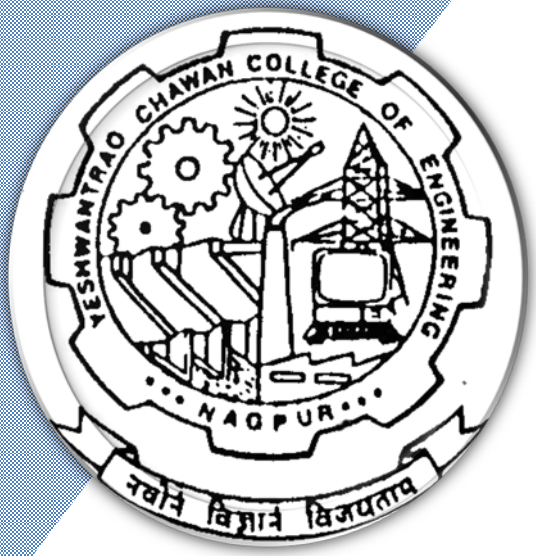
Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110



SoE & Syllabus 2019

M.Tech. Computer Science Engineering

28 June 2019

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2019

Computer Science Engineering

SN	Sem	Sub Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
					L	T	P	Hrs		MSEs*	TA	ESE	
I SEMESTER													
1	1	CSE3901	High Performance Computer Architecture	T	3	0	0	3	3	30	10	60	3
2	1	CSE3902	Real Time Systems	T	3	0	0	3	3	30	10	60	3
3	1	CSE3903	Network Security & Cryptography	T	3	0	0	3	3	30	10	60	3
4	1	CSE3904	**Lab:** Network Security & Cryptography	P	0	0	2	2	1		40	60	
5	1	CSE3905	Algorithm Design Techniques	T	3	0	0	3	3	30	10	60	3
6	1	CSE3906	**Lab:** Algorithm Design Techniques	P	0	0	2	2	1		40	60	
7	1		**Professional Elective-I**	T	3	0	0	3	3	30	10	60	3
8	1		**Professional Elective-II**	T	3	0	0	3	3	30	10	60	3
9	1	CSE3915	Software Lab 1	P	0	0	2	2	2		40	60	
Total					**18**	**0**	**6**	**24**	**22**				

List of Professional Electives-I

1	CSE3907	PE I: Advanced Digital Image Processing
1	CSE3908	PE I: Ethical Hacking
1	CSE3909	PE I: Machine Learning
1	CSE3910	PE I: Grid and Cloud Computing

List of Professional Electives-II

1	CSE3911	PE II: Soft Computing Techniques
1	CSE3912	PE II: Natural Language Processing
1	CSE3913	PE II: Optimization Techniques
1	CSE3914	PE II: Wireless Sensor Network

II SEMESTER													
1	2	CSE3916	Data Mining	T	3	0	0	3	3	30	10	60	3
2	2	CSE3917	Distributed Systems	T	3	0	0	3	3	30	10	60	3
3	2	CSE3918	Optimizing Compilers	T	3	0	0	3	3	30	10	60	3
4	2	CSE3919	**Lab:** Optimizing Compilers	P	0	0	2	2	1		40	60	
5	2	CSE3920	Software Architecture	T	3	0	0	3	3	30	10	60	3
6	2	CSE3921	**Lab:** Software Architecture	P	0	0	2	2	1		40	60	
7	2	CSE3922	Seminar (Technical Writing and Publishing)	P	0	0	2	2	1		100		1
8	2		**Professional Elective- III**	**T**	3	0	0	3	3	30	10	60	3
9	2		**Professional Elective-IV**	**T**	3	0	0	3	3	30	10	60	3
10	2	CSE3931	Software Lab 2	P	0	0	2	2	2		40	60	
Total					**18**	**0**	**8**	**26**	**23**				

List of Professional Electives-III

2	CSE3923	PE III: Computer Vision
2	CSE3924	PE III: Data Warehousing
2	CSE3925	PE III: Research Methodology & Statistics
2	CSE3926	PE III: Information Retrieval Systems

List of Professional Electives-IV

2	CSE3927	PE IV: Cyber Forensics
2	CSE3928	PE IV: Deep Learning
2	CSE3929	PE IV: Fundamentals of Bioinformatics
2	CSE3930	PE IV: Semantic Web and Social Networks

III SEMESTER													
1	3	CSE3939	Project Phase – I	P	0	0	16	16	8	100			
Total					**6**	**0**	**16**	**16**	**8**				
IV SEMESTER													
1	4	CSE3940	Project Phase - II	P	0	0	24	24	12		40	60	
Total					**0**	**0**	**24**	**24**	**12**				
Grand Total of Credits									**65**				

MSEs* = Three MSEs of 15 Marks each will be conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Chairperson	Dean (Acad. Matters)	June 2019 Date of Release	1.00 Version	Applicable for Sem 1 & 2 AY 2019-20 & Sem 3 & 4 AY 2020-21 Onwards

I SEMESTER

CSE3901	**High Performance Computer Architectures**	**L=3**	**T=0**	**P=0**	**Credits=3**

Evaluation Scheme	**MSEs**	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3hrs**

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Parallel Computer Models: The state of computing, Classification of parallel computers, Multiprocessors and multicomputer, Multivector and SIMD computers.

Unit II: Program Properties: Conditions of parallelism, Data and resource Dependences, Hardware and software parallelism, Program partitioning and scheduling, Grain Size and latency, Program flow mechanisms, Control flow versus dataflow, Dataflow Architecture, Demand driven mechanisms, Comparisons of flow mechanisms

Unit III: Pipelining Techniques: Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Mechanisms for instruction pipelining, Dynamic instruction scheduling, Branch Handling techniques, branch prediction, Arithmetic Pipeline Design, Computer arithmetic principles, Static Arithmetic pipeline, Multifunctional arithmetic pipelines

Unit IV: Cache Coherence Mechanism: Cache basics & cache performance, reducing miss rate and miss penalty, multilevel cache hierarchies, cache coherence protocols, memory based directory protocols, cache based directory protocols.

Unit V: Processors Hierarchy: Advanced processor technology, Instruction-set Architectures, CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector and Symbolic processors.

