PUDUCHERRY TECHNOLOGICAL UNIVERSITY

PUDUCHERRY–605014

(A Technological University of Government of Puducherry)

Curriculum and Syllabi

of

M.Tech in Internet of Things

(With effect from Academic year 2020-21)

(Approved in Sixth Academic Council Meeting held on 20th March 2021)

CURRICULUM

The curriculum of M.Tech. Information Technology (Specialization in Internet of Things) is designed to fulfill the Programme Educational Objectives (PEO) and Programme Outcomes (PO) listed below:

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO1	To provide graduates with a core foundation in mathematics, scientific and computing fundamentals required to develop IT solutions to real-world problems of Industries, Businesses and Society.
PEO2	To provide students with both fundamental and advanced knowledge in Internet of Things.
PEO3	To inculcate research and lifelong learning attitudes among the students.
PEO4	To inculcate leadership qualities, team work and effective communication skills in students for successful professional growth.
PEO5	To enable the students, practice ethical codes and guidelines, and contribute to sustainable development of society.

PROGRAMME OUTCOMES (PO)

PO1	Attain in-depth knowledge in the domain of Internet of Things (IoT)
PO2	Carry out research/investigation and development work independently to solve practical problems in the field of IoT.
PO3	Apply advanced techniques, skills, scientific and engineering tools for professional practice.
PO4	Explore new ideas and lifelong learning in the IoT field.
PO5	Practice individually and in teams with social obligation, ethical and environmental consciousness.

Distribution of Credits among the subjects grouped under various categories:

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Programme Core Courses	24	PCC
2	Programme Specific Elective Courses	15	PSE
3	Open Elective Courses	03	OEC
4	Professional Activity Courses (Project Work, Seminar)	28	PAC
5	Mandatory Audit Courses	Non Credit	MAC
	Total	**70**	

Semester Wise Courses and Credits

Semester I

Course Code	Course	CCC	Periods			Credits
			L	T	P	
MA252	Mathematical Foundation of Information Technology	PCC	3	0	0	3
IT251	Advanced Data Structures	PCC	3	0	0	3
IT252	IoT Architecture	PCC	3	0	0	3
ITZNN	Programme Specific Elective - 1	PSE	3	0	0	3
ITZNN	Programme Specific Elective - 2	PSE	3	0	0	3
IT253	Advanced Software Laboratory - I	PCC	0	0	4	2
IT254	Research Methodology and IPR	PCC	2	0	0	2
AD2NN	Audit Course - I	MAC	2	0	0	0
Total			**23**			**19**

Semester II

Course Code	Course	CCC	Periods			Credits
			L	T	P	
IT255	Advance Algorithms	PCC	3	0	0	3
IT256	Soft Computing	PCC	3	0	0	3
IT257	Sensor Networks &IoT	PCC	3	0	0	3
ITZNN	Programme Specific Elective - 3	PSE	3	0	0	3
ITZNN	Programme Specific Elective - 4	PSE	3	0	0	3
IT258	Advanced Software Laboratory- II	PCC	0	0	4	2
IT259	Mini Project and Seminar	PAC	0	0	4	2
AD2NN	Audit Course - II	MAC	2	0	0	0
Total			**25**			**19**

Semester III

Course Code	Course	CCC	Periods			Credits
			L	T	P	
ITZNN	Programme Specific Elective - 5	PSE	3	0	0	3
OE2NN	Open Elective	OEC	3	0	0	3
IT260	Dissertation – Phase I/ Industrial Project	PAC	0	0	20	10
Total			**26**			**16**

Semester IV

Course Code	Course	CCC	Periods			Credits
			L	T	P	
IT261	Dissertation – Phase II / Industrial Project	PAC	0	0	32	16
Total			**32**			**16**

Total Credits: 70

Audit Courses (MAC)

AD201	English for Research Paper Writing
AD202	Disaster Management
AD203	Value Education
AD204	Constitution of India
AD205	Pedagogy Studies
AD206	Stress Management by Yoga

Open Elective Courses (OEC)

