Scheme & Syllabus
of
M.Tech in Computer Science & Engineering

(With effect from 2020-2021 Academic year)

Outcome Based Education
with
Choice Based Credit System

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

(An Autonomous Institution Affiliated to VTU, Belagavi

Grant -in- Aid Institution (Government of Karnataka), World Bank Funded College (TEQIP)

Accredited by NBA & NAAC and Approved by AICTE, New Delhi.)

Ph : 08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running 6 Postgraduate programs. It consists of 4 M.Tech programs, which are affiliated to VTU. Other postgraduate programs are MBA and MCA.

India has become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan are among 16 signatories to the international agreement besides the US and the UK. Implementation of Outcome Based Education (OBE), has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted Credit Based system (CBCS) based semester Structure with OBE Scheme and grading system which provides the flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. There lies a shift in thinking, teaching and learning process moving towards students Centric from Teachers Centric Education which enhances the knowledge, skills & moral values of each student.

Choice Based Credit System (CBCS) provides the options for the students to select from the number of prescribed courses. The CBCS provides a 'cafeteria' type approach in which the students can choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach for learning which enables integration of concepts, theories, techniques. These are greatly enhances the skill/employability of students.

In order to increase the Industry Institute Interaction, Internship have been added to the existing curriculum of 2020-21. Further, Research Methodology & IPR and two Self Study Courses have been introduced to enhance their Research ability and Self Learning ability respectively. Lab Components are also included in I & II Semester.

(Dr. D.R.Umesh)
Deputy Dean (Academic)
Associate Professor
Dept. of Computer Science & Engg.

(Dr. Dr. Nagarathna)
Dean (Academic)
Professor
Dept. of Computer Science & Engg.

P.E.S. College of Engineering, Mandya

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals

MISSION

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
- Promote research, product development and industry-institution interaction.

Department of Computer Science and Engineering

The Vision of the department is:

"The Department of Computer Science and Engineering shall create professionally competent and socially responsible engineers capable of working in global environment.*"*

The mission of the department is:

DM1: Enforce best practices in teaching-learning, with dedicated faculty and supportive infrastructure to impart the knowledge in emerging technologies.
{Required to create professionally competent engineers}

DM2: Improve Industry-Institute relationship for mutual benefit.
{Required to create professionally competent engineers}

DM3: Inculcate ethical values, communication and entrepreneurial skills.
{Required to create professionally competent and socially responsible engineers}

DM4: Sensitize social, legal, environmental and cultural diversity issues through professional training and balanced curriculum.
{Required to create engineers capable of working in global environment}

Program Outcomes (POs)

The graduates of M. Tech. in Computer Science and Engineering (CSE) Program will be able to:

1. Student can independently carry out investigation and feasibility work to solve real time practical problems.
2. Student had Ability to Write and Present a substantial technical article report/document.
3. Apply knowledge of recent computing technologies, skills and current tools of computer science and engineering.
4. Student can Design software systems, components, or processes to meet identified needs within economic, environmental and social constraints.
5. Student can build capability to work in multidisciplinary and multicultural environment with professional, social and ethical responsibilities.
6. Recognize the need to engage in lifelong learning through continuing education and research.

About the Department The Department of Computer Science and Engineering was established in 1983. The department offers B.E. program with an intake of 120 students, M.Tech. in Computer Science and Engineering with 18 students, M.Tech. in Computer Engineering with 24 students and also Ph.D. programme. Currently the strength of teaching faculty is 32 and that of non teaching staff is 14. The teacher - student ratio is 1:15. The department has a research centre under VTU and University of Mysore, with 7 research guides and 8 research students. During the last five years, the department has published more than 200 technical papers in International / National Journals / Conferences. So far, the department has organized four international and 8 national conferences. The department is equipped with all the required infrastructure, laboratories, class rooms, departmental library. The departments wish to achieve the mission of developing and nourishing computer science engineers through well-trained, committed and experienced faculty members. Faculty members of the departments are involved in research activities in different fields such as Image Processing, Pattern Recognition, Data Mining, Wireless Networks, Big Data Analytics and Computer Vision.

Short Term Goals:

1. Strengthening of Infrastructure
2. Faculty development programmes
3. Encourage academic excellence
4. Project proposals to raise funded projects

Mid Term Goals:

1. Establishing centre of excellence
2. Conducting international conference
3. Establish industry-institute interaction

Long Term Goals:

1. Patents filing
2. Establishing new laboratories

Credit pattern

Programme: M.Tech Computer Science & Engineering

Core Courses	I Semester	12 credits
	II Semester	12 credits
Elective Course	I Semester	08 credits
	II Semester	08 credits
Technical Seminar	III Semester	02 credits
Lab	I Semester	02 credits
	II Semester	02 credits
Internship	III Semester	06 credits
Research Methodology and IPR	III Semester	04 credits
Self Study Course	III Semester	06 credits
Project work	II Semester	02 credits
Project work	III Semester	04 credits
Project work	IV Semester	18 credits
Mini Project	I Semester	02 credits
A total of 88 credits for 2 years		

Teaching and Examination for M.Tech. Computer Science & Engineering

I Semester M.Tech. Computer Science & Engineering

Sl. No.	Course Code	Course Title	Teaching Hours/Week			Examination Marks			Credits
			Theory	Tutorial	Practical / Field work / Assignment	CIE	SEE	Total	
1.	P20MCSE11	Advanced Algorithms	04	--	--	50	50	100	4
2.	P20MCSE12	Network Programming	04	--	--	50	50	100	4
3.	P20MCSE13	Internet of Things	04	--	--	50	50	100	4
4.	P20MCSE14X	Professional Elective – I	04	--	--	50	50	100	4
5.	P20MCSE15X	Professional Elective – II	04	--	--	50	50	100	4
6	P20MCSEL16	Advanced Algorithms Lab	-	--	04	50	50	100	2
7	P20MCSE17	Mini Project	--	--	--	50	50	100	2
Total			**20**	**--**	**04**	**350**	**350**	**700**	**24**

Professional Elective I

Sl. No.	Course Code	Course Title
1.	P20MCSE141	Artificial Intelligence
2.	P20MCSE142	Probability & Statistics

Professional Elective II

Sl. No.	Course Code	Course Title
1.	P20MCSE151	Natural Language processing
2.	P20MCSE152	Information & Cyber Security

II Semester M.Tech. Computer Science & Engineering

Sl. No.	Course Code	Course Title	Teaching Hours/Week			Examination Marks			Credits
			Theory	Tutorial	Practical / Field work / Assignment	CIE	SEE	Total	
1.	P20MCSE21	Data Science	04	--	--	50	50	100	4
2.	P20MCSE22	Multicore Architecture & Programming	04	--	--	50	50	100	4
3.	P20MCSE23	Block Chain Technologies	04	--	--	50	50	100	4
4.	P20MCSE24X	Professional Elective – III	04	--	--	50	50	100	4
5.	P20MCSE25X	Professional Elective – IV	04	--	--	50	50	100	4
6.	P20MCSE26	Project phase - I	--	--	--	100	--	100	2
7.	P20MCSEL27	Data Science Lab	-	--	04	50	50	100	2
Total			**20**	**--**	**04**	**400**	**300**	**700**	**24**

Professional Elective III

Sl. No.	Course Code	Course Title
1.	P20MCSE241	Deep Learning
2.	P20MCSE242	Business Intelligence & its Application

Professional Elective IV

Sl. No.	Course Code	Course Title
1.	P20MCSE251	Agile Technologies
2.	P20MCSE252	Network Management System

III Semester M.Tech. Computer Science & Engineering									
Sl. No.	Course Code	Course Title	Teaching Hours/Week			Examination Marks			Credits
			Theory	Tutorial	Practical / Field work / Assignment	CIE	SEE	Total	
1.	P20MCSE31	Research Methodology and IPR *[Common to all PG Programs]*	04	--	--	50	50	100	4
2.	P20MCSE32	Self-Study Course - I	--	--	--	100	--	100	3
3.	P20MCSE33	Self-Study Course - II	--	--	--	100	--	100	3
4.	P20MCSE34	Technical Seminar	--	--	--	100	--	100	2
5.	P20MCSE35	Project Phase – II	-	--	--	100	--	100	4
6.	P20MCSE36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters)			50	50	100	6
Total			**04**	**--**	**--**	**400**	**100**	**600**	**22**

IV Semester M.Tech. Computer Science & Engineering									
Sl. No.	Course Code	Course Title	Teaching Hours/Week			Examination Marks			Credits
			Theory	Tutorial	Practical / Field work / Assignment	CIE	SEE	Total	
1.	P20MCSE41	Project Phase – III	--	--	--	100	--	100	4
2.	P20MCSE42	Project Thesis Evaluation	--	--	--	100	--	100	6
3.	P20MCSE43	Project Viva - Voce	--	--	--	--	100	100	6
4	P20MCSE44	Term Paper	--	--	--	100	--	100	2
Total			**--**	**--**	**--**	**300**	**100**	**400**	**18**

Category of Courses:

1. Core Courses: The Core courses constitute the core of the programme of study. Core courses are to be compulsorily studied by a student and are mandatory to complete them to fulfill the requirements of a programme.

