview, RPC Transparency Issues.

Text Books:
1. UNIX Network Programming, Vol. I, SocketsAPI, 2nd Edition. - W.Richard Stevens, Pearson Edn. Asia.
2. UNIX Network Programming, 1st Edition, - W.Richard Stevens. PHI.
Reference Books:
1. UNIX Systems Programming using C++ T CHAN, PHI.
2. UNIX for Programmers and Users, 3rd Edition Graham GLASS, King abls, Pearson Education
3. Advanced UNIX Programming 2nd Edition M. J. ROCHKIND, Pearson Education

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I Year - I Semester		L	T	P	C
		3	0	0	3

Advanced Data Structures (MTCN1102)

Course Objective:

- The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem
- Students should be able to understand the necessary mathematical abstraction to solve problems
- To familiarize students with advanced paradigms and data structure used to solve algorithmic problems
- Student should be able to come up with analysis of efficiency and proofs of correctness

Course Outcomes:

- Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
- Develop algorithms for text processing applications.
- Identify suitable data structures and develop algorithms for computational geometry problems.
- Understand the implementation of symbol table using hashing techniques.

UNIT-I: Dictionaries-Definition, Dictionary Abstract Data Type, and Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.

UNIT-II: Skip Lists- Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists

UNIT-III: Trees-Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees

UNIT-IV: Text Processing: Sting Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem

UNIT-V: Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad-trees, k-D Trees. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem

Text Books:

1. Data Structures: A Pseudo-code Approach, 2/e, Richard F.Gilberg, Behrouz A.Forouzon, Cengage
2. Data Structures, Algorithms and Applications in Java, 2/e, Sartaj Sahni, University Press

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.

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I Year - I Semester		L	T	P	C
		3	0	0	3

Software Defined Networks (MTCN11XX)

Course Objectives

- To develop knowledge in networking fundamentals
- To gain conceptual understanding of Software Defined Networks (SDN)
- To study industrial deployment use-cases of SDN

Course Outcomes

- To develop conceptual design of SDN solutions
- To apply network virtualisation for industry standard solutions
- To solve industry case-studies based on SDN

UNIT-I: Introduction to Networking: OSI layers; TCP/IP Protocol Suite; Distance vector and link state routing algorithms, Network protocols (ARP, BGP, OSPF, RIP, ICMP) and network topologies.

UNIT-II: Introduction to SDN: Overview; History and evolution of SDN; Architecture of SDN; SDN Flavors; Scalability (Data Centers, Service provider networks, ISP Automation); Reliability (QoS, and Service Availability); Consistency (Configuration management, and Access Control Violations); Opportunities and Challenges;

UNIT-III: Control and Data Plane Separation: Introduction to OpenFlow; History and evolution; Control and data plane separation; virtual networking; Use-cases (Network Access Control, Virtual Customer Edge, Datacenter Optimization); **Control and Data Plane Separation:** Introduction to OpenFlow; History and evolution; Control and data plane separation; virtual networking; Use-cases (Network Access Control, Virtual Customer Edge, Datacenter Optimization);

UNIT-IV: Network Virtualization: Abstraction of Physical Network (constrained forwarding model, distributed state, detailed configuration); components of a virtual network (Virtual Switch, Bridge, Host-virtual adapter, NAT device, DHCP server, Network adapter); Network as a Service (NaaS)

UNIT-IV: Applications of SDN: Network management; Resource utilization; Network service chaining; Bandwidth calendaring and Network programmability.**SDN Design and Development:** Mininet; Applications; Network Virtual Machines; SDN Controller (POX, Floodlight, OpenDayLight; Applicability of OpenFlow protocols in SDN Controllers

Text Books:

1. Ying-Dar Lin, Ren-Hung Hwang, and Fred Baker, "Computer Networks: An Open Source Approach", McGraw-Hill Science/Engineering/Math, 2011.
2. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann, 2014.

Reference Books:

1. Siamak Azodolmolky, "Software Defined Networking with OpenFlow", Packt Publishing, 2013
2. Kingston Smiler, "OpenFlow® Cookbook", Packt Publishing, 2015
3. Doug Marschke, Jeff Doyle, Pete Moyer, "Software Defined Networking (SDN): Anatomy of OpenFlow® Volume I". Lulu Publishing Services, 2015

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		3	0	0	3

Network Coding Theory (MTCN11XX)

Course Objectives:

- Learn the fundamentals of network coding theory.
- Understand the performance parameters required for network coding.
- Gain the knowledge of the network coding design methods.
- Learn different approaches for the network coding.
- Understand error correction and detection methods of adversarial errors.

Course Outcomes:

- Demonstrate knowledge and understanding of the fundamentals of Network Coding Theory.
- Summarize all the performance parameters and resources for network coding.
- Construct the network code for different networks.
- Deal with different approaches of Network Coding in lossy and lossless networks.
- Deal with multiple sources network coding and detect adversarial errors.

UNIT–I: Introduction- A historical Perspective, Network Coding; Network Coding Benefits: Throughput, Robustness, Complexity, Security; Network Model, Main Theorem of Network Multicast: The Min-Cut Max-flow Theorem, The Main network coding Theorem, Theoretical Framework for Network Coding: A Network Multicast Model, algebraic Framework, Combinatorial Framework, Information-Theoretic Framework, Types of Routing and coding.

UNIT – II: Throughput Benefits of Network Coding- Throughput Measures, Linear Programming Approach, Configurations with Large Network Coding Benefits, Configurations with Small Network Coding Benefits, Undirected Graphs, Networks with Delay and Cycles: Dealing with Delay, Optimizing for Delay, Dealing with Cycles. Resources for Network Coding: Bounds on Code Alphabet Size, Bounds on the Number of Coding Points, Coding with Limited Resources.

UNIT-III: Network Code Design Methods for Multicasting- Common initial procedure, centralized algorithms, decentralized algorithms, scalability to network changes. Single-Source Linear Network Coding-Acyclic Networks, Linear network code, Desirable properties of a linear network code, Existence and construction, Algorithm refinement for multicast. Cyclic Networks-Delay-Free Cyclic Code, Non-equivalence between local and global descriptions, Convolutional network code, decoding of convolutional network code.

UNIT-IV: Inter-Session Network Coding- Scalar and vector linear network coding, Fractional coding problem formulation, Insufficiency of linear network coding, Information theoretic approaches: Multiple unicast networks, Constructive approaches- Pairwise XOR coding in wireline networks, XOR coding in wireless networks. Network Coding in Lossy Networks-Random linear network coding, Coding theorems: Unicast connections, Multicast connections, Error exponents for Poisson traffic with i.i.d. losses. Subgraph Selection- Flow-based approaches: Intra-session coding, Computation-constrained coding, Inter-session coding; Queue-Length-Based approaches: Intra-session network coding for multicast sessions, Inter-session coding.

UNIT-V: Multiple Sources Network Coding- Superposition coding and max-flow bound; Network Codes for Acyclic Networks- Achievable information rate region, Inner bound Rin, Outer bound Rout, RLP – An explicit outer bound. Security against adversarial Errors- Error Correcting bounds for centralized network coding, Distributed random network coding and polynomial-complexity error correction, Detection of adversarial errors: Model and problem formulation, Detection probability.