OE201	Business Analytics (IT)
OE202	Industrial Safety and Maintenance (ME)
OE203	Operations Research (ME)
OE204	Cost Management of Engineering Projects (CE)
OE205	Composite Materials (PH)
OE206	Waste to Energy (CE)

Programme Specific Electives (PSE):

PSE - 1	**ITZ01**	Web Data Mining
	ITZ02	Wireless Access Technologies
	ITZ03	Mobile Application Development
PSE -2	**ITZ04**	Machine Learning
	ITZ05	Internet of Things & Python Programming
	ITZ06	Logic and Functional Programming
PSE -3	**ITZ07**	Advanced Machine Learning
	ITZ08	Software Defined Networks
	ITZ09	RFID and Microcontrollers
PSE - 4	**ITZ10**	Big Data Analytics
	ITZ11	IoT Security
	ITZ12	Computational Models of Social Mining
PSE - 5	**ITZ13**	Cloud Architecture and Computing
	ITZ14	Smart Sensors for IoT
	ITZ15	Real-time Systems Design

Department: **Mathematics**		Programme: **M.Tech.(IOT)**						
Semester: **First**		Course Category Code:**PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
MA252	**Mathematical Foundation of Information Technology**	3	-	-	3	40	60	100
Prerequisite	Basic Mathematics and statistics							
Course Outcome	**CO1**	Able to understand the basic notions of discrete and continuous probability						
	CO2	Able to understand the methods of statistical inference and perform correct and meaningful statistical analyses of simple to moderate complexity						
	CO3	Able to understand different types of graphs, colouring principles, permutation and combination						
	CO4	Able to solve Linear and Nonlinear equations and Eigen Value Problems						
	CO5	Able to apply numerical methods for solving ordinary differential equations						

UNIT I	**Introduction to Probability theory and random variables**	**Periods** : **9**
Probability mass, density and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains.		**CO1**
UNIT II	**Sampling Theory, Statistics and Inference Theory**	**Periods** : **9**
Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood. Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over fitting model assessment.		**CO2**
UNIT III	**Graph Theory and Combinatorics**	**Periods** : **9**
Graph Theory: Isomorphism, Planar graphs, graph colouring, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems		**CO3**
UNIT IV	**Solution of nonlinear and linear equations and Eigen value problem**	**Periods** : **9**
Nonlinear equations: Bisection, false position and Newton-Raphson methods. Solution Linear equations: Gauss and Gauss Jordan elimination, Jacobi and Gauss Seidel methods. Gauss Jordan method to find inverse of a matrix. Eigen value problem by power method and Jacobi method.		**CO4**
UNIT V	**Numerical differentiation, Integration and differential equations**	**Periods: 9**
Numerical differentiation using Newton's forward and backward procedures. Numerical integration using Trapezoidal, Simpson's 1/3 and 3/8 rules. Solution of differential Equations: Taylor Series method, Euler and Improved Euler methods, Runge-Kutta method of fourth order, Milne's Predictor-Corrector method.		**CO5**

Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference Books

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E.Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley
5. P. Kandasamy, K. Gunavathy and K. Thilagavathy, Numerical Methods, S. Chand & Company Ltd, New Delhi, 2014
6. S.S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall publishers , New Delhi, 2008

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	2	2
CO3	3	3	2	2	2
CO4	2	3	2	3	2
CO5	3	3	2	3	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **I**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT251	**Advanced Data Structures**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	UG level course in Data Structures								
Course Outcome	**CO1**	Learning about various search tree structures and their applications							
	CO2	Learning about various heap structures and their applications							
	CO3	Learning and practicing various geometric structures							
	CO4	Learning various applications of graph structures							
	CO5	Learning various hashing techniques and their applications							