2. Professional Electives: Elective courses offer a choice of advanced or specialized courses related to the programme of study. They enable students to specialize in a domain of interest or tune their learning to suit career needs and current trends.

3. Laboratories: The Laboratories are evaluated for 100 marks which includes CIE: 50 marks & SEE: 50 marks. The assessment of CIE is done with execution of lab programs & report submission. The final SEE assessment is done with the conduction of exam and Viva-Voce.

4. Self-Study Course: The Self-Study Course should be chosen from the available 12 weeks NPTEL online courses recommended by the Department. The student can undergo NPTEL

course registration during II / III Semester and the credit will be considered in III Semester. The 100 marks CIE assessment is based on the final NPTEL score (i.e. Online assignments: 25% + Proctored exam: 75%). The NPTEL score will be mapped directly to the CIE marks only if he /she has completed the NPTEL course (i.e. Certification). Those, who do not take-up/ Complete the NPTEL course shall be declared as failed and have to complete during the subsequent examination after satisfying the NPTEL requirements.

5. Internship: All the students have to undergo mandatory internship of 8 weeks during the vacation of I and II semesters and / or II and III semesters. An examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/ Complete the internship shall be declared as failed and have to complete during the subsequent examination after satisfying the internship requirements.

6. Technical Seminar: CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide, in any and a senior faculty of the department. Participation in seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory. The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

7. Mini Project:

- Mini Project shall comprise of an exercise assigned to a student similar to major projects.
- The topics may be related to the field of their UG Programme, that address the social issues.
- A report (not less than 20 A4 pages) to be submitted, detailing the solution to the problem / concept worked out during the semester.
- The work may be evaluated for award of Internal Assessment marks (CIE) based on a presentation / demonstration and viva voce, by a committee coordinated by the Course coordinators.

8. Project Work: The Project Work carries 22 credits and spreads over THREE semesters, i.e. during II, III and IV semesters. Project work Phase-1, 2 & 3 to be awarded by the Department committee constituted for the purpose.

- The **Project Phase-I** evaluation shall be of 100 marks CIE. It is based on the submission report consisting of Title, Introduction, Literature Survey, Objectives and Methodology (50 Marks) and Presentation (50 marks).
- The **Project Phase-II** evaluation shall be of 100 marks CIE. It is based on submission report consisting of theoretical analysis and design approach of the work (50 Marks) and Presentation for 50 marks.
- The **Project Phase-III** evaluation shall be of 100 marks CIE. It is based on the overall completion &demonstration / execution of the project (50 Marks) and presentation for 50 marks.

- The **Project Phase-IV** [**Thesis]** evaluation shall be of 100 marks each for CIE& SEE. The Thesis Evaluation done by Internal Examiner & External examiner shall be considered for CIE & SEE marks respectively.
- The **Project Phase-V [Viva Voce]** evaluation shall be of 100 marks SEE. It is based on Thesis presentation and project viva voce has to be conducted jointly by internal and external examiner for a total of 100 marks SEE.

9. Term Paper: The term paper is purely based on the project work he/she chooses.

- The Term paper shall be for 100 marks CIE only. It has to be evaluated by the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate.
- The term paper evaluation is based on the publication of an article in peer reviewed conference/ journal (national/ international) and quality of the journal. If the term paper is not published by the candidate or the same is communicated for publication at the end of his/ her tenure, then the committee formed by HOD consisting of PG coordinator, guide and subject expert internal/ external for each candidate will assess for the award of credit.

Course Title: Advanced Algorithms			
Course Code: P20MCSE11	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE11 aims to:

1. Solve optimization problems using greedy method.
2. Design algorithms using Divide-and-Conquer Strategy.
3. Solve combinatorial optimization problems using dynamic-programming strategy.
4. Estimate optimal solution for the problem using approximation algorithms.
5. To make arbitrary choices for the problem using Randomized Algorithms.

Course Content

Unit -1

THE COMPLEXITY OF ALGORITHMS AND THE LOWER BOUNDS OF PROBLEMS : The time complexity of an algorithm, The best-, average- and worst-case analysis of algorithms, The lower bound of a problem , The worst-case lower bound of sorting , The average-case lower bound of sorting, Finding the lower bound by problem transformation.

THE GREEDY METHOD: The 2-way merge problem, The minimum cycle basis problem solved by the greedy algorithm, The 2-terminal one to any problem solved by the greedy method.

Self-Study Component: Kruskal's method to find a minimum spanning tree, Prim's method to find a minimum spanning tree.

10 Hours

Unit -2

THE DIVIDE-AND-CONQUER STRATEGY: The 2-dimensional maxima finding problem, the closest pair problem, The convex hull problem, The Voronoi diagrams constructed by the divide-and-conquer strategy, Applications of the Voronoi diagrams.

TREE SEARCHING STRATEGIES: Hill climbing, Branch-and-bound strategy, A personnel assignment problem solved by the branch-and-bound strategy, A job scheduling problem solved by the branch-and-bound approach, A* algorithm, A channel routing problem solved by a specialized A* algorithm.

Self-Study Component: The Fast Fourier Transform, Breadth-first search, Depth-first search.

10 Hours

Unit -3

PRUNE-AND-SEARCH: The general method, The selection problem, Linear programming with two variables.

DYNAMIC PROGRAMMING: The resource allocation problem , The longest common subsequence problem , The 2-sequence alignment problem , The RNA maximum base pair matching problem , The weighted perfect domination problem on trees, The weighted single step graph edge searching problem on trees , The m-watchmen routes problem for 1-spiral polygons solved by the dynamic programming approach.

Self-Study Component: 0/1 knapsack problem, The optimal binary tree problem.

11 Hours

Unit -4

APPROXIMATION ALGORITHMS : An approximation algorithm for the node cover problem , An approximation algorithm for the Euclidean traveling salesperson problem, An approximation algorithm for a special bottleneck traveling salesperson problem ,An approximation algorithm for a special bottleneck weighted k-supplier problem ,An approximation algorithm for the bin packing problem , An optimal approximation algorithm

for the rectilinear m-center problem ,An approximation algorithm for the multiple sequence alignment problem , A 2-approximation algorithm for the sorting by transposition problem.
Self-Study Component: The polynomial time approximation scheme, NPO-completeness.

10 Hours

Unit -5

RANDOMIZED ALGORITHMS: A randomized algorithm to solve the closest pair problem , The average performance of the randomized closest pair problem , A randomized algorithm to test whether a number is a prime , A randomized algorithm for pattern matching ,A randomized algorithm for interactive proofs , A randomized linear time algorithm for minimum spanning trees.

ON-LINE ALGORITHMS: The on-line Euclidean spanning tree problem solved by the greedy method , The on-line k-server problem and a greedy algorithm to solve this problem defined on planar trees.

Self-Study Component: An on-line obstacle traversal algorithm based on the balance strategy, The on-line bipartite matching problem solved by the compensation strategy.

11 Hours

Course outcomes:

1. Analyze and find the complexity of the given problem.
2. Design efficient algorithm using Divide-and-Conquer Strategy.
3. Design and analyze algorithms to optimization problems.
4. Compute optimal solution for the problem using approximation algorithms.
5. Apply randomized algorithms for the given problem.

Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Introduction to the Design and Analysis of Algorithms A Strategic Approach,	R. C. T. Lee ,S. S. Tseng , Taiwan R. C., and Y. T. Tsai	McGraw-Hill Education	Copyright © 2005 (ISBN 007-124346-1)
Reference Books				
1	Introduction to Algorithms	T. H Cormen, C E Leiserson, R L Rivest and C Stein	PrenticeHall of India	3rd Edition, , 2012.
2	Data Structures and Algorithms Analysis in C++	Mark Allan Weiss	Pearson,	4th Edition,2014, ISBN-13: 9780132847377 (Java, 3rd Edition, 2012, ISBN:0-132-57627-9 / 9780132576277)
3	Data structures and algorithms	Aho, Hopcroft and Ullman	Pearson Education.	1st edition

Course Articulation Matrix(CAM) -Advanced Algorithms – P20MCSE11								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2		1	1				
CO – 2	2		1	1				
CO – 3	2		1	1				
CO – 4	2		1	1				
CO – 5	2		1	1				

Course Title: Network Programming			
Course Code: P20MCSE12	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE12 aims to:

1. Demonstrate mastery of main protocols comprising the Internet.
2. Develop skills in network programming techniques.
3. Implement network services that communicate through the Internet.
4. Apply the client-server model in networking application.
5. Create client and server applications using the "Sockets" API.

Course Content

Unit -1

Introduction to network application, client/server communication, OSI Model, BSD Networking history, Test Networks and Hosts, Unix Standards, 64-bit architectures,
Self-Study Component: -Transport Layer: TCP, UDP and SCTP.

10 Hours

Unit – 2

Sockets Introduction – socket address structures, value-result arguments, byte ordering and manipulation functions, address conversion functions, Elementary TCP Sockets – socket, connect, bind, listen, accept , fork and concurrent server design, getcsockname and getpeername functions and TCP Client/Server Example- client/server programming through TCP sockets, Normal startup, termination.
Self-Study Component: -POSIX signal handling, Signal handling in server, Crashing, rebooting of server host, shutdown.

11 Hours

Unit – 3

I/O Multiplexing and Socket Options, Elementary SCTP Sockets- Interface Models, sctp_xx functions, shutdown function, Notifications, SCTP Client/Server Examples – One-to-Many, Head–of-Line Blocking, Controlling number of streams and Termination.
Self-Study Component: - IPv4 and IPv6 Interoperability–different interoperability scenarios.

10 Hours

Unit – 4

Daemon Processes, syslogd, daemonizing functions and the inetd super server, Advanced I/O functions- readv, writev, sendmsg and recvmsg, Ancillary data, Advanced polling, Unix domain protocols- socket address structure, functions and communication scenarios.
Self-Study Component: -Nonblocking I/O – connect and accept examples.

10 Hours

Unit – 5

ioctl operations- socket, file, interface configuration information, ARP cache and routing table operations, Routing sockets- data link socket address structure, reading and writing, sysctl operations, interface name and index functions, Key Management functions – reading, writing, SADB, SA, Dynamically Maintaining SA's, Out-of-Band data, Threads- basic thread functions, TCP echo server using threads.
Self-Study Component: -Mutexes and Conditional variables.

11 Hours

Course outcomes:

1. Understand client/server communication through Transport Layer protocols.
2. Develop applications that communicate with each other using TCP.
3. Develop applications that communicate with each other using SCTP.

4. Evaluate Socket Programming APIs.
5. Explain key management and routing sockets.

Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	UNIX Network Programming	W. Richard Stevens, Bill Fenner, Andrew M. Rudoff	Pearson	Volume 1, Third Edition, 2004
Reference Books				
1	Network Programming in C	Barry Nance	PHI	2002
2	Windows Socket Network Programming	Bob Quinn, Dave Shute	Pearson	2003

Course Articulation Matrix(CAM) - Network Programming – P20MCSE12								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2			2	1	2	2	
CO – 2	2		2	2	1	2	2	
CO – 3	2			2	1	2	2	
CO – 4	2			2	1	2	2	
CO – 5	2			2	1	2	2	

Course Title: Internet of Things			
Course Code: P20MCSE13	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE13 aims to:

1. Understand the definition and significance fundamentals of IoT.
2. Understand IoT Market Perspective.
3. Understand Knowledge about data acquired by the devices in IoT.
4. Discuss the architecture, operation and benefits of IoT.
5. Classify real world IoT design constraints, industrial automation in IoT.

Course Content

Unit -1

Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - **IoT and M2M** : M2M, Difference between IOT and M2M.
Self-Study Component: SDN and NFV for IOT

10 Hours

Unit–2

M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. **M2M to IoT-An Architectural Overview**– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
Self-Study Component: IoT architecture outline

11 Hours

Unit–3

M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics. .
Self-Study Component: Knowledge Management

10 Hour

Unit–4

IoT Architecture-State of the Art – Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model . **IoT Reference Architecture-** Introduction, Functional View, Information View, Other Relevant architectural views.
Self-Study Component: Deployment and Operational View

10 Hours

Unit–5

Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. **Industrial Automation-** Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things. **Commercial Building Automation-** Introduction, Case study: phase one-commercial building automation today.
Self-Study Component: phase two- commercial building automation in the future.

11 Hour

Laboratory Component

Using Arduino Board

1. Demonstrate Using Arduino board to blink the LED continuously.
2. Demonstrate to show that how to fade an LED on pin 9 using analogwrite() function.
3. Demonstrate the use of switch and to control the ON and OFF of LED.
4. Demonstrate using arduino board to read the status of switch.

Using Raspberry Pi

1. Program to blink LED continuously.
2. Interfacing the PIR Motion Sensor to the Raspberry Pi's input GPIO to detect motion.

Course Outcomes

Upon completion of this course, students will be able to

1. Explain the definition and understand the key components that makeup an IoT system.
2. Understand where the IoT concepts fit in future trends.
3. Compare and contrast the use of devices, gateways and data management in IoT.
4. Explain architecture in IoT.
5. Identify Real World Design Constraints.

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Internet of Things (A Hands-on-Approach)	Vijay Madisetti and Arshdeep Bahga	VPT	1st Edition, 2014.
2	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle	Academic Press	1st Edition, 2014.
Reference Books				
1	Rethinking the Internet of Things: A Scalable Approach to Connecting Everything	Francis daCosta,	Apress Publications,	1st Edition, 2013

Course Articulation Matrix(CAM)- Internet of Things – P20MCSE13								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	1	2	1				1	
CO – 2	1	1	2				1	
CO – 3	1	1	2				1	
CO – 4	2	2	2				1	
CO – 5	1	1	1				1	

Course Title: Artificial Intelligence			
Course Code: P20MCSE141	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE141 aims to:

The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning. Students will implement a small AI system in a team environment.

Course Content

Unit -1

Introduction -The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art;

Intelligent Agents -Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents;

Solving problem by searching -Problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions;

Adversarial Search-Alpha – Beta Pruning.

Self-Study Component: Solving problem by searching - Example Problems

12 Hour

Unit – 2

Logical Agents - Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic;

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic;

Inference in First-Order Logic - Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Self-Study Component: Inference in First-Order Logic - Propositional vs. First-Order Inference.

10 Hour

Unit – 3

Quantifying Uncertainty - Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Baye's Rule and Its Use;

Probabilistic Reasoning - Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First-Order Probability Models;

Probabilistic Reasoning over Time – Hidden Markov Models

Self-Study Component: Probabilistic Reasoning –Other Approaches to Uncertain Reasoning

10 Hour

Unit – 4

Learning from Examples – Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Support Vector Machines, Ensemble Learning.

Self-Study Component: Learning from Examples – Practical Machine Learning

10 Hour

Unit – 5

Knowledge in Learning – A Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming;

Learning Probabilistic Models – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables: The EM Algorithm;

Reinforcement Learning - Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search.

Self-Study Component: Reinforcement Learning **-** Applications of Reinforcement Learning

10 Hour

Course outcomes:

1. Define Artificial intelligence and identify problems for AI. Characterize the search techniques to solve problems and recognize the scope of classical search techniques
2. Define knowledge and its role in AI. Demonstrate the use of Logic in solving AI problems.
3. Demonstrate handling of uncertain knowledge and reasoning in probability theory.
4. Explain Learning methods in AI
5. Demonstrate Natural Language Processing and its application in Natural Language Communication

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Artificial Intelligence: A Modern Approach	Stuart Russell and Peter Norvig	Prentice Hall	3rd, 2009
Reference Books				
1	Artificial Intelligence: Structures and Strategies for Complex Problem Solving	George F Luger	Pearson Addison Wesley	6th Ed, 2008

Course Articulation Matrix(CAM)- Artificial Intelligence – P20MCSE141								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	1	2	1	2	1	2	1	
CO – 2	1	2	2	3	1	1	1	
CO – 3	2	3	1	2	2	2	1	
CO – 4	2	4	2	2	1	1	1	
CO – 5	3	4	5	6	2	1	1	

Course Title: Probability & Statistics			
Course Code: P20MCSE142	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE142 aims to:

1. Learn the basic concepts of probability and its applications.
2. Identify the different types of distributions.
3. Learn the fundamentals of stochastic process .
4. Analyze the probabilistic analysis of algorithms.
5. Understand the fundamentals of statistical inference and regression

Course Content

Unit-1

Introduction- combinatorial problems, conditional probability, Bayes' rule, Bernolli trials. **Discrete Random Variables**-Introduction, Random Variables and their Event spaces, The probability Mass, Function, Distribution Functions, Special Discrete Distribution.
Self-Study Component: Probability axioms.