Text Books:

1. Raymond W. Yeung, Shuo-Yen Robert Li, Ning Cai, Zhen Zhang, "Network Coding Theory", Now publishers Inc, 2006, ISBN: 1-933019-24-7.
2. Christina Fragouli, Emina Soljanin, "Network Coding Fundamentals", Now publishers Inc, 2007, ISBN: 978-1-60198-032-8.

Reference Books:

1. Tracey Ho, Desmond Lun, "Network Coding: An Introduction", Cambridge University Press, 2008, ISBN: 978-0-521-87310-9.
2. Muriel Medard, Alex Sprintson, "Network Coding: Fundamentals and Applications", 1st Edition, 2012, Academic Press, Elsevier, ISBN: 978-0-12-380918-6.

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I Year - I Semester		L	T	P	C
		3	0	0	3

Adhoc & Sensor Networks (MTCN11XX)

Course Objectives:

- Acquire the knowledge of various techniques in mobile networks/Adhoc networks and sensor based networks.
- The objective of this course is to facilitate the understanding of Infrastructure less networks and their importance in the future directions for wireless communications

Course Outcomes:

- Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks
- Describe the MAC protocol issues of ad hoc networks
- Describe routing protocols for ad hoc wireless networks with respect to TCP design issues
- Explain the concepts of network architecture and MAC layer protocol for WSN
- Discuss the WSN routing issues by considering QoS measurements

UNIT I: Introduction to Ad Hoc Wireless Networks- Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet, MAC protocols for Ad hoc Wireless Networks- Issues, Design Goals and Classifications of the MAC Protocols

UNIT II: Routing Protocols for Ad Hoc Wireless Networks- Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.

UNIT III: Security protocols for Ad hoc Wireless Networks- Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

UNIT IV: Basics of Wireless Sensors and Applications- The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks-Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

UNIT V: Security in WSNs- Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware-Components of Sensor Mote, Sensor Network Operating Systems– TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language-nesC, Dataflow style language: TinyGALS, Node-Level Simulators, NS-2 and its sensor network extension, TOSSIM.

Text Books:

1. Ad Hoc Wireless Networks – Architectures and Protocols, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2004
2. Ad Hoc and Sensor Networks – Theory and Applications, Carlos Corderio Dharma P.Aggarwal,
3. World Scientific Publications / Cambridge University Press, March 2006
4. Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010

Reference Books:

1. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009
2. Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008
3. Ad hoc Networking, Charles E.Perkins, Pearson Education, 2001
4. Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, Taylor & Francis Group, 2007

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		3	0	0	3
Distributed Systems (MTCN11XX)					

Course Objectives

- Students will get exposure to various Distributed Systems and their architectures
- Students will get exposed to Remote Invocation and Distributed file systems.
- Students will learn the different communication mechanisms and its advantages and disadvantages.
- Students will get exposure on transaction management and Replication.

Course Outcomes:

- Explain resource sharing in distributed systems and different system models used to construct Distributed system network between systems
- Illustrate Distributed Objects and Remote Invocation
- Explore functional distributed file systems
- Explain Distributed Transaction management, Coordination and Agreement between distributed processes
- Design a distributed system that fulfills requirements with regards to key distributed systems properties (such as scalability, transparency, etc)

UNIT I: Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and The Web, Challenges. (6 hours) System Models: Introduction, Architectural Models- Software Layers, System Architecture, Variations, Interface and Objects, Design Requirements for Distributed Architectures, Fundamental Models- Interaction Model, Failure Model, Security Model.

UNIT II: Distributed Objects and Remote Invocation: Introduction, Communication between Distributed Objects- Object Model, Distributed Object Modal, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; Remote Procedure Call, Events and Notifications, Case Study: JAVA RMI

UNIT III: Distributed File Systems: Introduction, File Service Architecture; Peer-to-Peer Systems: Introduction, Napster and its Legacy, Peer-to-Peer Middleware, Routing Overlays.

UNIT IV: Coordination and Agreement: Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication.

UNIT V: Transactions & Replications: Introduction, System Model and Group Communication, Concurrency Control in Distributed Transactions, Distributed Dead Locks, Transaction Recovery; Replication-Introduction, Passive (Primary) Replication, Active Replication.

Text Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems- Concepts and Design", Fourth Edition, Pearson Publication
2. Ajay D Kshemkalyani, Mukesh Sighal, "Distributed Computing, Principles, Algorithms and Systems", Cambridge

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I Year - I Semester		L	T	P	C
		3	0	0	3

Grid and Cluster Computing (MTCN11XX)

Course Objectives:

- To get introduced to the terminology and concepts of Data center, Grid computing architecture.
- To learn about grid computing tool kits and standards, SOA, OGSA and GT4
- To know about issues in grid data bases.
- To get introduced to cluster computing and also to get exposure of cluster objectives, architecture and applications.

Course Outcomes:

- Ability to grasp the importance of grid and cluster computing in today's network centric world. To learn basics of grid computing architecture.
- Ability to understand about grid computing tool kits and SOA.
- Ability to explain several grid computing frameworks and standards.
- Ability to understand grid and data bases.
- Ability to grasp the significance of cluster computing and its architecture.
- Ability to fully appreciate the early cluster architectures and interconnections.

UNIT-I Introduction : The Data Centre, the Grid and the Distributed / High Performance Computing, Cluster Computing and Grid Computing, Metacomputing – the Precursor of Grid Computing, Scientific, Business and e-Governance Grids, Web Services and Grid Computing, Business Computing and the Grid – a Potential Win – win Situation, eGovernance and the Grid. Technologies and Architectures for Grid Computing : Clustering and Grid Computing, Issues in Data Grids, Key Functional Requirements in Grid Computing, Standards for Grid Computing, Recent Technological Trends in Large Data Grids, World Wide Grid Computing Activities

UNIT-II: Organizations and Projects: Standard Organizations, Organizations Developing Grid Computing Tool Kits, Framework, and Middleware, Grid Projects and Organizations Building and Using Grid Based Solutions, Commercial Organizations Building and Using Grid Based Solutions. Web Services and the Service Oriented Architecture (SOA) :History and Background, Service Oriented Architecture, How a Web Service Works, SOAP and WSDL, Description, Creating Web Services, Server Side.

UNIT-III: OGSA and WSRF: OGSA for Resource Distribution, Stateful Web Services in OGSA, WSRF (Web Services Resource Framework), Resource Approach to Stateful Services, WSRF Specification. Globus Toolkit : History of Globus Toolkit, Versions of Globus Toolkit, Applications of GT4- Cases, GT4-Approaches and Benefits, Infrastructure Management, Monitoring and Discovery, Security, Data, Choreography and Coordination, Main Features of GT4 Functionality – a Summary, GT4 Architecture, GT4 Command Line Programs, GT4 Containers

UNIT-IV: The Grid and the Databases: Issues in Database Integration with the Grid, The Requirements of a Grid-enabled Database, Storage Request Broker (SRB), How to Integrate the Databases with the Grid?, The Architecture of OGSA-DAI for Offering Grid Database Services, What is Cluster Computing: Approaches to Parallel Computing, How to Achieve Low Cost Parallel Computing through Clusters, Definition and Architecture of a Cluster, What is the Functionality a Cluster can Offer? Categories of Clusters Cluster Middleware: An Introduction: Levels and Layers of Single System Image (SSI), Cluster Middleware Design Objectives, Resource Management and Scheduling.