Unit VI: Memory Hierarchy and GPU Programming: Symmetric shared memory architectures, distributed shared memory architectures, models of memory consistency. Multicore and Many core computing, GPU programming: OpenCL , CUDA

Text Books:

1. Kai Hwang, "Advanced computer architecture", TMH publications
2. D. A. Patterson and, J. L. Hennessey, "Computer organization and design", Morgan Kaufmann

Reference Books:

1. J. P. Hayes, "Computer Architecture and organization", MGH
2. Ryojitsuchiyama, Takashi Nakamura, Takurolizuka, Akihiro Asahara, satoshi Miki "OpenCL Programming Book", Kindle Edition
3. Edward Kandrot, Jason Sanders, "CUDA by Example, An Introduction to General-Purpose GPU Programming" Prentice Hall Publications.
4. V. Rajaranam & C. S. R. Murthy, "Parallel computer", PHI
5. R. K. Ghose, Rajan Moona & Phalguni Gupta, "Foundation of Parallel Processing", Narosa Publications
6. Kai Hwang and Zu, "Scalable Parallel Computers Architecture", MGH.
7. M. J. Flynn, "Computer Architecture, Pipelined and Parallel Processor Design", Narosa Publishing.
8. D. A. Patterson, J. L. Hennessy, "Computer Architecture: Aquantitative approach", Morgan Kauffmann
9. Cuda toolkit documentation from NVIDIA and developer.nvidia.com/cuda-zone

I SEMESTER

CSE3902	Real Time Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction to real-time systems- Example real-time applications, Hard vs. soft real time, Reference model, Classic uniprocessor scheduling, Static scheduling, Dynamic scheduling, Cyclic executives

Unit II: Dynamic-priority scheduling- Optimality of EDF and LLF, Utilization-based schedulability test for EDF, Non preemptive EDF, Static-priority scheduling: Optimality of RM and DM, Utilization-based schedulability test for RM, Demand-based scheduling: conditions for static-priority systems. Dealing with complexities arising in real systems: Practical considerations, Timing analysis.

Unit III: Preemptive systems- Dynamic-priority systems, Static-priority systems, Non preemptive systems, Dynamic-priority systems, Static-priority systems

Unit IV: Resources and resource access control: Independent Task Models, Resource sharing, Priority inheritance and priority ceiling protocols, stack resource protocol, Lock-free approach Global multiprocessor schedulability analysis, Hard real-time analysis for global EDF, Soft real-time analysis for global EDF.

Unit V: Synchronization in multiprocessors and distributed systems: Multiprocessor locking protocols, End-to-end scheduling. Mixing real-time and non-real-time, Deferrable servers, Sporadic servers, Constant utilization and total bandwidth servers fairness and starvation

Unit VI: Survey of commercial RTOS and non-real-time OS: Basic operating-system functions needed for real-time computing, survey of LynxOS, QXN, VRTX, Vxworks, windows NT

Text Books:

1. Hermann Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications, Springer
2. Jane W. S. Liu: Real-Time Systems, Prentice Hall,

Reference Books:

1. Philip A. Laplante, Seppo J. Ovaska: Real-Time Systems Design and Analysis: Tools for Practitioner
2. C.M. Krishna, Kang G. Shin, "Real Time Systems", McGraw – Hill International Edition
3. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI

I SEMESTER

CSE3903	Network Security & Cryptography	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction: Security Trends, Security Goals, Security Attacks, Security Services, Security Mechanisms, Relation between Services and Mechanisms, Network Security model, Techniques.

Unit II: Encryption Techniques: Traditional Symmetric Key Ciphers: Substitution, Transposition, Stream and Block Ciphers, Modern Symmetric Key Ciphers: Introduction, Data Encryption Standard (DES), AES. Symmetric Key Cryptography: RSA, Rabin, ElGamal Cryptosystem.

Unit III: Integrity, Authentication: Message Integrity, Message Authentication, Cryptographic Hash Functions, Digital signature, Entity Authentication.

Unit IV: Key Management: KDC, Kerberos, symmetric Key Management: Diffie–Hellman key management, Public Key Distribution: Trusted Center, Certification Authority, X.509, Public Key Infrastructure (PKI).

Unit V: Security at Application Layer: Pretty Good Privacy (PGP), S/MIME.
Security at Transport Layer: Secure Socket Layer (SSL), Transport Layer Security (TLS).
Security at Network Layer: IPsec.

Unit VI: System Security: Intruders, Intrusion detection, Password Management, Malicious Software, Viruses and related threats, Virus Counter measures, Distributed Denial of Service Attacks, Firewalls, Firewall design principles, Trusted systems.

Text Books:

1. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw-Hill
2. William Stalling, "Cryptography and Network Security", Fourth Ed., Prentice Hall

Reference Books:

1. William Stalling, Network Security Essentials Applications & Standards, Fourth Ed., Prentice Hall
2. William Stalling, "Cryptography and Network Security, Principles & Practice", Fourth Ed., Prentice Hall
3. Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill

I SEMESTER

CSE3904	Lab : Network Security and Cryptography	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

List of Practical:

1. Study of various types of network security attacks, attack detection and defense mechanism.
2. Use of different network attacking, traffic monitoring, detection and defense tools in Linux/ Window
3. Report on YCCE Campus wide networking and its performance monitoring.
4. Installation and configuration of Apache Web Server on Linux/Windows Platform.
5. Installation and configuration of Apache Tomcat Application Server on Linux/Windows Platform.

I SEMESTER

CSE3905	Algorithm Design Techniques	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Algorithmic analysis: Analyzing control structures, Solving recurrences, Review of data structures. **Greedy algorithms**: General characteristics, Graphs algorithms, Scheduling.

Unit II: Divide and conquer algorithms: General template, Searching, Sorting, Matrix multiplication, Exponentiation and its application in cryptography. **Dynamic programming**: Principle of optimality, Shortest paths, Chained matrix multiplication, Approaches using recursion, Memory functions.

Unit III: Linear programming: Formulating problems as linear programs, The simplex algorithm, Duality.

Unit IV: Probabilistic algorithms: Introduction, Pseudorandom generation, Numerical probabilistic algorithms, Monte Carlo algorithms, Las Vegas algorithms. **Heuristic algorithms and Approximate algorithms**: Heuristic algorithms, NP-hard approximation problems

Unit V: Parallel algorithms: Basic techniques, Parallel evaluation of expressions, Parallel sorting networks, parallel sorting, Distributed computation.

Unit VI: Computational complexity: Introduction, Linear reductions, Introduction to NP-completeness.