10 Hours

Unit -2

Continuous Random variables-The exponential distribution, Some important distributions – Normal or Gaussian Distribution, Functions of a random variable Jointly distributed Random variables **Expectation-**, Expectation of functions of more than one random variable Transform methods, Moments and Transforms of Some important Distributions. Computation of mean time failure, Inequalities and limit theorems.
Self-Study Component: Moments.

11 Hours

Unit-3

Conditional Distribution and conditional expectation –Definitions, Mixture distributions conditional expectation. Imperfect fault coverage and reliability, Random sums. **Stochastic Processes**-Introduction, Classification, Bernoulli, Poisson, Renewal processes. Availability analysis.
Self-Study Component: Random Incidence.

10 Hours

Unit-4

Discrete –parameter Markov chains-computation of n-step transition probabilities, State Classification and Limiting distributions, Distribution of times be a Birth –Death Model. Non-Birth Death Process. Markov Chains with absorbing states. **Networks of queues**-Introduction, Open Queuing Networks, Closed Queuing Networks, Non-exponential Service –Time Distributions and Multiple Job Types,
Self-Study Component: Non-Product-Form Networks.

11 Hours

Unit-5

Statistical inference-Introduction, Parameter estimation, Hypothesis testing.
Regression, correlation and analysis of variance-Least squares curve fitting, the coefficient of determination confidence interval in linear regression, correlation analysis Simple nonlinear regression,
Self-Study Component: **H**igher dimensional least squares fit, analysis of variance.

10 Hours

Course Outcome:

On successful completion of the course the students will be able to

1. Discuss the fundamental concepts of probability and its applications.
2. Identify the different types of distributions with their applications.
3. Solve the practical stochastic modeling problems..
4. Identify and analyse the probabilistic analysis of algorithms.
5. Learn to solve the problems of statistical inference and regression.

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Probability and Statistics with Reliability, Queuing and Computer Science Applications.	K.S. Trivedi		
Reference Books				
1	Probability and statistics for Engineers and Scientists	Walpole,myers,Myers		
2	Probability and statistics for Engineers Fifth edition – Richard A Johnson.	Miller and Freund's		

Course Articulation Matrix(CAM) Probability & Statistics - P20MCSE142								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2	2				1	1	
CO – 2	2	1				1	1	
CO – 3	2	2	1			1	1	
CO – 4	2	1				1	1	
CO – 5	2	2	2			1	1	

Course Title: Natural Language Processing			
Course Code: P20MCSE151	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE151 aims to:

This subject aims to achieve the following goals:

1. To introduce students the challenges of empirical methods for natural language processing (NLP) applications.
2. To introduce basic mathematical models and methods used in NLP applications to formulate computational solutions.
3. To provide students with the knowledge on designing procedures for natural language resource annotation and the use of related tools for text analysis and hands-on experience of using such tools.
4. To introduce students research and development work in information retrieval, information extraction, and knowledge discovery using different natural language resources.
5. To give students opportunities to sharpen their programming skills for computational linguistics applications

Course Content

Unit -1

Introduction

Introduction to NLP: Definition, Knowledge in speech and language processing, Word Classes: Review of Regular Expressions, Morphology: Inflectional, derivational, parsing and parsing with FST, Combining FST lexicon and rules.

Self-Study Component: Human morphological processing.

10 Hours

Unit-2

Phonology:

Speech sounds, phonetic transcription, phoneme and phonological rules, optimality theory, machine learning of phonological rules, phonological aspects of prosody and speech synthesis. Pronunciation, Spelling and N-grams: Spelling errors, detection and elimination using probabilistic models, pronunciation variation (lexical, allophonic, dialect), decision tree model, counting words in Corpora, simple N-grams, smoothing (Add One, Written-Bell, Good-Turing).

Self-Study Component: N-grams for spelling and pronunciation.

11 Hours

Unit-3

POS Tagging:

Tag sets, concept of HMM tagger, rule based and stochastic POST, algorithm for HMM tagging, transformation based tagging, Sentence level construction & unification: Noun phrase, co-ordination, sub-categorization.

Self-Study Component: Concept of feature structure and unification.

10 Hours

Unit-4

Lexical Semantics and Word Sense Disambiguation

Semantics: Representing Meaning: Unambiguous representation, canonical form, expressiveness, meaning structure of language, basics of FOPC, semantics of FIPC. Semantic Analysis**:** Syntax driven, attachment & integration, robustness. Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, internal structure of words, creativity and the

lexicon: metaphor and metonymy and their computational approaches. Word Sense Disambiguation: Selectional restriction-based, machine learning based.
Self-Study Component: Dictionary based approaches.

11 Hours

Unit-5

Pragmatics:
Discourse: Reference resolution and phenomena, syntactic and semantic constraints on Co reference, pronoun resolution algorithm, text coherence, discourse structure. Dialogues: Turns and utterances, grounding, dialogue acts and structures. Natural Language Generation: Introduction to language generation, architecture, discourse planning.
Self-Study Component: Text schemata, rhetorical relations.

10 Hours

Course outcomes:
At the end of the course the student will be capable of:

1. Understanding of the fundamental mathematical models and algorithms in the field of NLP.
2. Apply these mathematical models and algorithms in applications in software design and implementation for NLP.
3. Understanding the principles of language resource annotation and its use in machine learning applications and apply the above principles in analysis of data and acquire intended information through the use of available tools.
4. Understanding the design and implementation issues in various NLP applications such as information retrieval and information extraction.
5. Understanding the complexity of Natural Language Generation.

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	*Speech and Language Processing* – An introduction to Language processing, Computational Linguistics, and Speech Recognition.	D. Jurafsky & J. H. Martin	Pearson	Volume 1, Third Edition, 2009
Reference Books				
1	Natural Language *Processing A Pananian Perspective*	Barry Nance	Prentice Hall	Eastern Economy Edition. Eugene Cherniak
2	*Natural Language Understanding*.	Allen, James.	Benjamin/ Cummings	2nd ed. Bharathi, A Vineet Chaitanya and Rajeev Sangal. 1995.

Course Articulation Matrix(CAM) - Natural Language Processing – P20MCSE151								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	1		2	2				2
CO – 2	2		3	3	2		2	2
CO – 3	3	1	3	3	2		2	2
CO – 4	3	3	3	3	3	2	2	2
CO – 5	3	2	3	3	3	2	2	2

Course Title: Information & Cyber Security			
Course Code: P20MCSE152	**Sem: I**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE152 aims to:

The course aims to gain knowledge on:

1. Information Security, Attacks, Legal and Ethical Issues.
2. Information Security Planning and Strategies.
3. Cyber Crime and Legal Issues, Cyber Offences.
4. Hand Held Devices, Tools and Methods used in Cyber Crime
5. Organizational Implications and Forensics

Course Content

Unit -1

Introduction: Information security: History, key information, critical characteristics, component, communities of interest, Need for security: Business needs, Threats, Attacks, Risk identification, assessment and control strategies.

Self-Study Component: Legal ethical and professional Issues in information security.

10 Hours

Unit-2

Planning for Security: Information Security Planning and governance, Continuity strategies. Security technology: Firewalls and VPNs, IDS and Prevention system and other Security Tools: Access control, Firewalls, Cryptographic tools, Protocols for secure communications, Attack on crypto systems, Physical security.

Self-Study Component: **S**ecurity policy standards and practices.

10 Hours

Unit-3

Cyber Security:

CYBERCRIME: Introduction, Cybercrime definition and origins of the word, Cybercrime and information security, who are Cybercriminals, Classifications of cybercrimes,

Cybercrime: The legal perspectives, Cybercrimes: An Indian perspective, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.

CYBEROFFENSES:

Introduction**,** How criminal plan the attacks, Social Engineering, Cyber stalking, Cybercafé and Cybercrimes, the Fuel for Cybercrime.

Self-Study Component: Attack vector, Cloud computing.