UNIT-V: Early Cluster Architectures and High Throughput Computing Clusters: Early Cluster Architectures, High Throughput Computing Clusters, Condor Networking, Protocols & I/O for Clusters : Networks and Interconnection/Switching Devices, Design Issues in Interconnection Networking/Switching, Design Architecture-General Principles and Tradeoffs, HiPPI, ATM (Asynchronous Transmission Mode), Myrinet, Memory Channel (MC), Gigabit Ethernet

Text Book:

1. C.S.R.Prabhu – "Grid and Cluster Computing"-PHI(2008)

Reference Book:

1. Jankiram, "Grid Computing Models : A Research Monograph", TMH (2005)

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I Year - I Semester		L	T	P	C
		3	0	0	3

Wireless Networks (MTCN11XX)

Course Objectives:

- The students should get familiar with the wireless/mobile market and the future needs and challenges.
- To get familiar with key concepts of wireless networks, standards, technologies and their basic Operations.
- To learn how to design and analyze various medium access.
- To learn how to evaluate MAC and network protocols using network simulation software tools.
- The students should get familiar with the wireless/mobile market and the future needs and challenges

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

- Demonstrate advanced knowledge of networking and wireless networking and understand various types of wireless networks, standards, operations and use cases.
- Be able to design WLAN, WPAN, WWAN, Cellular based upon underlying propagation and performance analysis.
- Demonstrate knowledge of protocols used in wireless networks and learn simulating wireless networks.
- Design wireless networks exploring trade-offs between wire line and wireless links.
- Develop mobile applications to solve some of the real-world problems.

UNIT-I: Introduction- Wireless Networking Trends, Key Wireless Physical Layer Concepts, Multiple Access Technologies - CDMA, FDMA, TDMA, Spread Spectrum technologies, Frequency reuse, Radio Propagation and Modelling, Challenges in Mobile Computing: Resource poorness, Bandwidth, energy etc. Wireless Local Area Networks- IEEE 802.11 Wireless LANs Physical & MAC layer, 802.11 MAC Modes (DCF& PCF) IEEE 802.11 standards, Architecture & protocols, Infrastructure vs. Adhoc Modes, Hidden Node & Exposed Terminal Problem, Problems, Fading Effects in Indoor and outdoor WLANs, WLAN Deployment issues.

UNIT–II: Wireless Cellular Networks-1G and 2G, 2.5G, 3G, and 4G, Mobile IPv4, Mobile IPv6, TCP over Wireless Networks, Cellular architecture, Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, Spread spectrum Technologies.

UNIT-III: WiMAX (Physical layer, Media access control, Mobility and Networking), IEEE802.22 Wireless Regional Area Networks, IEEE 802.21 Media Independent Handover Overview, Wireless Sensor Networks: Introduction, Application, Physical, MAC layer and Network Layer, Power Management, Tiny OS Overview.

UNIT–IV: Wireless PANs-Bluetooth AND Zigbee, Introduction to Wireless Sensors.

UNIT–V: Security-Security in wireless Networks Vulnerabilities, Security techniques, Wi-Fi Security, DoS in wireless communication. **Advanced Topics:**
IEEE 802.11x and IEEE 802.11i standards, Introduction to Vehicular Adhoc Networks

Text Books:

1. Schiller J., Mobile Communications, Addison Wesley, 2000.
2. Stallings W., Wireless Communications and Networks, Pearson Education 2005

Reference Books:

1. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc, 2002
2. Yi Bing Lin and Imrich Chlamtac, Wireless and Mobile Network Architectures, John Wiley and Sons Inc, 2000
3. Pandya Raj, Mobile and Personal Communications Systems and Services, PHI, 2000

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I Year - I Semester		L	T	P	C
		2	0	0	2
RESEARCH METHODOLOGY AND IPR					

UNIT 1:

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 2:

Effective literature studies approaches, analysis Plagiarism, Research ethics, 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 3:

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 4:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT 5:

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.

REFERENCES:

(1) Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
(2) Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
(3) Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
(4) Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
(5) Mayall, "Industrial Design", McGraw Hill, 1992.
(6) Niebel, "Product Design", McGraw Hill, 1974.
(7) Asimov, "Introduction to Design", Prentice Hall, 1962.
(8) (8) Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
(9) T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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I Year - I Semester		L	T	P	C
		0	0	4	2

Transport Control Protocol/Internet Protocol (TCP/IP) Lab (MTCN1106)

Course Objectives:

From the course the student will learn

- To understand the working principle of various communication protocols.
- To analyze the various routing algorithms and know the concept of data transfer between nodes.
- Able to analyse a communication system by separating out the different functions provided by the network, and understand that there are fundamental limits to any communications system;
- Understand the general principles behind multiplexing, addressing, routing, reliable transmission and other stateful protocols as well as specific examples of each& understand what FEC is and how CRCs work
- Aable to compare communications systems in how they solve similar problems
- View of both the internal workings of the Internet and of a number of common Internet applications and protocols.

Course Outcomes:

- Demonstrate data link layer functionalities.
- Develop the client server application using socket programming.
- Choose routing protocols to solve real world problems.
- Evaluate FTP, DNS/ HTTP of application layer functionalities.

Experiment 1

Implementation of Stop & Wait Protocol and Sliding Window Protocol.

Experiment 2

Study of Socket Programming and Client Server model.

Experiment 3

Write a code simulating ARP /RARP protocols.

Experiment 4

Write a code simulating PING and TRACEROUTE commands.

Experiment 5

Create a socket for HTTP for web page upload and download.

Experiment 6

Write a program to implement RPC (Remote Procedure Call).

Experiment 7

Implementation of Subnetting .

Experiment 8

Applications using TCP Sockets like

a. Echo client and echo server b. Chat c. File Transfer

Experiment 9
Applications using TCP and UDP Sockets like
a.DNS b. SNMP c. File Transfer

Experiment 10
Study of Network simulator(NS) and Simulation of Congestion Control Algorithms using NS.

Experiment 11
Configure a DNS server.

Experiment 12
Implement the client for Simple Mail Transfer Protocol (SMTP).

Experiment 13
Configure a mail server for IMAP/POP protocols and write a simple SMTP client to send and receive mails.

Experiment 14
Configuring a Cisco Router as a DHCP Server.

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I Year - I Semester		L	T	P	C
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Advanced Data Structures Lab (MTCN1107)

Course Objectives:

From the course the student will learn

- Knowing about oops concepts for a specific problem.
- Various advanced data structures concepts like arrays, stacks, queues, linked lists, graphs and trees.

Course Outcomes:

- Identify classes, objects, members of a class and relationships among them needed for a specific problem.
- Examine algorithms performance using Prior analysis and asymptotic notations.
- Organize and apply to solve the complex problems using advanced data structures (like arrays, stacks, queues, linked lists, graphs and trees.)
- Apply and analyze functions of Dictionary

Experiment 1:
Implement Multi stacks.