Text Books:

1. T. H. Cormen, C. E. Leiserson, R.L. Rivest, C. Stein, "Introduction to Algorithms", PHI.

Reference Books:

1. G. Brassard, P. Bratley, "Fundamentals of Algorithmics", PHI
2. A.V. Aho, J. E. Hopcroft, J.D. Ulman, "The Design & Analysis of Computer Algorithms", Addison Wesley.
3. Horowitz E., Sahni S, Rajasekharan S., "Fundamentals of computer algorithms", University press

I SEMESTER

CSE3906	Lab : Algorithm Design Techniques	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

List of Practical:

1. Write an algorithm and program for fractional knapsack problem using greedy strategy.
2. Implement Strassen's algorithm using divide and conquer strategy.
3. Write an algorithm and program for 0-1 knapsack problem using dynamic programming strategy
4. Write an algorithm and program to demonstrate the Simplex Method.
5. Write an algorithm and program to implement randomized quicksort algorithm.
6. Study of NESL: A Parallel Programming Language
7. Study of Heuristic algorithm for TSP
8. Study of Approximation algorithm for TSP

I SEMESTER

CSE3907	PE I: Advanced Digital Image Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Overview of Digital Image Processing and Image Enhancement: A Simple Image Model, Sampling and Quantization, Basic Relationship Between Pixel, Basic gray level Transformation, Histogram Equalization, Histogram Processing, Local Enhancement, Image Subtraction, Image Averaging, Basics of Spatial Filtering, Smoothing Spatial Filtering, Sharpening Spatial Filters, Discrete Fourier Transformation, Fast Fourier Transformation, Fourier Properties, 2DFT, Inverse Fourier Transform, Filtering in Frequency Domain**,** Correspondence between Filtering in the Spatial and Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homographic Filtering.

Unit II: Image Segmentation: Fundamentals, Point, line and edge detection, thresholding, Region Oriented Segmentation, Motion Based Segmentation.

Unit III: Morphing, Representation and Description: Introduction, Basic Morphological Algorithm, Chain Code, Polygonal Approximation, Signatures, Boundary Segments, Skeleton of a region, Boundary Descriptors, Shape Numbers, Fourier Descriptors, Regional Descriptors, Simple Descriptors, Topological Descriptors.

Unit IV: Model of the Image Degradation/Restoration Process: Noise Models, Restoration in the presence of Noise only-Spatial Filtering, Periodic Noise reduction by frequency domain filtering, Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse Filtering, Wiener Filtering, Constrained Least Square Filtering.

Unit V: Wavelets: Image Pyramids, Haar Transform, Multiresolution Expansions, Wavelet Transforms in1D, Fast wavelet Transform, wavelet packets.

Unit VI: Image Compression: Fundamentals of Image compression, coding redundancy, spatial and temporal redundancy, Irrelevant Information, Measuring Image Information, Fidelity criteria, Image compression models, compression standards, Basic compression methods, Huffman coding, colomb coding, arithmetic coding, LZW coding, runlength coding, Symbol based coding, Block transform coding, predictive coding.

Text Books:

1. Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing", Pearson Education.
2. A. K. Jain, "Fundamental of Digital Image Processing", PHI.

Reference Books:

1. Rosefield Kak, "Digital Image Processing".
2. W. K. Pratt, "Digital Image Processing".

I SEMESTER

CSE3908	PE I: Ethical Hacking	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction to Ethical Hacking, Ethics, and Legality: Ethical Hacking Terminology, Types, Phases and Stages of Ethical Hacking: Passive and Active Reconnaissance, Scanning, Gaining Access, Maintaining Access, Covering Tracks, Hacktivism, Hacker Classes, Skills Required to Become an Ethical Hacker, Vulnerability Research, Ways to Conduct Ethical Hacking, Creating a Security Evaluation Plan, Types of Ethical Hacks, Testing Types, Ethical Hacking Report

Footprinting and Social Engineering: Footprinting, Information Gathering Methodology, Competitive Intelligence, DNS Enumeration, Who is and ARIN Lookups, Types of DNS Records, Traceroute, E-Mail Tracking , Web Spiders, Social Engineering, Types of Attacks: Insider Attacks, Identity Theft, Phishing Attacks, Online Scams, URL Obfuscation, Social-Engineering Countermeasures.

Unit II: Scanning and Enumeration: Types of Scanning , CEH Scanning Methodology ,Ping Sweep Techniques, Nmap Command Switches, SYN, Stealth, XMAS, NULL, IDLE, and FIN Scans, TCP Communication Flag Types, War-Dialing Techniques, Banner Grabbing and OS Fingerprinting Techniques, Proxy Servers, Anonymizers, HTTP Tunneling Techniques, IP Spoofing Techniques, Enumeration, Null Sessions, SNMP Enumeration & Steps Involved

Unit III: System Hacking: Password-Cracking Techniques, LAN Manager Hash Cracking Windows 2000 Passwords, Redirecting the SMB Logon to the Attacker SMB Redirection, SMB Relay MITM Attacks and Countermeasures, NetBIOS, DoS Attacks, Password-Cracking Countermeasures, Types of Passwords Passive Online Attacks, Active Online Attacks, Offline Attacks, Non electronic Attacks, Keyloggers and Spyware Technologies Escalating Privileges, Buffer Overflows, Planting Root kits on XP Machines, Rootkit Embedded TCP/IP Stack Rootkit Countermeasures, Hiding Files, NTFS File Streaming NTFS Stream Countermeasures, Steganography Technologies, How to Cover Your Tracks and Erase Evidence, Disabling Auditing, Clearing the Event Log

Unit IV: Trojans, Backdoors, Viruses, and Worms: Trojans and Backdoors, Overt and Covert Channels, Types of Trojans, Reverse-Connecting Trojans, Netcat Trojan ,Wrapping, Trojan Construction Kit and Trojan Makers, Countermeasure Techniques, Trojan-Evading Techniques, System File Verification, Viruses and Worms, Types of Viruses, Antivirus Evasion Techniques, Virus Detection Methods Sniffers: Protocols Susceptible to Sniffing, Active and Passive Sniffing, ARP Poisoning, Ethereal Capture and Display Filters, MAC Flooding, DNS Spoofing Techniques, Sniffing Countermeasures

Denial of Service and Session Hijacking: Denial of Service, Types of DoS Attacks, DDoS Attacks DoS/DDoS Countermeasures, Session Hijacking, Spoofing vs. Hijacking, Session Hijacking, Sequence Prediction, Prevention of Session Hijacking

Unit V : Hacking Web Servers, Web Application Vulnerabilities, and Web-Based Password Cracking: Web Server Vulnerabilities, Attacks against Web Servers, IIS Unicode Exploits, Patch Management Techniques, Web Server Hardening Methods, Web Application Vulnerabilities, Objectives, Anatomy of an Attack, Web Application Threats, Google Hacking, Web Application Countermeasures, Web-Based Password Cracking Techniques, Authentication Types, Password Cracker, Password Attacks, Password-Cracking Countermeasures

SQL Injection and Buffer Overflows: SQL Injection, SQL Server, Vulnerabilities, SQL Injection Countermeasures, Buffer Overflows, Types and Methods of Detection, Stack-Based Buffer Overflows, Mutation Techniques

Unit VI: Linux Hacking: Linux Basics, Compile a Linux Kernel, GCC Compilation Commands, Install Linux Kernel Modules, Linux Hardening Methods
Penetration Testing Methodologies: Security Assessments, Penetration Testing Methodologies, Penetration Testing Steps, Pen-Test Legal Framework, Automated Penetration Testing Tools, Pen-Test Deliverables

Text Books:
1. CEH Certified Ethical Hacker study Guide V6, Wiley Publication.