11 Hours

Unit-4

CYBERCRIME: MOBILE AND WIRELESS DEVICES

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

TOOLS AND METHODS USED IN CYBERCRIME

Introduction**,** Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks,

Self-Study Component: Proxy Servers and Anonymizers.

11 Hours

Unit-5

COMPUTER FORENSICS

Investigation, Setting of a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography, Relevance of the OSI 7 Layer Model to the Computer Forensics and Social Networking Sites: The Security/Privacy Threats, Forensics Auditing, Anti Forensics.

ORGANIZATIONAL IMPLICATIONS

Cost of Cybercrimes and IPR Issues: Lesson for Organizations, Web Treats for Organizations: The Evils and Perils, Security and Privacy Implications from Cloud Computing, Protecting People's Privacy in the Organization, Organizational. Guidelines for Internet Usage, Safe Computing Guidelines and Computer Usage Policy.

Self-Study Component: Relevance of the OSI 7 Layer Model to the Computer Forensics and Social Networking. **10 Hours**

Course outcomes:

1. Describe Information Security Issues, Planning and Legal Issues, cybercrime, legal perspectives and Identify different types of attacks.
2. Analyze Information security challenges, mobile devices and information systems access in the cybercrime world and Use tools and methods used in cybercrime.
3. Describe and Analyze Cyber Crime and Offences, Demonstrate phishing, identity theft and Illustrate the challenges faced in punishing the cybercriminals.
4. Summarize the fundamental concepts in cyber forensics.
5. Implement tools used for the forensics of hand-held devices and Develop data privacy and security best practices essential for organizations.

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Principles of Information Security	Michael E. Whitman, Herbert J. Mattord,	Cengage Learning.	4th Edition 2012, Course Technology,
2	Nina Godbole, Sunit Belapure,	Cyber Security	Wiley India,	2014.
Reference Books				
1	Information Systems Security,	Nina Godbole,	Wiley India, New Delhi.	2nd Edition 2007
2	Cyber Security & Global Information.	Kennetch J. Knapp,	Information Science Reference.	1 edition 2009
3	Cryptography and Network Security	William Stallings	Pearson Publication.	

Course Articulation Matrix(CAM)- Information & Cyber Security – P20MCSE152								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	1	2	3	3	3	2	1	
CO – 2	1	3	4	2	1	1	1	
CO – 3	1	2	4	2	2	3	1	
CO – 4	1	2	3	2	3	2	1	
CO – 5	1	3	3	2	3	4	1	

Course Title: Advanced Algorithms Lab			
Course Code: P20MCSEL16	**Sem: I**	**L-T-P-H: 0:0:4:4**	**Credits - 2**
Contact Period: Lab: Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSEL16 aims to:

1. Apply the algorithms and design techniques to solve problems.
2. Prove the correctness of the running time of the algorithms in various domains.
3. Model real problems using the language of graphs and flows.
4. To implement various designing paradigms of algorithms for solving problems in different domains.

Design, develop and execute the following algorithms and determine their performance.

1. Implement Euclidean Nearest Neighbor Searching algorithm.
2. Implement algorithm to merges two Voronoi diagrams into one Voronoi diagram
3. Implement an algorithm to construct a convex hull based on the divide-and-conquer strategy.
4. Write a program to solve the 2-dimensional closest pair problem using divide-and-conquer method.
5. Write a program to find a Hamiltonian cycle using tree searching technique (graph should have minimum of 6 nodes).
6. Implement algorithm to find the shortest path between the given two nodes by the branch-and-bound strategy.
7. Implement A* algorithm.
8. Implement prune-and-search algorithm to find the kth smallest element.
9. Implement prune-and-search algorithm to solve a special linear programming problem.
10. Implement longest common subsequence problem.
11. Implement RNA maximum base pair matching algorithm.
12. Implement an approximation algorithm for the node cover problem

Course Outcome

1. Compare the performance of different algorithms for the same problem.
2. Solve problems by reducing to other problems whose solution is known and show that problems are hard by reducing from other problems.
3. Make intelligent decisions about alternative data structures and algorithmic techniques in the context of software problems, choosing from existing data structures and algorithms or design own when necessary.
4. Develop the efficient algorithms for the problem with suitable techniques.

Course Title: Data Science			
Course Code: P20MCSE21	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE21 aims to:

1. Explain Big Data and Data Science, Statistical modeling, probability distributions, fitting a model
2. Explain Exploratory Data Analysis and the Data Science Process, Three Basic Machine Learning Algorithms
3. Focuses on the Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes.
4. Expose Feature Generation and Feature Selection
5. Visualize the data and follow of ethics

Course Content

Unit -1

Introduction: What is Data Science? Big Data and Data Science hype – and getting past the hype, Why now? – Datafication, Current landscape of perspectives, Skill sets. Needed Statistical Inference: Populations and samples, Statistical modelling, probability distributions, fitting a model, - Introduction to R

Self-Study Component: Statistical modeling **using** R.

10 Hours

Unit-2

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbors (k-NN), k-means

Self-Study Component: Logistic Regression and Apriori.

10 Hours

Unit-3

More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web

Self-Study Component: CNN

10 Hours

Unit-4

Feature Generation and Feature Selection (Extracting Meaning From Data): Motivating application: user (customer) retention. Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms. Filters; Wrappers; DecisionTrees; Random Forests. Recommendation Systems: Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, SingularValue Decomposition, Principal Component Analysis, Exercise: build your own recommendation system

Self-Study Component: Vectorisation

10 Hours

Unit-5

Mining Social-Network Graphs: Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs,Data Visualization: Basic principles, ideas and tools for data visualization. Data Science and Ethical Issues, Discussions on privacy, security, ethics, Next-generation data scientists.

Self-Study Component: Data visualisation using Tensorflow

10 Hours

Course outcomes:

1. Define data science and its fundamentals
2. Demonstrate the process in data science
3. Explain machine learning algorithms necessary for data sciences
4. Illustrate the process of feature selection and analysis of data analysis algorithms
5. Visualize the data and follow of ethics

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Doing Data Science , Straight Talk From The Frontline	Cathy O'Neil and Rachel Schutt	O'Reilly	2014
Reference Books				
1	Mining of Massive Datasets. v2.1	Jure Leskovek,Anand Rajaraman and Jeffrey Ullman	Cambridge University Press	2014
2	Machine Learning: A Probabilistic Perspective	Kevin P. Murphy		2013
3	Data Mining: Concepts and Techniques	. Jiawei Han, Micheline Kamber and Jian Pei	Third Edition	2012.

Course Articulation Matrix(CAM)- Data Science – P20MCSE21								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	1	1	2	2	1	1	1	
CO – 2	2	2	4	2	1	2	1	
CO – 3	1	2	2	4	2	2	1	
CO – 4	3	4	5	2	1	2	1	
CO – 5	2	1	5	2	2	1	1	

Course Title: Multicore Architecture & Programming			
Course Code: P20MCSE22	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE22 aims to:

1. Analyze technologies of multicore architecture and performance measures
2. Demonstrate problems related to multiprocessing
3. Illustrate windows threading, posix threads, openmp programming.
4. Analyze the common problems in parallel programming

Course Content

Unit -1

Introduction to Multi-core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi-core Architectures from Hyper- Threading Technology, Multi-threading on Single-Core versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. **System Overview of Threading:** Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading.

Self-Study Component: Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization.

11 Hours

Unit-2

Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis of the Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives. Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages,

Self-Study Component: Flow Control- based Concepts, Fence, Barrier, Implementation-dependent Threading Features. **11 Hours**

Unit-3

Threading APIs: Threading APls for Microsoft Windows, Win32/MFC Thread APls, Threading APls for Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads,

Self-Study Component: Thread Synchronization, Signaling, Compilation and Linking.

11 Hours

Unit-4

OpenMP: A Portable Solution for Threading : Challenges in Threading a Loop, Loopcarried Dependence, Data-race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work-sharing Sections, Performance-oriented Programming, Using Barrier and No wait, Interleaving Single-thread and Multi-thread Execution, Data Copy-in and Copy-out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions,

Self-Study Component: OpenMP Environment Variables, Compilation, Debugging, performance **10 Hours**

Unit-5

Solutions to Common Parallel Programming Problems : Too Many Threads, Data Races, Deadlocks, and Live Locks, Deadlock, Heavily Contended Locks, Priority Inversion, Solutions for Heavily Contended Locks, Non-blocking Algorithms, ABA Problem, Cache Line Ping-ponging, Memory Reclamation Problem, Recommendations, Thread-safe Functions and Libraries, Memory Issues, Bandwidth, Working in the Cache, Memory Contention, Cache-related Issues, False Sharing, Memory Consistency

Self-Study Component: Current IA-32 Architecture, Itanium Architecture, High-level Languages, Avoiding Pipeline Stalls on IA-32,Data Organization for High Performance.