Experiment 2:
Implement Double Ended Queue (Dequeues) & Circular Queues.

Experiment 3:
Implement various Recursive operations on Binary Search Tree.

Experiment 4:
Implement various Non-Recursive operations on Binary Search Tree.

Experiment 5:
Implement BFS for a Graph

Experiment 6:
Implement DFS for a Graph.

Experiment 7:
Implement Merge & Heap Sort of given elements.

Experiment 8:
Implement Quick Sort of given elements.

Experiment 9:
Implement various operations on AVL trees.

Experiment 10:
Implement B: Tree operations.

Experiment 11:
Implementation of Binary trees and Traversals (DFT, BFT)

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Experiment 12:
Implement Krushkal's algorithm to generate a min-cost spanning tree.

Experiment 13:
Implement Prim's algorithm to generate a min-cost spanning tree.

Experiment 14:
Implement functions of Dictionary using Hashing.

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I Year - II Semester		L	T	P	C
		3	0	0	3
Network Security					

Course Objectives:
To learn the basics of security and various types of security issues.

- To study different cryptography techniques available and various security attacks.
- Explore network security and how they are implemented in real world.
- To get an insight of various issues of Web security and biometric authentication.

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

- To understand basics of security and issues related to it.
- Understanding of biometric techniques available and how they are used in today's world.
- Security issues in web and how to tackle them.
- Learn mechanisms for transport and network security.

UNIT–I: Data security- Security Attacks, Security Services, Security Mechanisms, A Model for Network Security, Standards, Review of cryptography- Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation, Public Key Cryptography Principles, Public-Key Cryptography Algorithms.

UNIT–II: Authentication- Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, non-repudiation and message integrity, Digital signatures and certificates. Protocols using cryptography (example Kerberos), X.509 Certificate, Federated identity management.

UNIT–III: Network security- Firewalls- The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations, Proxy-Servers, Network intrusion detection, Transport security- Mechanisms of TLS, SSL, IPSec- IP Security Policy, Encapsulating Security Payload.

UNIT–IV: Web security – The Web Protocols, Risks to the Clients, Risks to the Server, Web Servers vs Firewalls, The Web and Databases, SQL injection, XSS, etc, Software security and buffer overflow, Malware types and case studies. Access Control, firewalls and host/network intrusion detection.

UNIT–V: Biometric Authentication- Secure E-Commerce (ex. SET), Smart Cards, Security in Wireless Communication, IDS- Types of IDSs, Administering an IDS Malicious Software- Types of Malicious Software, Viruses, Virus Countermeasure.
Text Books:

1. Network Security Essentials: Applications and Standards, 4E, William Stallings, Prentice Hall, 2011
2. Firewalls and Internet Security, W. R. Cheswick and S. M. Bellovin, Addison Wesley, 2003.

Reference Books:

1. Cryptography and Network Security, 4E, W. Stallings, , Prentice Hall, 2005.

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I Year - II Semester		L	T	P	C
		3	0	0	3
Wireless Sensor Networks					

Course Objectives:

- Understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities.
- Knowledge of outline of the techniques for developing a secure application.
- Recognize opportunities to apply secure coding principles.

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

- Explain common wireless sensor node architectures.
- Be able to carry out simple analysis and planning of WSNs.
- Demonstrate knowledge of MAC protocols developed for WSN.
- Demonstrate knowledge of routing protocols developed for WSN.
- Explain mobile data-centric networking principles.
- Be familiar with WSN standards.

UNIT-I: Characteristics Of WSN: Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

UNIT-II: Medium Access Control Protocols: Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contentionbased protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

UNIT-III: Routing And Data Gathering Protocols Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

UNIT-IV: Embedded Operating Systems: Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

UNIT-V: Applications Of WSN: WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Text Books

1.Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.
2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

Reference Books

1.K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
2.Philip Levis, " TinyOS Programming" 3.Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

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I Year - II Semester		L	T	P	C
		3	0	0	3

Web Security

Course Objectives:

- Underlying security principles of the web
- Overview of concrete threats against web applications
- Insights into common attacks and countermeasures
- Current best practices for secure web applications

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

- Demonstrate security concepts, security professional roles, and security resources in the context of systems and security development life cycle
- Justify applicable laws, legal issues and ethical issues regarding computer crime
- Explain the business need for security, threats, attacks, top ten security vulnerabilities, and secure software development
- Apply information security policies, standards and practices, the information security blueprint
- Analyze and describe security requirements for typical web application scenario

UNIT–I: Introduction- A web security forensic lesson, Web languages, Introduction to different web attacks. Overview of N-tier web applications, Web Servers-Apache, IIS.

UNIT–II: Securing the Communication Channel- Understanding the dangers of an insecure communication channel. Practical advice on deploying HTTPS, and dealing with the impact on your application. Insights into the latest evolutions for HTTPS deployments.

UNIT–III: Web Hacking Basics: HTTP & HTTPS URL, Web under the Cover Overview of Java security Reading the HTML source, Applet Security Servlets Security Symmetric and Asymmetric Encryptions, Network security Basics, Firewalls & IDS.

UNIT–IV: Securely Handling Un-Trusted data:
Investigation of injection attacks over time. Understanding the cause behind both server-side and client-side injection attacks. Execution of common injection attacks, and implementation of various defences.

UNIT–V: Preventing unauthorized access: Understanding the interplay between authentication, authorization and session management. Practical ways to secure the authentication process, prevent authorization bypasses and harden session management mechanisms, Securing Large Applications, Cyber Graffiti.

Text Books:

1. McClure, Stuart, Saumil Shah, and Shreeraj Shah. Web Hacking: attacks and defense. Addison Wesley. 2003.
2. Garms, Jess and Daniel Somerfield. Professional Java Security. Wrox. 2001.

Reference Books (e-books):

1. Collection of Cryptography Web Sites, Publications, FAQs, and Reference Books::http://world.std.com/~franl/crypto.html
2. FAQ: What is TLS/SSL? http://www.mail.nih.gov/user/faq/tlsssl.htm
3. The Open SSL Project (SDKs for free download): http://www.openssl.org/
4. Windows & .NET security updates Web site: http://www.ntsecurity.net/
5. Preventing Unauthorized access Web site: https://www.edx.org/course/web-security-fundamentals

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		3	0	0	3

Internet of Things

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes:

After the completion of the course, student will be able to

- Summarize on the term 'internet of things' in different contexts.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

UNIT I:

FUNDAMENTALS OF IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II:

IoT PROTOCOLS: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT. Bluetooth Smart Connectivity-Overview, Key Versions, BLE-Bluetooth Low Energy Protocol, Low Energy Architecture.