Reference Books:
1. Rich Annings, Himanshu Dwivedi, Zane Lackey, "Hacking Exposed Web 2.0", Tata McGraw Hill
2. Michael T, "Ethical Hacking & Network Defense", Simpson
3. Joel Scambray, cissp, Stuart Mcclure, Cissp, "Hacking Exposed Windows", 3rd Edition, Tata McGraw Hill
4. Joel Scambray Stuart Mcclure, "Hacking Exposed Window server 2003", Tata McGraw Hill

I SEMESTER

CSE3909	PE I: Machine Learning	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction - Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias

Unit II: Decision Tree learning and Artificial Neural Networks: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search indecision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. Introduction to Artificial Neural Networks, Neural network representation, Appropriate problems for neural network learning, Perceptions, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition Advanced topics in artificial neural networks.
Evaluation Hypotheses- Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms

Unit III: Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibs algorithm, NaïveBayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm

Unit IV: Computational learning theory: Introduction, Probability learning an approximately correct hypothesis, Sample complexity for Finite Hypothesis Space, Sample Complexity for infinite Hypothesis Spaces, The mistake bound model of learning.
Instance-Based Learning- Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning
Genetic Algorithms – Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

Unit V: Learning Sets of Rules: Introduction, Sequential Covering Algorithms, Learning Rule Sets: Summary, Learning First Order Rules, Learning Sets of First Order Rules: FOIL, Induction as Inverted Deduction, Inverting Resolution
Analytical Learning- Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge

Unit VI: Combining Inductive and Analytical Learning: Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators,
Reinforcement Learning – Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

Text Books:
1. Tom M. Mitchell, "Machine Learning", MGH
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Taylor & Francis (CRC)

Reference Books:
1. William W Hsieh, "Machine Learning Methods in the Environmental Sciences, Neural Networks", Cambridge Univ Press.

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

I SEMESTER

CSE3910	PE I: Grid and Cloud Computing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction to Cloud Computing and its Models: System models for advanced computing –clusters of cooperative computing, grid computing and cloud computing; software systems for advanced computing-service oriented software and parallel and distributed programming models with introductory details, Features of grid and cloud platform.

Unit II: Cloud Architecture, Services and Applications: Cloud Computing services models and features in Saas, Paas and Iaas. Service oriented architecture and web services; Features of cloud computing architectures and simple case studies.

Unit III: Virtualization- Characteristic features, Taxonomy Hypervisor, Virtualization and Cloud Computing, Pros and Cons of Cloud Computing, Technology Examples/Case Studies.

Unit IV: Cloud programming Environmental- Map Reduce Hadoop Library from Apache, Open Source Cloud Software Systems –Eucalyptus.

Unit V: Grid Computing and its Applications: Grid Architecture and Service modeling, Grid resource management, Grid Application trends.

Unit VI: Grid Case Studies: Monitoring: Windows Azure, Amazon Web Services, Google Cloud, Amazon EC2, TeraGRID IS, Data Transfer: LIGO, Task Distribution: GEO600 etc.

Text Books:

1. Kaittwang Geoffrey C.Fox and Jack J Dongrra, "Distributed and Cloud Computing, Elsevier India
2. Raj Kumar Buyya, Christian Vecchiola and S.TanuraiSelvi, "Mastering Cloud Computing",TMH,

Reference Books:

1. John W. Ritting House and James F Ramsome, "Cloud Computing", CRC Press
2. Gautam Shroff, "Enterprise Cloud Computing", Cambridge University Press

I SEMESTER

CSE3911	**PE II: Soft Computing Techniques**	**L=3**	**T=0**	**P=0**	**Credits=3**

Evaluation Scheme	**MSEs**	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3hrs**

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.

Unit II: Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. **Operations on Fuzzy Sets:** Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.

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

Unit IV: Introduction of Neuro Fuzzy Systems: Architecture of Neuro Fuzzy Networks.

Unit V: Application of Fuzzy Logic: Engineering, Economics, etc.

Unit VI: Computational Learning Theory: - Instance-Based Learning: k-Nearest-neighbor algorithm, Learning first-order rules etc.

Text Books:

1. R. A. Aliev, R. R. Aliev, "Soft Computing and Its Applications"
2. Bar Kosko, "Neural Networks and Fuzzy Systems", Prentice-Hall

Reference Books:

1. Melanie Mitchell, "An Introduction to Genetic Algorithms (Complex Adaptive Systems)", MIT Press

I SEMESTER

CSE3912	PE II: Natural Language Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction to NLP: Computational Models of Language, Organization of NLP Systems, Natural Language Generation.

Unit II: Syntax: Linguistic Background, Elements of Simple Sentences, Parsing Techniques, Features and Augmented Grammars, Deterministic Parsing.

Unit III: Semantic: Logical Form, Case Relations, Semantic Networks.

Unit IV: Context & World Knowledge: Knowledge Representation, Question, Answering Systems: Natural Language Generation, Typical NLP Systems and their Architectures, Cognitive Aspects of Natural Languages

Unit V: Indian Language Processing: Techniques of Machine Translation, Approaches to Machine Translation, Typical Case Studies in Indian Language Context

Unit VI: Introduction to Speech Processing: Word level Morphology and Computational Phonology; Basic Text to Speech; Introduction to HMMs and Speech Recognition, Part of Speech Tagging; Parsing with CFGs; Probabilistic Parsing. Representation of Meaning; Semantic Analysis; Lexical Semantics; Word Sense; Disambiguation; Discourse understanding; Indian language case studies

Text Book:

1. James Allen, "Natural Language Understanding", Pearson Education.
2. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Prentice-Hall

Reference Books:

1. Christopher Manning "Foundations of Statistical Natural Language Processing", MIT Press, Cambridge.
2. Akshar Bharathi, Vineet Chaitanya, Rajeev Sangal, "Natural Language Processing – A Paninian Perspective", Prentice Hall
3. Tom Mitchell, "Machine Learning", McGraw Hill
4. Ronald Hausser, "Foundations of Computational Linguistics", Springer-Verlog,
5. Winograd, "Language as a cognitive process- syntax", Addison Wesley.
6. Popov, "Talking with computer in Natural language", Springer Verlog,

I SEMESTER

CSE3913	PE II: Optimization Techniques	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Unconstrained Optimization: Optimizing Single-Variable Functions, conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.