10 Hours

Course outcomes:

1. **Analyze** the salient features of different multicore architectures and the exploitation parallelism.
2. **Define** fundamental concepts of parallel programming and its design issues.
3. **Compare** the different threading API"S.
4. **Demonstrate** the role of OpenMP and programming concept.
5. **Explain** the concepts of deadlocks, data races & Design a Nonblocking Algorithms

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Multicore Programming , Increased Performance through Software Multi-threading	Shameem Akhter and Jason Roberts	Intel Press	2006

Course Articulation Matrix(CAM) - Multicore Architecture & Programming – P20MCSE22								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2	2	1			2		
CO – 2	2	1	1	2		2		
CO – 3	2					2		
CO – 4	2		2	1		1		
CO – 5	2		1		1	2		

Practical Components

OPENMP PROGRAMS

1. Write an OpenMP program which performs C=A+B& D=A-B in separate blocks/sections where A,B,C & D are arrays.
2. Write an OpenMP program to add all the elements of two arrays A & B each of size 1000 and store their sum in a variable using reduction clause.
3. Write an OpenMP program to multiply two matrices A & B and find the resultant matrix C
4. Write an OpenMP program to find the number of processes, number of threads, etc (the environment information).
5. Write an OpenMP program to find the largest element in an array using critical section.
6. Write an OpenMP program to find the sum of an array A and store the result in a variable.
7. Write an OpenMP program to print all the letters of the alphabet A- Z using threads.
8. Write an OpenMP program to show how thread private clause works.

Course Title: Block Chain Technologies			
Course Code: P20MCSE23	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Prerequisite:

Expertise In Programming, Basic Knowledge Of Computer Security, Cryptography, Networking, Concurrent Or Parallel Programming.

Course Learning Objectives:

1. Be Able to explain what is blockchain
2. Be able to explain why we need blockchain? What is the real world problems that blockchain is trying to solve?
3. Understand and describe how blockchain works
4. Explain the underlying technology of transactions, blocks, proof-of-work, and consensus building
5. How does blockchain exist in the public domain (decentralized, distributed) yet maintain transparency, privacy, anonymity, security, immutability, history
6. How is blockchain incentivized without any central controlling or trusted agency
7. How bitcoin crypto currency works
8. Why people value a 'digital' currency, how it can be protected against scam, fraud, hacking and devaluation
9. Design and implement new ways of using blockchain for applications other than crypto currency
10. Explore platforms such as Ethereum to build applications on blockchain

Course Content

Unit: 1

Introduction to Block chain: Backstory of Block chain, what is Block chain? Centralized vs. Decentralized Systems, Layers of Block chain, why is Blockchain Important? Limitations of Centralized Systems, Blockchain Adoption So Far, Blockchain Uses and Use Cases **How Blockchain Works-1:** Laying the Blockchain Foundation, Cryptography, Symmetric Key Cryptography, Cryptographic Hash Functions.

Self Study: MAC and HMAC **10 Hours**

Unit-2

How Blockchain Works-2: Asymmetric Key Cryptography, Diffie-Hellman Key Exchange, Symmetric vs. Asymmetric Key Cryptography, Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals' Problem, Zero-Sum Games, Why to Study Game Theory, Computer Science Engineering, The Blockchain, Merkle Trees, Putting It All Together, Properties of Blockchain Solutions, Blockchain Transactions, Distributed Consensus Mechanisms, Blockchain Applications, Scaling Blockchain, Off-Chain Computation, Sharding Blockchain State

Self Study: Game Theory **10 Hours**

Unit-3

How Bitcoin Works: The History of Money, Dawn of Bitcoin, What Is Bitcoin? Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Bitcoin Scripts, Bitcoin Transactions Revisited, Scripts, Full Nodes vs. SPVs, Full Nodes, SPVs,Bitcoin Wallets.

Self Study: Putting it All Together **10 Hours**

Unit-4

How Ethereum Works: From Bitcoin to Ethereum, Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Enter the Ethereum Blockchain, Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem, Swarm, Whisper, DApp, Development Components

Self Study: Ethereum Ecosystem **10 Hours**

Unit 5

Blockchain Application Development : Decentralized Applications, Blockchain Application Development, Libraries and Tools, Interacting with the Bitcoin Blockchain, Setup and Initialize the bitcoinjs Library in a node.js Application, Create Keypairs for the Sender and Receiver, Get Test Bitcoins in the Sender's Wallet, Get the Sender's Unspent Outputs, Prepare Bitcoin Transaction, Sign Transaction Inputs, Create Transaction Hex, Broadcast Transaction to the Network, Interacting Programmatically with Ethereum—Sending Transactions, Set Up Library and Connection, Set Up Ethereum Accounts, Get Test Ether in Sender's Account, Prepare Ethereum Transaction, Sign Transaction, Send Transaction to the Ethereum Network, Interacting Programmatically with Ethereum—Creating a Smart Contract, Prerequisites, Program the Smart Contract, Compile Contract and Get Details, Deploy Contract to Ethereum Network, Interacting Programmatically with Ethereum—Executing Smart, Contract Functions, Get Reference to the Smart Contract, Execute Smart Contract Function, Blockchain Concepts Revisited, Public vs. Private Blockchains, Decentralized Application Architecture.

Self Study: Public Nodes vs. Self-Hosted Nodes, Decentralized Applications and Servers **12 Hours**

Text Book:

1. Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions by Bikram Aditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda

Reference Books:

1. Blockchain Technology: Cryptocurrency and Applications by S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Oxford University Press 2019.
2. Bitcoin and cryptocurrency technologies: a comprehensive introduction by Arvind Narayanan et. Al, Princeton University Press 2016

3. https://www.coursera.org/specializations/introduction-to-blockchain
4. https://nptel.ac.in/courses/106/104/106104220/

Course Outcome's

1. Understand the structure of a blockchain and why/when it is better than a simple distributed database
2. Explain the significance of cryptographic algorithms in blockchain
3. Describe the features and importance of Bitcoin
4. Explain about the principles of Ethereum Virtual Machine
5. Design, build, and deploy smart contracts and distributed applications,

Course Articulation Matrix(CAM) - Block Chain Technilogies – P20MCSE23								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2		2	2	2	2	1	
CO – 2	2		1	1	1	1	1	
CO – 3	2		2	2	2	2	2	
CO – 4	2		2	2	2	2	1	
CO – 5	2		2	2	2	2	2	

Course Title: Deep Learning			
Course Code: P20MCSE241	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE241 aims to:

1. Student need to understand the concept of Deep Learning.
2. Student need to analyze Deep Networks
3. Student need to implement optimization of Deep Learning models
4. Student need to compare the Sequences of Deep Learning
5. Student Need to understand Practical importance of deep learning in social life

Course Content

Unit -1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm,
Self-Study Component: Challenges Motivating Deep Learning.

10 Hours

Unit – 2

Deep Feed forward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. **Regularization:** Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations.
Self-Study Component: Bagging, Dropout.

11 Hours

Unit – 3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. **Convolutional Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms.
Self-Study Component: Random or Unsupervised Features.

11 Hours

Unit – 4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks.
Self-Study Component: Long short-term memory.

10 Hours

Unit – 5

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyper parameters, Debugging Strategies, Example: Multi-Digit Number Recognition.
Self-Study Component: Applications: Vision, NLP, Speech.

10 Hours

Course Outcomes:

1. Understand the Basics of Machine Learning Concept.
2. Apply approaches on data classification.
3. Analyze the training modules.
4. Evaluate sequence Modeling.
5. Generate Practical Methodology

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	**Deep Learning**	Lan Good fellow, Yoshua Bengio and Aaron Courville	MIT Press,	2016
2				
Reference Books				
1	Neural Networks: Asystematic Introduction	Raúl Rojas		1996.

Course Articulation Matrix(CAM) - Deep Learning – P20MCSE241								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2	1	2	1	1		1	
CO – 2	1	2	3	2	2	2	1	
CO – 3	1	1	2	1	1	2	1	
CO – 4	1		1			1	1	
CO – 5	1	1	2	2	2		1	

Course Title: Business Intelligence & its Application			
Course Code: P20MCSE242	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE242 aims to:

1. To make students exposed with the basic rudiments of business intelligence system.
2. To provide knowledge about modeling aspects behind Business Intelligence
3. To provide knowledge about the business intelligence life cycle and the techniques used in it.
4. To make students be exposed with multidimensional data modeling techniques.
5. To provide knowledge about applying business intelligence methods to various situations.