UNIT III:

DESIGN AND DEVELOPMENT: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV:

Arm Based Embedded System Design: ARM Cortex-A class processor, Embedded Devices-ARM Cortex-M Class processor, Networking-Bluetooth Smart Technology

Introduction to embedded systems: CPUs vs MCU's vs Embedded Systems, Examples, Options for Building Embedded Systems, Features of Embedded Systems, Building Embedded Systems, Building Embedded Systems using MCUs, Introduction to mbedTM Platform

UNIT V:

CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. The Definative Guide to ARM Cortex-MR3 and M4 Processor, 3rd Edition, Joseph Yiu

Reference Books:

1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
3. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
4. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
5. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O'Reilly Media, 2011.
6. Cortex–A series Programmer's Guide for ARMv7-A by Arm http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.den0013d/index.htmlc

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I Year - II Semester		L	T	P	C
		3	0	0	3
Intrusion Detection & Prevention Systems					

Course Objectives:

- Understand when, where, how, and why to apply Intrusion Detection tools and techniques in order to improve the security posture of an enterprise.
- Apply knowledge of the fundamentals and history of Intrusion Detection in order to avoid common pitfalls in the creation and evaluation of new Intrusion Detection Systems
- Analyze intrusion detection alerts and logs to distinguish attack types from false alarms

Course Outcomes:

- Explain the fundamental concepts of Network Protocol Analysis and demonstrate the skill to capture and analyze network packets.
- Use various protocol analyzers and Network Intrusion Detection Systems as security tools to detect network attacks and troubleshoot network problems.

UNIT-I: History of Intrusion detection, Audit, Concept and definition, Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

UNIT-II: Intrusion Prevention Systems, Network IDs protocol based Ids, Hybrid IDs, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis.

UNIT-III: Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple, Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes.

UNIT-IV: Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc. Plugins, Preprocessors and Output Modules, Using Snort with MySQL.

UNIT-V: Using ACID and Snort Snarf with Snort, Agent development for intrusion detection, Architecture models of IDs and IPs.

Text Books:

1. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003.

References:

1. Christopher Kruegel,Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.
2. Carl Endorf, Eugene Schultz and Jim Mellander " Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
3. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002
4. T. Fahringer, R. Prodan, "A Text book on Grid Application Development and Computing Environment". 6th Edition, KhannaPublihsers, 2012.

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		3	0	0	3

Firewall and VPN Security

Course Objectives:

- Identify and assess current and anticipated security risks and vulnerabilities
- Develop a network security plan and policies
- Establish a VPN to allow IPSec remote access traffic
- Monitor, evaluate and test security conditions and environment
- Develop critical situation contingency plans and disaster recovery plan
- Implement/test contingency and backup plans and coordinate with stakeholders
- Monitor, report and resolve security problems

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

- To show the fundamental knowledge of Firewalls and it types
- Construct a VPN to allow Remote Access, Hashing, connections with Cryptography and VPN Authorization
- Elaborate the knowledge of depths of Firewalls, Interpreting firewall logs, alerts, Intrusion and Detection
- Infer the design of Control Systems of SCAD, DCS, PLC's and ICS's
- Evaluate the SCADA protocols like RTU, TCP/IP, DNP3, OPC,DA/HAD

UNIT–I: Firewall Fundamentals: Introduction, Types of Firewalls, Ingress and Egress Filtering, Types of Filtering, Network Address Translation (NAT), Application Proxy, Circuit Proxy, Content Filtering, Software versus Hardware Firewalls, IPv4 versus IPv6 Firewalls, Dual-Homed and Triple-Homed Firewalls, Placement of Firewalls.

UNIT–II: VPN Fundamentals: VPN Deployment Models and Architecture, Edge Router, Corporate Firewall, VPN Appliance, Remote Access, Site-to-Site, Host-to-Host, Extranet Access, Tunnel versus Transport Mode, The Relationship Between Encryption and VPNs, Establishing VPN Connections with Cryptography, Digital Certificates, VPN Authorization.

UNIT–III: Exploring the Depths of Firewalls: Firewall Rules, Authentication and Authorization, Monitoring and Logging, Understanding and Interpreting Firewall Logs and Alerts, Intrusion Detection, Limitations of Firewalls, Downside of Encryption with Firewalls, Firewall Enhancements, and Management Interfaces.

UNIT– IV: Overview of Industrial Control Systems: Overview of SCADA, DCS, and PLCs, ICS Operation, Key ICS Components, Control Components, Network Components, SCADA Systems, Distributed Control Systems, Programmable Logic Controllers, Industrial Sectors and Their Interdependencies.

UNIT– V: SCADA Protocols: Modbus RTU, Modbus TCP/IP, DNP3, DNP3 TCP/IP, OPC, DA/HAD, SCADA protocol fuzzing, Finding Vulnerabilities in HMI: software- Buffer Overflows, Shell code. Previous attacks Analysis- Stuxnet, Duqu.

Text Books:

1. Michael Stewart "Network Security, Firewalls, and VPNs" Jones & Bartlett Learning September 2010.
2. T. Macaulay and B. L. Singer, Cyber security for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS, Auerbach Publications, 2011.
3. J. Lopez, R. Setola, and S. Wolthusen, Critical Infrastructure Protection Information Infrastructure Models, Analysis, and Defense, Springer-Verlag Berlin Heidelberg, 2012.

Reference Books:

1. J. Lopez, R. Setola, and S. Wolthusen, Critical Infrastructure Protection Information Infrastructure Models, Analysis, and Defense, Springer-Verlag Berlin Heidelberg, 2012.
2. Robert Radvanovsky and Jacob Brodsky, editors. Handbook of SCADA/Control Systems Security. CRC Press, 2013.
3. A.W. Colombo, T. Bangemann, S. Karnouskos, S. Delsing, P. Stluka, R. Harrison, et al. Industrial cloud-based cyber-physical systems Springer International Publishing, 2014.
4. D. Bailey, Practical SCADA for Industry. Burlington, MA: Newnes, 2003.

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Machine Learning

Course Objectives:

- To be able to formulate machine learning problems corresponding to different applications.
- To understand a range of machine learning algorithms along with their strengths and weaknesses.
- To understand the basic theory underlying machine learning.

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

- Student should be able to understand the basic concepts such as decision trees and neural networks.
- Ability to formulate machine learning techniques to respective problems.
- Apply machine learning algorithms to solve problems of moderate complexity.

UNIT – I: Introduction: An illustrative learning task, and a few approaches to it. What is known from algorithms? Theory, Experiment. Biology. Psychology. Overview of Machine learning, related areas and applications. Linear Regression, Multiple Regression, Logistic Regression,logistic functions, Concept Learning: Version spaces. Inductive Bias. Active queries. Mistake bound/ PAC model. basic results. Overview of issues regarding data sources, success criteria.

UNIT –II: Decision Tree Learning- Minimum Description Length Principle. Occam's razor. Learning with active queries Introduction to information theory, Decision Trees, Cross Validation and Over fitting. Neural Network Learning: Perceptions and gradient descent back propagation, multilayer networks and back propagation.

UNIT –III: Sample Complexity and Over fitting: Errors in estimating means. Cross Validation and jackknifing VC dimension. Irrelevant features: Multiplicative rules for weight tuning., Support Vector Machines: functional and geometric margins, optimum margin classifier, constrained optimization, Lagrange multipliers, primal/dual problems, KKT conditions, dual of the optimum margin classifier, soft margins, and kernels. Bayesian Approaches: The basics Expectation Maximization. Bayes theorem, Naïve Bayes Classifier, Markov models,Hidden Markov Models.