Unit II: Constrained Optimization: Optimizing Multivariable Functions with Equality Constraint: Direct Search Method, Lagrange Multipliers Method, Constrained Multivariable Optimization with inequality constrained: Kuhn-Tucker Necessary conditions, Kuhn –Tucker Sufficient Conditions.

Unit III: Optimization: Quasi-Newton Methods and line search, least squares optimization, Gauss-Newton, Levenberg- Marquartd, Extensions of LP to Mixed Integer Linear Programming (MILP),

Unit IV: Non-Liner Programming: The Newton Algorithm, Non-Linear Least Squares, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming,

Unit V: Optimization in Operation Research: Dynamic Programming, Transportation – Linear Optimization Simplex and Hitchcock Algorithms, Algorithms, Minimax and Maximum Algorithm, Discrete Simulation,

Unit VI: Integer Programming: Cutting Plane Methods, Separable Programming, Stochastic Programming, Goal Programming, Integer Linear Programming, Pure and Mixed Strategy in theory of Games, Transshipment Problems, Heuristic Methods.

Text Books.

1. Winston W L, "Operations Research: Applications and Algorithms",
2. Rao S.S., "Optimization: Theory and Applications".
3. Walsh G R., "M methods of Optimization".
4. Williams H.P., "Model Building in Mathematics Programming".
5. Williams H.P., "Model Solving in Mathematics Programming".

Reference Books:

1. G.L. Nemhauser and L.A. Wolsey., "Intger and Combinational Optimization".
2. R.G. Parker and R.L. Rardin., "Discrete Optimization".

I SEMESTER

CSE3914	PE II: Wireless Sensor Network	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks.

Unit II: Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.

Unit III: Communication Protocols: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , Contention based Protocols, Schedule based protocols

Unit IV: Link Layer Protocols: Fundamental, Error Control, Framing, Link Management, Naming And Addressing – Fundamentals, Assignment of MAC Address, Distributed assignment of locally unique addresses, Content based and geographic addressing

Unit V: Infrastructure Establishment: Localization and Positioning, Topology Control, Clustering

Unit VI: Middleware for WSN: Middleware for Wireless Sensor Network, Network Management for WSN

Text Books:

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

Reference Books:

1. Christian Poellabauer, Waltenegus Dargie, "Fundamentals of wireless sensor networks: Theory Practice", John Wiley & Sons, Ltd.

I SEMESTER

CSE3915	**Software Lab 1**	**L=0**	**T=0**	**P=2**	**Credits=2**

Evaluation Scheme	**Continuous Evaluation**	**ESE**	**Total**	**ESE Duration**
	40	**60**	**100**	

I. **Unix/Linux Lab**

a. Common Commands – ls, passwd, wc, chdir, mkdir, chmod, cd, mv, df, du, netstat, ps, more, set, env, setenv, chgrp, man, rm, rmdir, grep, vi, tar, untar, uuencode, find, cat, history, ping, ifconfig, traceroute, cksum, cmp, ln, lynx, gzip, gunzip

b. Piping and redirection
c. Editing, Scripting and Pattern Matching – vi, emacs, awk, sed, bash script – variables, conditionals, and loops
d. Parameter passing to C program from shell (argc / argv)
e. Introduction to using different tools for identification of possible errors in C program – gdb, concepts of "core dump", backtracing using "bt", using "info" to dump all registers, creating watch-list / watch variables.
f. DDD (Data Display Debugger) – introduction and usage

II. **Web Technologies and Networking Lab**

a. Creating your own homepage
b. HTML, XML, XSD
c. J2EE introduction: Using Eclipse to create webpages
d. JavaScript and JavaScript debugging
e. Networking Commands – inetd, host, ifconfig, netstat, nslookup, ping, ssh, traceroute
g. Network Monitoring tools – Nagios, Wireshark, OpenNMS

III. Programming and Data Structures Lab

a. Introduction to Python: List, tuple, dictionary, array, Functions, Generating permutation/combinations, generating truth-table for a logical formula

IV. Object Oriented Lab

a. OO Concepts – Classes, Objects, Inheritance, Overloading
b. Exceptions and Error Handing
c. Threading and Synchronization in Java/C++

II **SEMESTER**

CSE3916	Data Mining	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction to data mining: Process of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task primitives, Major issues in Data Mining, Applications of Data Mining

Unit II: Classification and Clustering Classification: Introduction, decision tree, building a decision tree- the tree induction algorithm, split algorithm based on information theory, gini index, over fitting and pruning, decision tree rules, naïve Bayes method. Types of data in cluster analysis, Categorization of major clustering methods: Partitioning methods, Hierarchical methods, Applications of clustering.

Unit III: Mining Frequent Patterns and Association Rules: Market Basket Analysis, Frequent Item sets and Association rules, A Priori Algorithm, Improving the efficiency of A priori, FP- growth Algorithm.

Unit IV: Social Media Analytics: Social network analysis, Representation of social data, Social media analysis, Tools to collect and analyze data of social media based on NODEXL.

Unit V: Visualization and Prediction Visualization: Motivation for visualization, General concepts, Techniques
Prediction: Linear regression (Least Square method), Analyzing regression error, Analyzing goodness of fit

Unit VI: Statistical Mining: Logistic Regression, Multivariate regression, ANOVA, PCA, Factor analysis, Graph Mining

Text Books:

1 Jiawei Han & Micheline Kamber, "Data Mining – Concepts and Techniques", Harcourt India.
2. Arun K Pujari, "Data Mining Techniques", University Press.
1. Charu C. Agrawal "Data Mining"

Reference Books:

1. Pang-ning Tan, Michael Steinbach, Vipin Kumar, "Introduction to Data mining"

II SEMESTER

CSE3917	Distributed Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Characterization of Distributed Systems: Introduction, Examples of Distributed Systems, Resource Sharing and The Web, Challenges, 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: Interprocess Communication: Introduction, The API for the Internet Protocols- The Characteristics of Interprocess communication, Sockets, UDP Datagram Communication, TCP Stream Communication; External Data Representation and Marshalling; Client Server Communication; Group Communication- IP Multicast- an implementation of group communication, Reliability and Ordering of Multicast.

Unit III: Distributed Objects and Remote Invocation: Introduction, Communication between Distributed Objects- Object Model, Distributed Object Model, Design Issues for RMI, Implementation of RMI, Distributed Garbage Collection; RPC, Events and Notifications, Case Study: JAVA RMI

Unit IV: Operating System Support: Introduction, The Operating System Layer, Protection, Processes and Threads –Address Space, Creation of a New Process, Threads.