Course Content

Unit -1

Introduction to Business Intelligence: Business enterprise organization, Its functions, and core business processes, Key purpose of using IT in business, The connected world: Characteristics of Internet-Ready IT Applications, Enterprise Applications, Introduction to digital data and its types – structured, semi-structured and unstructured.

Introduction to OLTP and OLAP:

On-Line Transaction Processing (OLTP) and On-Line Analytical Processing (OLAP): Different, OLAP architectures, OLTP and OLAP, Data models for OLTP and OLAP, Role of OLAP tools in the BI architecture, OLAP performance directly on operational databases, A peek into the OLAP operations on multidimensional data, Leveraging ERP data using analytics.

Self-Study Component: OLTP and OLAP for a Nationalized Banking system.

12 Hours

Unit – 2

Getting started with business intelligence: Using analytical information for decision support, Information sources before dawn of BI, Business intelligence (BI) defined, Evolution of BI and role of DSS, EIS, MIS and digital dashboards, Need for BI at virtually all levels, BI for past, present and future, The BI value chain, Introduction to business analytics.

BI Definitions and concepts: BI Component framework, Need of BI, BI Users, Business Intelligence applications, BI Roles and responsibilities, Best practices in BI/DW, The complete BI professional, Popular BI tools.

Self-Study Component: Contribution of business intelligence in the growth of Nationalized Banking system.

10 Hours

Unit – 3

Basis of data integration: Need for data warehouse, Definition of data warehouse, data mart, OSS, Raiph Kimball's approach vs. W.H.Inmon's approach, Goals of a data warehouse, Constituents of a data warehouse, Extract, transform, load, Data Integration, Data integration technologies, Data quality, Data profiling.

Self-Study Component: Construct a data warehouse for a company and apply ETL techniques.

10 Hours

Unit – 4

Multidimensional data modeling: Introduction, Data modeling basis, Types of data model, Data modeling techniques, Fact table, Dimension table, typical dimensional models,

Dimensional modeling life-cycle, designing the dimensional model, Step-by-step lab guide to analyze data using MS Excel 2010

Measures, metrics, KPIs, and Performance management: Understanding measures and performance, Measurement system terminology, Navigating a business enterprise, role of metrics, and metrics supply chain, "Fact-Based Decision Making" and KPIs

Self-Study Component: Construct a KPI for a company.

10 Hours

Unit – 5

KPI Usage in companies, business metrics and KPIs, Connecting the dots: Measures to business decisions and beyond

Basics of enterprise reporting: Reporting perspectives common to all levels enterprise, Report standardization and presentation practices, Enterprise reporting characteristics in OLAP world, Balanced scorecard, Dash boards and its creation, Scorecards vs. Dashboards, The buzz behind analysis, Step-by-step lab guide to create enterprise reports using MS Acess.

Self-Study Component: Construct balanced scorecard and dashboard for a company.

10 Hours

Course Outcomes:

1. **Illustrate** role of business intelligence in the IT applications.
2. **Construct** OLAP operations to analyze business intelligence.
3. **Apply** various ETL techniques of data integration.
4. **Identify** data modeling technique to analyze data for a successful business enterprise.
5. **Construct** enterprise reports for various situations of a business enterprise.

Textbook/ Textbooks				
Sl. No.	**Title of the book**	**Name of the Author/s**	**Publisher Name**	**Edition and year**
1	Fundamentals of Business Analytics", Publishers:	R N Prasad and Seema Acharya	Wiley India.	
2	Business Intelligence: The Savvy Manager's Guide	David Loshin	Morgan Kaufmann	
Reference Books				
1	Business Intelligence Roadmap : The Complete Project Lifecycle for Decision Support Applications	Larissa T Moss and Shaku Atre	Addison Wesley Information Technology Series	
	Delivering Business Intelligence with Microsoft SQL Server 2005,	Brian Larson	Mc Graw Hill.	

Tutorials : Keeping in mind your college and its operations as a business, identify the core business processes and explain the different levels of users and their roles.

Practical Exposure: Students are expected to practice relevant lab exercises to get exposure to BI concepts and tool. With this objective, students should take up the following projects by the time of completion of the course:

Project 1: A project that allows the students to apply *Technical, Behavioral, Process* concepts learnt in the course by:

- Executing near real-life project (with large data)
- Working in teams (project teams will ideally comprise of 4 members)
- Experiencing expectations from different roles

Project 2: Data in disparate data sources such as Excel, text file, databases etc. will be provided to the students. They will be expected to extract, cleanse, integrate and load it into the data-warehouse.

Project 3: Design reports according to given business scenarios. The data for the reports is to be pulled from the data-warehouse built in the earlier project.
Integrated Project: Extract data from various data sources, perform transformations, load into target database/spreadsheet, create a cube and pull reports on the data.

Software Requirements

Software required for Tutorials and Practical:

Sl. No	Course	S/W on Students Machine	Remarks
1.	Business Intelligence (BI) and its application	Kettle – open source MS Office – MS Access + MS Excel	Office 2007/2010

Course Articulation Matrix(CAM) - Business Intelligence & its Application – P20MCSE242								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1								
CO – 2								
CO – 3								
CO – 4								
CO – 5								

Course Title: Agile Technologies			
Course Code: P20MCSE251	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE251 aims to:

1. To understand the basic concepts of Agile Software Process.
2. To gain knowledge in the area of various Agile Methodologies.
3. To develop Agile Software Process
4. To know the principles of Agile Testing
5. Assess product quality risks within an Agile project

Course Content

Unit -1

INTRODUCTION

Software is new product development – Iterative development – Risk (Driven and Client (Driven iterative planning – During the Iteration, No changes from external stakeholders – Evolutionary and adaptive Development (Evolutionary requirements analysis – Early "Top Ten" high (level requirements and skilful analysis Evolutionary and adaptive planning – Incremental delivery – Evolutionary delivery – The most common mistake – Specific iterative and Evolutionary methods.

Self-Study Component: Time boxed iterative development

12 Hours

Unit – 2

AGILE AND ITS SIGNIFICANCE

Agile development – Classification of methods – The agile manifesto and Principles – Agile project management – Embrace communication and feedback –.– Empirical Vs defined and prescriptive Process – Principle(based versus Rule(Based – Sustainable discipline: The human touch – Team as a complex adaptive system – Agile hype – Specific agile methods. The facts of change on software projects –Key motivations for iterative Development – Meeting the requirements challenge iteratively – Problems with the Waterfall. Research evidence – Early historical project evidence – Standards (Body evidence – Expert and thought leader evidence – A Business case for iterative development – The historical accident of waterfall validity.

Self-Study Component: Simple practices of Agile Methods and project tools

10 Hours

Unit – 3

Method overview – Lifecycle – Work products, Roles and Practices values – Common mistakes and misunderstandings – Sample projects – Process mixtures – Adoption strategies – Fact versus fantasy – Strengths versus "Other" history.

Self-Study Component: Common mistakes and misunderstandings.

10 Hours

Unit – 4

SCRUM

Concepts –deliverable and methods. XP: Concepts –deliverable and methods Unified process: Concepts- deliverable-methods.EVE: Concepts- Methods-deliverable. EVO: Method Overview, Lifecycle, Work Products, Roles and practices, Common mistakes and Misunderstandings, Sample Projects.

Self-Study Component: Unified process.

10 Hours

Unit – 5

AGILE PRACTICING AND TESTING

Project management – Environment – Requirements – Test – The agile alliances – The manifesto – Supporting the values – Agile testing – Nine principles and six concrete practices for testing on agile teams.