UNIT—IV: Instance-based Techniques: Lazy vs. eager generalization. K nearestneighbor, case- based reasoning. Clustering and Unsupervised Learning: K-means clustering, Gaussian mixture density estimation, model selection.

UNIT—V: Genetic Algorithms: Different search methods for induction - Explanation-based Learning: using prior knowledge to reduce sample complexity. Dimensionality reduction: feature selection, principal component analysis, linear discriminant analysis, factor analysis, independent component analysis, multidimensional scaling, manifold learning

Text Books:

1. Tom Michel, Machine Learning, McGraw Hill, 1997
2. Trevor Has tie, Robert Tibshirani & Jerome Friedman. The Elements of Statically Learning, Springer Verlag, 2001

Reference Books:

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc.,2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

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I Year - II Semester		L	T	P	C
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Service Oriented Architecture

Course Objectives:

- Expose students to component architecture & service orientation
- Expose students to architectural paradigms of service oriented architecture.
- Expose students to different technologies that make dynamic service oriented architecture applications possible.

Course Outcomes:

- Explain in detail the basic paradigm and merits of service oriented architecture.
- Explain the considerations and circumstances for building applications using service oriented architecture.
- Able to fully understand the concept of enterprise service bus.

UNIT-I: Software Architecture: Need for Software Architecture, Objectives of Software architecture, Types of IT Architecture, Architectural patterns and styles Service-Oriented Architecture: Service orientation in daily life, Evolution of SOA, Drivers for SOA, Dimensions of SOA, Key components of SOA, Perspectives of SOA.

UNIT-II: Enterprise wide SOA: Considerations for Enterprise wide SOA, Strawman architecture, Enterprise SOA layers, Application development process, SOA methodology for enterprise. Enterprise Applications: Architectural considerations, Solution architecture for enterprise applications, solution architecture for enterprise.

UNIT-III: Web services Overview: Heterogeneity problem, XML, SOAP, WSDL, UDDI registry,WS-I Basic profile Enterprise Service Bus : Routing and Scalable connectivity, Protocol transformation, Data/message transformation, core functionalities, optional features, logical components, deployment configurations, types of ESBs, Practical usage scenarios.

UNIT-IV: Service Oriented Analysis and Design: Need for models, principles of service design, design of activity services, design of data, client and business process services SOA Governance, Security and Implementation: SOA governance, SOA security,approach for enterprise wide SOA implementation

UNIT-V: Technologies for SOA: XML : Namespaces, schemas, processing/passing models SOAP : messages, elements, attributes and processing model, message exchange types ,HTTP binding WSDL : containment structure, elements of abstract description, elements of the implementation part, logical relationships, SOAP binding UDDI Registry: Basic data model, tmodel, categorization and identification schemes, binding template, use of WSDL in the UDDI registry

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Text Books:

1.SOA Based Enterprise Integration : A step by step guide to services based application integration – WaseemRoshen, Tata Mc-Graw Hill Edition.

2. Service Oriented Architecture for Enterprise and Cloud applications – Second edition – Shankar Kambhampaty- Wiley India

Reference Books:

1. "Introduction to service oriented modeling"-Service oriented Modeling: Service analysis, design and architecture – Wiley & Sons.

2. Service Oriented Architecture : Concepts, technology and design-Thomas Erl-Pearson Education 2005

3. SOA and Cloud computing :Practices,patterns and technologies – Anthony Assi,TouficBobez, Nitin Gandhi-Prentice Hall/Pearson PTR

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I Year - II Semester		L	T	P	C
		0	0	4	2
Network Security Lab					

Course Objectives:

- To know about various encryption techniques.
- To understand the concept of Public key cryptography.
- To study about message authentication and hash functions
- To impart knowledge on Network security

Course Outcomes:

- Classify the symmetric encryption techniques
- Illustrate various Public key cryptographic techniques
- Evaluate the authentication and hash algorithms.
- Discuss authentication applications
- Summarize the intrusion detection and its solutions to overcome the attacks.
- Basic concepts of system level security

Experiment 1:
Write a C program that contains a string (char pointer) with a value \Hello World'. The program should XOR each character in this string with 0 and displays the result.

Experiment 2:
Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result

Experiment 3:
Write a Java program to perform encryption and decryption using the following algorithms:
a) Ceaser Cipher
b) Substitution Cipher
c) Hill Cipher

Experiment 4:
Write a Java program to implement the DES algorithm logic

Experiment 5:
Write a C/JAVA program to implement the BlowFish algorithm logic

Experiment 6:
Write a C/JAVA program to implement the Rijndael algorithm logic.

Experiment 7:
Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java keytool.

Experiment 8:
Write a Java program to implement RSA Algorithm

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Experiment 9:
Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).

Experiment 10:
Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

Experiment 11:
Calculate the message digest of a text using th

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I Year - II Semester		L	T	P	C
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Advanced Network Programming Lab					

Course Objectives:

- To write, execute and debug c programs which use Socket API.
- To understand the use of client/server architecture in application development
- To understand how to use TCP and UDP based sockets and their differences.
- To get acquainted with unix system internals like Socket files, IPC structures.
- To Design reliable servers using both TCP and UDP sockets

Course Outcomes:

- Understand and explain the basic concepts of Grid Computing;
- Explain the advantages of using Grid Computing within a given environment;
- Prepare for any upcoming Grid deployments and be able to get started with a potentially available Grid setup.
- Discuss some of the enabling technologies e.g. high-speed links and storage area networks.
- Build computer grids.

Experiment 1:
Understanding and using of commands like ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute, whoisetc. Usage of elementary socket system calls (socket (), bind(), listen(), accept(),connect(),send(),recv(),sendto(),recvfrom()).

Experiment 2:
Implementation of Connection oriented concurrent service (TCP).

Experiment 3:
Implementation of Connectionless Iterative time service (UDP).

Experiment 4:

Implementation of Select system call.

Experiment 5:

Implementation of gesockopt (), setsockopt () system calls.

Experiment 6:

Implementation of getpeername () system call.

Experiment 7:

Implementation of remote command execution using socket system calls.

Experiment 8:

Implementation of Distance Vector Routing Algorithm.

Experiment 9:

Implement the following:

i. SMTP
ii. FTP
iii. HTTP
iv. RAS Algorithm

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KAKINADA – 533 003, Andhra Pradesh, India

II Year - I Semester		L	T	P	C
		3	0	0	3

Trustworthy Computing

Course Objectives:

- To make students realize the practical risks and concerns in network security
- To introduce a coherent framework for understanding network security
- To introduce the field's essential security concepts and techniques used to secure a network
- To expose the students to new state-of-the-art research topics in network security

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

- Demonstrate the knowledge of cryptography, network security concepts and applications.
- Ability to apply security principles in system design.
- Ability to identify and investigate vulnerabilities and security threats and mechanisms to counter them.

UNIT–I: Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security, Standards, Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles, Symmetric Block Encryption Algorithms, Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation.