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

Unit VI: Coordination and Agreement: Introduction, Distributed Mutual Exclusion, Elections, Multicast Communication. 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
3. Andrew S Tanenbaum, Maarten Van Steen: "Distributed Systems- Principles and Paradigms", Pearson Publication

Reference Books:

1. Bredan Burns,"Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services", Kindle eTextbook store.

II SEMESTER

CSE3918	Optimizing Compilers	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Overview: Overview of Lexical analyzer, Syntax analyzer, Semantic analysis

Unit II: Intermediate code generation and Parallelization: Intermediate code generation, Compiler Challenges for High-Performance Architectures, Dependence and its Properties, Parallelization and Vectorization

Unit III: Loop Optimization: Loop optimization, Data flow analysis, Enhancing Fine-Grained Parallelism

Unit IV: Parallelism and cache management: Creating Coarse-Grained Parallelism, Cache management.

Unit V: Scheduling and Allocation: Scheduling, Register allocation & Assignment

Unit VI: Case Studies: Case studies of compilers.

Text Books:

1. Randy Allen and Ken Kennedy, "Optimizing compilers for modern architectures", Morgan Kaufmann Publishers
2. Steven S. Muchnick, "Advanced Compiler Design and implementation".
3. A. V. Aho, R. Sethi, & J. D. Ullman, "Compilers: Principles, Techniques &Tools", Pearson Edu.

Reference Books:

1. C. Fischer and R. LeBlanc, "Crafting a Compiler", Pearson Education.
2. A. C. Holub, "Compiler Design in C", Pearson Education.
3. Appel Modern Compiler Implementation in Java: Basic Design, Cambridge Press.
4. Fraser and Hanson, "A Retargetable C Compiler: Design and Implementation, Pearson Education.

II **SEMESTER**

CSE3919	Lab: Optimizing Compilers	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

List of Practical:

1. Study of Fast Lexical Analyzer (FLEX).
2. Write a FLEX program to display welcome message to the user along with his name when user enters the word "Hello"
3. Write a FLEX program to recognize input as integer number, decimal number, character, word, identifier or special symbol.
4. Write a FLEX program to count number of Characters, Words and Lines in a given input text file.
5. Write a FLEX program to recognize whether the entered arithmetic expression is correct or not.
6. Write a FLEX program to solve arithmetical expression of two numbers entered by user.
7. Study of Yet Another Compiler Compiler (YACC).
8. Write a YACC program to display the message "Hello <user>" when user enters his name using standard input.
9. Write a YACC program perform arithmetic operations like +, -, /, *

II **SEMESTER**

CSE3920	Software Architecture	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction and Overview of Software Architecture: Architectural Models: Models for characterizing and reasoning about architectures, Tools for architectural modeling

Unit II: Typical software system structures: (Architectural styles), Techniques for Designing and Implementing these structures,

Unit III: Types of Architecture: Role of architecture in Software engineering; Enterprise Architectures, Zachman's Framework, Software Product Lines and its Architecture Configurable Software

Unit IV: Design Patterns: Various design patterns, Component based development

Unit V: Architectural Description Languages

Unit VI: Case studies: Self-Adaptive Software, Feature Modeling, Architecture and Model-Based Testing, Detailed Case study on contemporary Software Architecture**.**

Text Books:

1. Software Architecture: Foundations, Theory, and Practice by Eric M. Dashofy, Nenad Medvidovic, Ricard N. Taylor, John Wiley & Sons
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, MiachelStal, Douglas Schmidt, "*Pattern Oriented Software Architecture",* Volumes 1 &2, Wiley Publications.
3. Len Bass, Paul Clements, Rick Katzman, Ken Bass, "*Software Architecture in Practice",* Pearson Edu.

Reference Books:

1. Kurt Wallnau, Scott Hissam and Robert Seacord, "Building Systems from Commercial Components", Addison-Wesley
2. George T. Heineman, William T. Councill, "Component Based Software Engineering", Addison-Wesley

II **SEMESTER**

CSE3921	Lab: Software Architecture	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

List of Practical:

1. Creation of software architecture document
2. Identify appropriate architectural style for B.E. project
3. Implementation of simple connectors or client server using middleware
4. Identify & familiarize tools and techniques for architectural modelling
5. Architectural analysis of B.E. project
6. Implementation of framework
7. Study of non-functional properties of an operating system
8. Web service implementation
9. Study typical industry cases for design pattern
10. Creation of domain model in a known domain

II **SEMESTER**

CSE3922	**Seminar (Technical Writing and Publishing)**	**L=0**	**T=0**	**P=2**	**Credits=1**

Evaluation Scheme	**Continuous Evaluation**	**CA**	**ESE**	**Total**	**ESE Duration**
		100		**100**	

UNIT I
Identification of research domain and the broader area of work.

UNIT II
Report/Paper Writing – Introduction, Background to the Study, Literature Study, Methodology, Conclusion

UNIT III
Data Analysis: Analyzing multiple results obtained over time and reporting those using charts and graphs

UNIT IV
Document Preparation System: Latex

UNIT V
Summarizing papers/articles into a report and adapt the ethics of publication.

UNIT VI
Presentation using power point slides and publication based on the work carried out.

Text books and/or other required material:
1. Strunk and White: The Elements of Style
2. Gretchen Hargis *et., al*.: Developing Quality Technical Information: A Handbook for Writers and Editors, Second Edition, IBM, 2004.
3. Leslie Lamport: LaTex

II **SEMESTER**

CSE3923	PE III: Computer Vision	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction: Introduction to Human and Computer Vision, Image Registration algorithm

Unit II: Pattern Recognition Techniques: Statistical, Structural, Neural and Hybrid Techniques, Feature Extraction Techniques, Training and Classification

Unit III: Stereo Vision: Sensing 3D Shapes, How the 3rd dimension changes the problem, Stereo 3D description,3D Model, Matching

Unit IV: **CBIR:** Introduction, Content based image retrieval

Unit V: Virtual Reality: Introduction, basics of Virtual reality

Unit VI: **Emerging CV applications:** Recognition of characters, Fingerprint, Iris and Face

Text Books:

1. Shapiro and G. Stockman, "Computer Vision", Prentice Hall
2. David A. Forsyth, Jean Ponce, "Computer Vision", Prentice Hall

Reference Books:

1. A. K. Jain, "Fundamentals of Digital Image Processing"
2. Milan Sonka,Vaclav Hlavae, "Image Processing and Machine Vision"
3. J.T. Tou and R. C. Gonzalez , "Pattern Recognition Principles"
4. King Sun Fun, "Syntactic Pattern Recognition and Applications"
5. Fairhurst, "Computer Vision", Prentice Hall

II **SEMESTER**

CSE3924	PE III: Data Warehousing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction: Introduction to data warehousing, real time applications, scope of mining and warehousing for various applications. Data warehousing- Various schema, three-tier architecture, design issues, multidimensional model. Data warehouse development life cycle Data Warehouse Design - Massive denormalization, STAR schema design, Data ware house Architecture, OLAP, ROLAP and MOLAP , concepts of Fact and dimension table.