Self-Study Component: Agile Testing Principles

10 Hours

Course outcomes:

1. Demonstrate a systematic understanding of current agile techniques and practices used in industry.
2. Apply industry standard agile techniques in develop software in a team.
3. Use group and individual retrospectives to critically evaluate and propose improvements in developing software in a professional context.
4. Apply concepts of XP and EVE in develop a software
5. Managing the changes applying different testing techniques

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	"Agile and Iterative Development – A Manager's Guide"	Craig Larman	Pearson Education	2004
2	"Agile Testing"	Elisabeth Hendrickson	Quality Tree Software Inc	2008
Reference Books				
1	Shore"Art of Agile Development"	Shore	Shroff Publishers & Distributors	2007

Course Articulation Matrix(CAM) - Agile Technologies – P20MCSE251								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2	2	4	4	3	1	1	
CO – 2	1	2	4	3	2	2	1	
CO – 3	1	1	3	3	2	2	1	
CO – 4	2	2	2	2	4	2	1	
CO – 5	2	3	3	3	3	2	1	

Course Title: Network Management System			
Course Code: P20MCSE252	**Sem: II**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Contact Period: Lecture: 52 Hrs., Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSE252 aims to:

1. Illustrate the need for interoperable network management.
2. Explain the concepts and architecture behind standards based network management.
3. Differentiate the concepts and terminology associated with SNMP and TMN.
4. Explain Use RMON for monitoring the behavior of the network.
5. Describe network management as a typical distributed application.

Course Content

Unit -1

Introduction: Analogy of Telephone Network Management, Data and Telecommunication Network, Distributed computing Environments, TCP/IP-Based Networks: The Internet and Intranets, Communications Protocols and Standards- Communication Architectures, Protocol Layers and Services; Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions- Goal of Network Management, Network Provisioning, Network Operations and the NOC, Network Installation and Maintenance; Network and System Management, Network Management System platform, Current Status and Future of Network Management.

Self-Study Component: Case Histories of Networking and Management – The Importance of topology, Filtering Does Not Reduce Load on Node, Some Common Network Problems;

11 Hours

Unit – 2

Basic Foundations: Standards, Models, and Language: Network Management Standards, Network Management Model, Organization Model, Information Model – Management Information Trees, Managed Object Perspectives, Communication Model; ASN.1- Terminology, Symbols, and Conventions, Objects and Data Types, Object Names.

Self-Study Component: Example of ASN.1 from ISO 8824; Encoding Structure; Macros, Functional Model.

11 Hours

Unit – 3

SNMPv1 Network Management: Managed Network: The History of SNMP Management, Internet Organizations and standards, Internet Documents, The SNMP Model, The Organization Model, System Overview. The Information Model – Introduction, The Structure of Management Information, Managed Objects, Management Information Base. The SNMP Communication Model – The SNMP Architecture, Administrative Model, SNMP Specifications, SNMP Operations, SNMP MIB Group, Functional Model SNMP Management – RMON: Remote Monitoring, RMON SMI and MIB, RMONI1- RMON1 Textual Conventions, RMON1 Groups and Functions, Relationship Between Control and Data Tables, RMON1 Common and Ethernet Groups, RMON Token Ring Extension Groups.

Self-Study Component: RMON2 – The RMON2 Management Information Base, RMON2 Conformance Specifications.

10 Hours

Unit – 4

Broadband Access Networks, Broadband Access Technology; HFCT Technology: The Broadband LAN, The Cable Modem, The Cable Modem Termination System, The HFC Plant, The RF Spectrum for Cable Modem; Data Over Cable, Reference Architecture; HFC Management – Cable Modem and CMTS Management, HFC Link Management, RF Spectrum Management, DSL Technology; Asymmetric Digital Subscriber Line Technology – Role of the ADSL Access Network in an Overall Network, ADSL Architecture, ADSL Channeling Schemes, ADSL Encoding Schemes; ADSL Management – ADSL Network Management Elements, ADSL Configuration Management, ADSL Fault Management, ADSL Performance Management.

Self-Study Component: SNMP-Based ADSL Line MIB, MIB Integration with Interfaces Groups in MIB-2, ADSL Configuration Profiles, TR-069 concepts.

10 Hours

Unit – 5

Network Management Applications: Configuration Management- Network Provisioning, Inventory Management, Network Topology, Fault Management- Fault Detection, Fault Location and Isolation 24 Techniques, Performance Management – Performance Metrics, Data Monitoring, Problem Isolation, Performance Statistics; Event Correlation Techniques – Rule-Based Reasoning, Model-Based Reasoning, Case-Based Reasoning, Codebook correlation Model, State Transition Graph Model, Finite State Machine Model, Security Management – Policies and Procedures, Security Breaches and the Resources Needed to Prevent Them, Firewalls, Cryptography, Authentication and Authorization.

Self-Study Component: Client/Server Authentication Systems, Messages Transfer Security, Protection of Networks from Virus Attacks, Accounting Management, Report Management, Policy- Based Management, Service Level Management

10 Hours

Course outcomes:

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

1. Analyze the issues and challenges pertaining to management of emerging network technologies such as wired/wireless networks and high-speed internets.
2. Apply network management standards to manage practical networks.
3. Use on SNMP for managing the network .
4. Use RMON for monitoring the behavior of the network.
5. Identify the various components of network and formulate the scheme for the managing them.

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Network Management- Principles and Practice	Mani Subramanian	Pearson	2nd Edition, 2010
Reference Books				
1	Network management Concepts and Practices	J. Richard Burke	PHI	2008

Course Articulation Matrix(CAM) - Network Management System – P20MCSE252								
Course Outcomes (CO's)	**Program Outcomes(PO's)**						**PSO's**	
	1	**2**	**3**	**4**	**5**	**6**	**1**	**2**
CO – 1	2	2	2	1	2	1	2	
CO – 2	1	2	2	1	1	1	2	
CO – 3	2	2	2	1	2	2	2	
CO – 4	3	1	3	2	2	2	2	
CO – 5	2	3	3	2	2	2	2	

Course Title: Data Science Lab			
Course Code: P20MCSEL27	**Sem: II**	**L-T-P-H: 0:0:4:4**	**Credits - 2**
Contact Period: Lab: 04 hrs/week Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Learning Objectives (CLO's)

The course P20MCSEL27 aims to:

1. Apply the algorithms and design techniques to solve problems.
2. Prove the correctness of the running time of the algorithms.
3. Model real problems using the language of graphs and flows.
4. To implement various designing paradigms of algorithms for solving problems in different domains.

Design, develop and execute the following algorithms and determine their performance

1. Implementation of AND/OR/NOT Gates using single layer perception
2. Implementation of XOR Gate using multi-layers perceptron/error back propagation
3. Understanding the concept of perceptron learning rule
4. Understanding the concept of hebbiann learning rule
5. Understanding the concept of correlation learning rule
6. Understanding the functioning of fuzzication process
7. Implement and demonstrate FIND S Algorithm
8. Implement and demonstrate Candidate-Elimination algorithm.
9. Program to demonstrate the working of the decision tree based ID3 algorithm.
10. implement and demonstrate the Back propagation algorithm TO CONSTRUCT an Artificial Neural Network
11. Implement the naïve Bayesian classifier and compute the accuracy of the classifier.
12. Implement k-Nearest Neighbour algorithm to classify the iris data set.
13. Implement the non-parametric Locally Weighted Regression algorithm
14. Implement and demonstrate the Random forest algorithm
15. Implement and demonstrate k-means algorithm

Course Outcome

1 Compare the performance of different algorithms for the same problem.
2 Solve problems by reducing to other problems whose solution is known and show that problems are hard by reducing from other problems.
3 Make intelligent decisions about alternative algorithmic techniques in the context of software problems, choosing from existing algorithms or design own when necessary.
4 Develop the efficient algorithms for the problem with suitable techniques.

Ref: Virtual Labs an MHRD Govt of India initiative, IIT Bombay

Course Title: Research Methodology and IPR			
Course Code: P20MCSE31	**Sem: III**	**L-T-P-H: 4:0:0:4**	**Credits - 4**
Exam: 3 Hrs		**Weightage: CIE:50; SEE:50**	

Course Content

Unit -1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Unit – 2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Unit – 3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Unit – 4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Unit – 5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention onBiological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition,

17 Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Course outcomes:

1. Discuss research methodology and the technique of defining a research problem
2. Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
3. Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
4. Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
5. Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.

Sl. No.	Title of the book	Name of the Author/s	Publisher Name	Edition and year
1	Research Methodology: Methods and Techniques C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018	C.R. Kothari, Gaurav Garg New Age International 4th Edition, 2018	New Age International	4th Edition, 2018
2	Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2)	Ranjit Kumar	SAGE Publications	3rd Edition, 2011
3	Study Material (For the topic Intellectual Property under module 5)	Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament,		
Reference Books				
1	Research Methods: the concise knowledge base Trochim Atomic Dog Publishing 2005	Trochim	Atomic Dog	Publishing 2005
2	Conducting Research Literature Reviews: From the Internet to Paper	Fink A	Sage Publications	2009