UNIT-II: Public-Key Cryptography and Message Authentication: Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures.

UNIT – III: Key Distribution and User Authentication: Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure.

UNIT – IV: Electronic Mail Security; Pretty Good Privacy, S/MIME, Domain Keys Identified Mail. IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites.

UNIT – V: Intruders: Intruders, Intrusion Detection, Password Management, Malicious Software: Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Distributed Denial of Service Attacks, Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations.

Text Book:

1. Network Security Essentials: Applications and Standards (4th edition) (Paperback), William Stallings, Prentice Hall, 2010, ISBN: 978-0136108054

Reference Book:

1. Trusted Computing, Tsinghua University Tsinghua University Press, Dengguo Feng, O' Relly, 2017

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II Year - I Semester		L	T	P	C
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Advanced Storage Area Networks

Course Objectives:

- To understand the fundamentals of storage centric and server centric systems
- To understand the metrics used for Designing storage area networks
- To understand the RAID concepts
- To enable the students to understand how data centre's maintain the data with the concepts of backup mainly remote mirroring concepts for both simple and complex systems

Course Outcomes: The students should be able to:

- Identify the need for performance evaluation and the metrics used for it
- Apply the techniques used for data maintenance.
- Realize storage virtualization concept,
- Develop techniques for evaluating policies for LUN masking, file systems.

UNIT-I: Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access. **Intelligent Disk Subsystems:** Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.

UNIT-II: I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage. **Network Attached Storage:** The NAS Architecture, The NAS hardware Architecture, The NAS Software Architecture, Network connectivity, NAS as a storage system. **File System and NAS**: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.

UNIT-III: Storage Virtualization: Definition of Storage virtualization ; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network

UNIT-IV: SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective. **Software Components of SAN:** The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.

UNIT-V: Management of Storage Network: System Management, Requirement of management System, Support by Management System, Management Interface, Standardized Mechanisms, Property Mechanisms, In-band Management, Use of SNMP, CIM and WBEM, Storage Management Initiative Specification (SMI-S), CMIP and DMI, Optional Aspects of the Management of Storage Networks

Text Book:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2013.

Reference Books:

1. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2011.
2. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
3. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2000

II Year - I Semester		L	T	P	C
		3	0	0	3

Cloud Computing

Course Objectives:

From the course the student will learn

- The student will also learn how to apply trust-based security model to real-world security problems.
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Course Outcomes:

- Analyze the Cloud computing setup with it's vulnerabilities and applications using different architectures.
- Design different workflows according to requirements and apply map reduce programming model.
- Apply and design suitable Virtualization concept, Cloud Resource Management and design scheduling algorithms.
- Create combinatorial auctions for cloud resources and design scheduling algorithms for computing clouds
- Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application

UNIT–I: Introduction- Network centric computing, Network centric content, peer-to –peer systems, cloud computing delivery models and services, Ethical issues, Vulnerabilities, Major challenges for cloud computing, **Parallel and Distributed Systems-** Introduction, architecture, distributed systems, communication protocols, logical clocks, message delivery rules, concurrency, model concurrency with Petri Nets.

UNIT-II: Cloud Infrastructure- At Amazon, The Google Perspective, Microsoft Windows Azure, Open Source Software Platforms, Cloud storage diversity, Intercloud, energy use and ecological impact, responsibility sharing, user experience, Software licensing, **Cloud Computing-** Applications and Paradigms: Challenges for cloud, existing cloud applications and new opportunities, architectural styles, workflows, The Zookeeper, The Map Reduce Program model, HPC on cloud, biological research.

UNIT-III: Cloud Resource virtualization- Virtualization, layering and virtualization, virtual machine monitors, virtual machines, virtualization- full and para, performance and security isolation, hardware support for virtualization, Case Study: Xen, vBlades, **Cloud Resource Management and Scheduling-** Policies and Mechanisms, Applications of control theory to task scheduling, Stability of a two-level resource allocation architecture, feedback control based on dynamic thresholds, coordination, resource bundling, scheduling algorithms, fair queuing, start time fair queuing, cloud scheduling subject to deadlines, Scheduling Map Reduce applications, Resource management and dynamic application scaling.

UNIT-IV: Storage Systems- Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system., Apache Hadoop, BigTable, Amazon Simple Storage Service(S3), **Cloud Security-** Cloud security risks, security – atop concern for

cloud users, privacy and privacy impact assessment, trust, OS security, Virtual machine security, Security risks.

UNIT-V: Cloud Application Development- Amazon Web Services- EC2, instances, connecting clients, security rules, launching, usage of S3 in Java, Installing Simple Notification Service on Ubuntu 10.04, Installing Hadoop on Eclipse, Cloud based simulation of a Distributed trust algorithm, Cloud service for adaptive data streaming, **Google-** Google App Engine, Google Web Toolkit, **MicroSoft-** Azure Services Platform, Windows live, Exchange Online, Share Point Services, Microsoft Dynamics CRM.

Text Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu,MK Elsevier
2. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH

Reference Books:

1. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi

II Year - I Semester		L	T	P	C
		3	0	0	3

Python Programming

Course Objectives:

- Knowledge and understanding of the different concepts of Python.
- Using the GUI Programming and Testing in real-time applications.
- Using package Python modules for reusability.

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

- Demonstrate and comprehend the basics of python programming.
- Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
- Explain the use of the built-in data structures list, sets, tuples and dictionary.
- Make use of functions and its applications.
- Identify real-world applications using oops, files and exception handling provided by python.

UNIT–I: Introduction- History of Python, Python Language, Features of Python, Applications of Python, Using the REPL (Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT–II: Types, Operators and Expressions-Types - Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations, Control Flow- if, if-elif-else, for, while, break, continue, pass.

UNIT–III: Data Structures-Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

UNIT–IV: Functions- Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions(Function Returning Values), Scope of the Variables in a Function - Global and Local Variables, Modules: Creating modules, import statement, from.. import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

UNIT–V: Object Oriented Programming OOP in Python-Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Datahiding,
Brief Tour of the Standard Library - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, Testing: Why testing is required ?, Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press
2. Think Python, Allen Downey, Green Tea Press

3. Core Python Programming, W. Chun, Pearson

II Year - I Semester		L	T	P	C
		3	0	0	3

Principles of Cyber Security

Course Objectives:

- To learn threats and risks within context of the cyber security architecture.
- Student should learn and Identify security tools and hardening techniques.
- To learn types of incidents including categories, responses and timelines for response.

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

- Apply cyber security architecture principles.
- Demonstrate the risk management processes and practices.
- Appraise cyber security incidents to apply appropriate response
- Distinguish system and application security threats and vulnerabilities.
- Identify security tools and hardening techniques

UNIT–I: Introduction to Cyber security- Cyber security objectives, Cyber security roles, Differences between Information Security & Cyber security. Cyber security Principles- Confidentiality, integrity, &availability Authentication & non repudiation.

UNIT–II: Information Security (IS) within Lifecycle Management-Lifecycle management landscape, Security architecture processes, Security architecture tools, Intermediate lifecycle management concepts, Risks & Vulnerabilities-Basics of risk management, Operational threat environments, Classes of attacks.