Unit II: System Processes: Extract and Load process, Clean and transform data, Backup and Archive, Query management process. Process Architecture: Load, Warehouse, and Query Manager, Detailed and summary information, Metadata, Data marts

Unit III: Operations: Aggregations, Data warehouse analysis and statistical queries, CUBE, ROLL UP and STAR queries.

Unit IV: Space Management in Data warehouse: Schemas for storing data in warehouse using different storage structures, B-tree index, hash index, clusters, Bitmap index functional index, domain index, Data partitions.

Unit V: Performance and Tuning: Query optimization, memory management, process management. I/o management for Data warehouse.

Unit VI: BIG Data: Handling BIG data, NO sql database, Columnar database.

Text Books:

1. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & Sons
2. Sam Anahony, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley
3. W.H. Inmon, "Building the Data Warehouse", 3rd Ed., John Wiley & Sons.
4. W.H.Inmon, C.Kelly, Developing the Data Warehouse", John Wiley & Sons.
5. Thomas Connoly, Carolyn Begg, "Database Systems-A practical approach toDesign, Implementation and management" 3rdEdition, Pearson Education

Reference Books:

1. W. H. Inmon, "Building the operational data store", 2nd Ed., John Wiley
2. Kamber and Han, "Data Mining Concepts and Techniques", Hartcourt India

II **SEMESTER**

CSE3925	PE III: Research Methodology	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I : Research Foundations: Introduction to Research, Objective and importance of research, Types of research, Scientific Research, Research and Theory, Conceptual and theoretical Models, Importance of research methodology in scientific research steps involved in research, Quantitative vs. Qualitative Approach, Understanding Theory, Building and Validating Theoretical Models, Exploratory vs. Confirmatory Research, Experimental vs Theoretical Research, Importance of reasoning in research.

Unit II : Defining Research Problem: Problem Definition Meaning, Sources of research problem, Criteria and Characteristics of a good research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, Research design, Methods of research design, Literature Survey /Review, Need for Reviewing Literature, contents of Review and purpose of Review, Literature Search Procedure, Sources of Literature, Planning of Review work, Note Taking, Role of libraries in Information Retrieval, Tools for identifying literatures, Indexing and abstracting services, Citation indexes, Documentation, Intellectual property rights (IPR) - patents-copyrights-Trademarks.

Unit III : Planning of Research: The planning process ,Selection of a Problem for Research, Formulation of the Selected Problems, Hypothesis formation, Measurement, Research Design/Plan

Unit IV: **Data Collection:** Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Observation, Surveys, Inferential Statistics, and Interpretation of Results Ethical considerations in research.

Unit V: Data Analysis and interpretation: Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Error Analysis, Interpretation of results and discussions

Unit VI: Technical Writing and reporting of research: Types of research report, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. Data and Data Analysis Reporting in a Thesis Use of Endnote, Bibliography, API , appendix, table, Observations arrangement, Preparation of type script and lay-out of thesis, Use of report writing tool, Indexing of Journals, Impact factor and social Media for Researchers.

Text Books:

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers, ISBN:81-224-1522-9.
2. Fisher R. A, "Statistical Methods for Research Workers", Cosmo Publications, New Delhi, ISBN:81-307-0128-6 .

Reference Books:

1. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, Sage Publications.
2. Montogomery D.C., "Design and Analysis of Experiments", (2001), John Wiley, ISBN: 0471260088.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age".
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.

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II **SEMESTER**

CSE3926	PE II: Information Retrieval Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction: Boolean Retrieval, Vocabulary and postings lists, Dictionaries and tolerant retrieval, Index construction, Index compression

Unit II: Vector Space Model: Scoring, Weighting and the vector space model, Computing scores in a complete search system, Evaluation in information retrieval, Relevance feedback and query expansion

Unit III: Retrieval Models: XML retrieval, Probabilistic information retrieval, Language models for information retrieval, Text, Classification, Vector space classification

Unit IV: Support Vector Machines: Support Vector Machines and Machine Learning on documents, Flat clustering, Hierarchical clustering, Matrix decompositions and Latent Semantic Indexing.

Unit V: Web Information Retrieval: Web search basics, Web Crawling and Indexes, Link analysis

Unit VI: Case studies

Text Books:

1. Christopher D. Manning and Prabhakar Raghavan and Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press

Reference Books:

1. Kowalski, Gerald, Mark T Maybury, "Information Storage and Retrieval Systems: Theory and Implementation", Springer.
2. Ricardo Baeza-Yates, "Modern Information Retrieval", Pearson Education
3. David A Grossman and Ophir Frieder, "Information Retrieval: Algorithms and Heuristics", 2nd Edition, Springer
4. William B Frakes, Ricardo Baeza-Yates, "Information Retrieval Data Structures and Algorithms", Pearson Education
5. Robert Korfhage, "Information Storage & Retieval", John Wiley & Sons.

II SEMESTER

CSE3927	PE IV: Cyber Forensics	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction: Review of TCP/IP and TCP, IP Header analysis, Introduction to Cyber World, Cyber attacks and cyber security

Unit II: Cyber Crimes: Information warfare and cyber terrorism, Types of cyber attacks, Cyber Crime and Digital Fraud, Overview of Types of computer forensics i.e. Media Forensics, Network forensics (internet forensics), Machine forensic, Email forensic (e-mail tracing and investigations).

Unit III: Live Data collection and investigating windows environment: windows Registry analysis, Gathering Tools to create a response tool kit, obtaining volatile Data, Computer forensics in windows environment, Log analysis and event viewer, File auditing, identifying rogue machines, hidden files and unauthorized access points.

Unit IV: Live Data collection and investigating Linux environment: Proc file system overview, Gathering Tools to create response toolkit.

Unit V: Handling Investigations: Log Analysis (Network, host, user logging details), Recording incident time/date stamps, Identifying rogue processes, unauthorized access points, unauthorized user/group accounts

Unit VI: Forensic tools and report generation: Recovery of Deleted files, Analyzing network traffic, sniffers, Ethical Hacking, Hardware forensic tools like Port scanning and vulnerability assessment tools like Nmap, Netscan etc. Password recovery (tools like John the ripper, L0phtcrack, and THC-Hydra), Mobile forensic tools and analysis of called data record Template for computer for ensic reports.