UNIT–III: Incident Response- Incident categories, Incident response Incident recovery. Operational security protection: Digital and data assets, ports and protocols, Protection technologies, Identity and access Management, configuration management.

UNIT–IV: Threat Detection and Evaluation (DE): Monitoring- Vulnerability Management, Security Logs and Alerts, Monitoring Tools and Appliances. Analysis- Network traffic Analysis, packet capture and analysis

UNIT–V: Introduction to backdoor System and security-Introduction to metasploit, Backdoor, demilitarized zone(DMZ),Digital Signature, Brief study on Harding of operating system.

Text Books:

1. NASSCOM: Security Analyst Student Hand Book, Dec 2015
2. Information Security Management Principles, Updated Edition, David Alexander, Amanda Finch, David Sutton, BCS publishers, June 2013

Reference Books:

1. Cyber Security Fundamentals-Cyber Security, Network Security and Data Governance Security, 2nd Edition, ISACA Publishers

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II Year - I Semester		L	T	P	C
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Internet of Things

Course Objectives:

- To Understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications.

Course Outcomes:

After the completion of the course, student will be able to

- Summarize on the term 'internet of things' in different contexts.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

UNIT I: Fundamentals of IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II: IoT Protocols: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT. Bluetooth Smart Connectivity-Overview, Key Versions, BLE-Bluetooth Low Energy Protocol, Low Energy Architecture.

UNIT III: Design And Development: Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT IV: Arm Based Embedded System Design: ARM Cortex-A class processor, Embedded Devices-ARM Cortex-M Class processor, Networking-Bluetooth Smart Technology **Introduction to embedded systems**: CPUs vs MCU's vs Embedded Systems, Examples, Options for Building Embedded Systems, Features of Embedded Systems, Building Embedded Systems, Building Embedded Systems using MCUs, Introduction to mbedTM Platform

UNIT V: Case Studies/Industrial Applications: Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

Text Books:

a. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
b. The Definative Guide to ARM Cortex-MR3 and M4 Processor, 3rd Edition, Joseph Yiu

Reference Books:

i. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
2. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).
2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
~~3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds),~~ Springer, 2011.
4. [illegible] Expand, and Enhance [illegible], Michael Margolis, Arduino Cookbook and

O'Reilly Media, 2011.
5. Cortex–A series Programmer's Guide for ARMv7-A by Arm http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.den0013d/index.htmlc

II Year - I Semester		L	T	P	C
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Artificial Intelligence and Machine Learning

Course Objectives:
- To learn the basic concepts and techniques of AI and machine learning
- To explore the various mechanism of Knowledge and Reasoning used for building expert system.
- To become familiar with supervised and unsupervised learning models
- To design and develop AI and machine learning solution using modern tools.

Course Outcomes: At the end of the course, student will be able to
- Explain the fundamentals of AI and machine learning.
- Identify an appropriate AI problem solving method and knowledge representation technique.
- Identify appropriate machine learning models for problem solving.
- Design and develop the AI applications in real world scenario.
- Compare the relationship between AI, ML, and Deep Learning,

UNIT– I: Introduction to AI- Definition, Problem, State space representation. Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Applications of AI, Current trends in AI, Intelligent Agents: Anatomy, structure, Types.

UNIT– II: Problem solving-Solving problem by Searching: Problem Solving Agent, Formulating Problems. Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods- Greedy best first Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems- Hill climbing search Simulated annealing and local beam search.

UNIT – III: Knowledge and Reasoning-Knowledge based Agents, The Wumpus World, and Propositional logic**. First Order Logic**- Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining, Knowledge Engineering in First-Order Logic, Unification and Resolution.

UNIT – IV: Concepts of Machine learning -Supervised, unsupervised, semi-supervised, Rote learning, Reinforcement learning, Issues, steps and applications, Designing a learning System. Case study- hand written digit recognition, stock price prediction. Learning Models- Decision tree learning. Probabilistic Models, Deterministic Models, Hidden Markov Model, Reinforcement Learning-Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.

UNIT – V: Artificial Neural Network: Introduction, neural network representation, Problems for neural network learning, perception, multilayer network & Back propagation Algorithm**.** Deep learning- Definition, relationship between AI, ML, and Deep Learning, Trends in Deep Learning.

Text Books:
1. Artificial Intelligence and Machine Learning, 1st Edition, Vinod Chandra S.S., Anand Hareendran S, 2014
2. Artificial Intelligence: A Modern Approach, Second Edition, Pearson Education, Stuart J. Russell, Peter Norvig, 2003

3. Machine Learning, McGraw-Hill Education, Tom M. Mitchell, 1997
4. Introduction to machine learning, 2nd edition, The MIT Press, Ethem Alpaydin 2010

Reference Books:

1. PROLOG Programming for Artificial Intelligence", Third Edition, Pearson Education, Ivan Bratko, 2002
2. Artificial Intelligence, Third Edition, McGraw Hill Education, Elaine Rich and Kevin Knight, 2017
3. Data Mining Concepts and Techniques, Morgann Kaufmann Publishers, Han Kamber, 2011
4. Machine learning with R, 2nd Edition, Brett Lantz, 2015
5. Genetic Algorithms: Search, Optimization and Machine Learning, Davis E. Goldberg, Addison Wesley, N.Y., 1989

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	L	T	P	C
IV Semester				
	0	**0**	**32**	**16**

(DISSERTATION) DISSERTATION PHASE – I AND PHASE – II

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

- As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.
- The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q &A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, a record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q &A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

Course Outcomes:

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

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
4. Presenting the work in International/ National conference or reputed journals.

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AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:
Students will be able to:
Understand that how to improve your writing skills and level of readability
Learn about what to write in each section
Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries

they work in

Syllabus		
Units	**CONTENTS**	**Hours**
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**Repercussions Of Disasters And Hazards**: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man- made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	**Disaster Prone Areas In India** Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	**Disaster Preparedness And Management** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	**Risk Assessment** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	**Disaster Mitigation** Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep

Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Unit	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	4
2	Order Introduction of roots Technical information about Sanskrit Literature	4
3	Technical concepts of Engineering-Electrical,	4
4	Technical concepts of Engineering - Mechanical.	4
5	Technical concepts of Engineering - Architecture.	4
6	Technical concepts of Engineering – Mathematics.	4

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline	4
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	4
4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	4
5	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women.	4
6	All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	4

Suggested reading

1 Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course outcomes

Students will be able to 1.Knowledge of self-development
2.Learn the importance of Human values 3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus		
Units	**Content**	**Hours**
1	**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	**Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4
4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4
5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discussthe intellectual originsof the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus		
Units	**Content**	**Hours**
1	**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	4
3	Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	4
4	Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
5	Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
6	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	4

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	5
2	Yam and Niyam. Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha	5
3	Yam and Niyam. Do`s and Don't's in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	5
4	Asan and Pranayam Various yog poses and their benefits for mind & body	5
5	Regularization of breathing techniques and its effects-Types of pranayam	4

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue)	4
2	Neetisatakam-Holistic development of personality Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	4
3	Approach to day to day work and duties. Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,	4
4	Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	4
5	Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18	4
6	Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	4

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

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