Text Books:

1. Mandia, K., Prosise, C., Pepe, M., "Incident Response & Computer Forensics", 2nd edition, Tata-McGraw Hill,
2. Bill Nelson, Amelia Phillips**,** Frank Enfinger, and Chris Steuart, "Guide to Computer Forensics and Investigations", 2nd Edition, Thomson Learning

Reference Books:

1. Eoghan Casey, "Digital Evidence and Computer Crime", 2nd Edition, Academic Press File System
2. Brian Carrier, "Forensic Analysis", Wesley
3. Harlan Carvey, "Windows Forensic Analysis" DVD Toolkit, Syngress Publication
4. Steve Bunting, "EnCE: The Official En Case Certified Examiner Study Guide, 2nd Edition, Sybex Publication

II **SEMESTER**

CSE3928	PE IV: Deep Learning	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: History of Deep Learning: Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons,

Unit II: Neural Networks: Feedforward Neural Networks, Representation Power of Feedforward Neural Networks ,FeedForward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam

Unit III: Encoders: Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders, Regularization: Bias Variance Tradeoff,L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

Unit IV: Training and Execution: Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization

Unit V: Recurrent Neural Networks: Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Unit VI: Convolutional Neural Networks: Convolutional Neural Networks, LeNet,AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet,Encoder Decoder Models, Attention Mechanism, Attention over images

Text Books

1. Deep Learning: A Practitioner's Approach By Josh Patterson, Adam Gibson

Reference Books:
1.Deep Learning Kindle Edition by Rajiv Chopra Khanna Publishing

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II SEMESTER

CSE3929	PE IV: Fundamentals of Bioinformatics	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration
	30	10	60	100	3hrs

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Introduction and Information Retrieval: Introduction, Historical overview, Bioinformatics Applications, major databases, data management, data analysis, molecular biology, Tools for Web Search, Data Retrieval tools, Data mining of biological databases.

Unit II: Molecular Biology and Bioinformatics: Introduction to Genes and Proteins Genome Sequences Genome rearrangement, bock allignmeny, global sequence alignment, ORFs, Genes, Intones, Exons, Splice Variants DNA/RNA Secondary Structure, Triplet Coding Protein Sequences, bioinformatics algorithms.

Unit III: Information molecule and information flow: Central dogma of molecular biology, Problem in molecular and bioinformatics approach, Basic component, Chemistry of DNA and RNA, Basics of DNA replication

Unit IV: Introduction to protein, Amino acid and Protein Structure: Secondary, Tertiary, Quaternary, protein Folding protein function, protein purification and characterization, Data integration and Data Analysis, Multiplicity of Data and redundancy

Unit V: Genome Analysis and Gene Mapping: Pairwise Sequence Alignment, Database Similarity Searching: BLAST, FASTA, Multiple Sequence Alignment, Profiles and Hidden Markov Models Structure prediction methods for gene, Gene expression and Microarray. Protein classification and Structure Visualization, Protein structure Prediction, Proteomics, Protein folding

Unit VI: Applications: Drug Discovery**:** Introduction, Technology, Cell Cycle, G-Protein coupled Receptor as drug target.

Text Books:

1. S. C. Rastogi, Namita Mendirata, Parag Rastogi„ "Bioinformatics concepts Skills and application", CBS publisher
2. S. C. Rastogi, Namita Mendirata, Parag Rastogi„"Bioinformatics Methods and application", PHI

Reference Books:

1. D. Baxevanis and F. Oulette, "Bioinformatics: A practical guide to the analysis of genes and proteins", Wiley
2. Arthur M. Lesk, "Introduction to Bioinformatics", Oxford University

II SEMESTER

CSE3930	**PE IV: Semantic Web and Social Networks**	**L=3**	**T=0**	**P=0**	**Credits=3**

Evaluation Scheme	**MSEs**	**TA**	**ESE**	**Total**	**ESE Duration**
	30	**10**	**60**	**100**	**3hrs**

MSEs = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Unit I: Web Intelligence: An Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Unit II: Knowledge Representation for the Semantic Web: Ontologies and their role in the semantic web, Ontology Languages for the Semantic Web –Resource Description Framework(RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema.

Unit III: Ontology Engineering: Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Unit IV: Semantic Web Applications, Services and Technology: Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods,

Unit V: Social Network Analysis and Semantic web: Social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Unit VI: Case Studies

Text Books:

1. Berners Lee, Godel and Turing, "Thinking on the Web", Wiley Interscience
2. Peter Mika, "Social Networks and the Semantic Web", Springer

Reference Books:

1. J. Davies, Rudi Studer, Paul Warren, "Semantic Web Technologies, Trends and Research in Ontology Based Systems", John Wiley & Sons.
2. Liyang Lu, Chapman and Hall, "Semantic Web and Semantic Web Services", CRC Publishers,(Taylor & Francis Group)
3. Heiner Stuckenschmidt, Frank Van Harmelen, "Information Sharing on the semantic Web", Springer Publications.
4. T. Segaran, C. Evans, J. Taylor, O. Reilly, "Programming the Semantic Web", SPD.

II SEMESTER

CSE3931	Software Lab 2	L=0	T=0	P=2	Credits=2

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

I. Unix/Linux Lab

a. Versioning system like CVS – versioning and branching

b. Linux System Administration

Installing Linux in a virtual machine

Mounting/Unmounting Disks

Setting and using Path and Environment Variables

Starting telnet, ftp, smtp services and using them

rcp, rsh, rlogin

Super user commands/priviledges – su, sudo, install/uninstall of packages, updating linux system

c. OS related exercises – Accessing iNode, Creation of threads, fork / join, creation of semaphore / mutex, assignments on synchronizing threads. Pthreads and Java threading APIs.

II. **Advanced Programming and Data Structures Lab**

a. Sparse Matrix, trees, graphs

III. Open Sources Lab

a. Using automatic testing tools – Selenium/JMeter/Junit/ NUnit/ TestNG

b. Installing and using Apache Web server to develop a website, Installing and using mysql to store some data

c. Use of open source cloud platforms:

- Integration of gmail with google calendar
- Creating a website on Salesforce cloud for tracking inventory from east, west, north, south regions in India separately.
- Accessing google-map via google-map APIs

e. Downloading and Installing Hadoop on 3 to 4 machines and writing a distributed sorting program on the same.

f. Introduction to Progressive Web App, Single Page App

g. Introduction to SSL. Use digital certificates to encrypt / decrypt data in transfers

h. Introduction to Android Platform and APIs / libraries provided. A sample game / application on Android.

III SEMESTER

CSE3932	**Project Phase –I**	**T=0**	**P=16**	**Credits=8**

Evaluation Scheme	**Continuous Evaluation**	**CA**	**ESE**	**Total**	**ESE Duration**
		100		**100**	

IV SEMESTER

CSE3933	Project Phase –II	T=0	P=24	Credits=12

Evaluation Scheme	Continuous Evaluation	CA	ESE	Total	ESE Duration
		40	60	100	