UNIT I	**SEARCH STRUCTURES**	**Periods** : **9**
Binary Search Trees – AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – B+ Trees - Splay Trees – Tries (standard tries, compressed tries, suffix tries)		**CO1**
UNIT II	**HEAP STRUCTURES**	**Periods** : **9**
Single and double ended priority queue - Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy Binomial Heaps -Pairing Heaps –Interval Heaps		**CO2**
UNIT III	**GEOMETRIC STRUCTURES**	**Periods** : **9**
Segment Trees – 1-Dimensional Range Searching – k-d Trees – Line Segment Intersection –Range Trees – Voronoi Diagram –Point quad trees – R trees – TV trees		**CO3**
UNIT IV	**GRAPHS**	**Periods** : **9**
Representation – Shortest path algorithms: Unweighted shortest path, Dijkstra's algorithm, Graphs with negative edge - costs, Acyclic graphs, All pairs shortest path – Network Flow problems – Activity Networks – DFS applications: Biconnectivity, Euler Circuits		**CO4**
UNIT V	**DISJOINT SETS AND HASHING**	**Periods** : **9**
Representation – Union and find operations - Hashing: Static hashing – Dynamic hashing - Overflow handling - Bloom filters - Locality sensitive hashing		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Mark de Berg, Otfried Cheong, Marc Van Kreveld and Mark Overmars, Computational Geometry Algorithms and Applications, Springer-Verlang, 3rd Edition, 2008.
2. S.Sahni, Data Structures, Algorithms and Applications in C++, 2nd Edition, Universities Press, 2005.
3. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.
4. Venkatesan R and Lovelyn Rose S, Data Structures, Wiley India Pvt. Ltd., New Delhi, 2015.
5. Mark Allen Weiss, Data structures and Algorithm Analysis in C++, Pearson Education, New Delhi, 2013.
6. Peter Brass, Advanced Data Structures, Cambridge University Press, New York, 2008.
7. Adam Drozdek, Data Structures and Algorithms in C++, Cengage Learning, USA, 2013.

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	1	1
CO2	3	2	2	2	2
CO3	1	3	2	1	2
CO4	2	2	1	2	3
CO5	3	1	3	3	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **I**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
IT252	**IoT Architecture**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite								

Course Outcome		
	CO1	Interpret the vision of IoT from a global context
	CO2	Determine the Market perspective of IoT
	CO3	Implement state of the art architecture in IoT.
	CO4	Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints
	CO5	Illustrate the application of IoT in Commercial Building Automation and identify Real World Design Constraints

UNIT I	**M2M to IoT - the global context**	**Periods** : **9**
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. 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		**CO1**
UNIT II	**M2M to IoT- An Architectural Overview**	**Periods** : **9**
M2M to IoT-An Architectural Overview- Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. 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, Knowledge Management		**CO2**
UNIT III	**IoT Architecture- State of the Art**	**Periods** : **9**
Introduction, State of the art. Architecture Reference Model: Introduction, Reference Model and architecture, IoT reference Model: IoT domain model, Information model, functional model, communication model. IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints, Data representation and visualization		**CO3**
UNIT IV	**IoT Implementation Examples**	**Periods** : **9**
Implementation Examples: 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		**CO4**
UNIT V	**Case study**	**Periods** : **9**
Commercial Building Automation- Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014. (ISBN-13: 978-0124076846)
2. Jamil Y. Khan (Editor), Mehmet R. Yuce , “Internet of Things (IoT): Systems and Applications” Jenny Stanford Publishing, 2019
3. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014. (ISBN-13: 978-8173719547)
4. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013. (ISBN-13: 978- 1430257400)

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	2	1
CO2	3	2	2	2	1
CO3	3	2	3	2	1
CO4	3	3	3	3	1
CO5	3	3	3	3	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **I**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT253	**Advanced Software Laboratory I**		**-**	**-**	**4**	**2**	**40**	**60**	**100**
Prerequisite									
Course Outcome	**CO1**	Design and implement Advanced Data Structures							
	CO2	Design and implement efficient algorithms with minimum complexity							
	CO3	Design and Implement Python programs for general and IoT applications							

List of Experiments :

1. Implement **ANY TWO** of the following tree structures with the operations – store and print the given tree with appropriate structure definition, search for a given data and print whether it is a successful or unsuccessful search a. Binary search tree b. AVL TREE c. B TREE d. TRIE 2. Implement single and double ended priority queue (using array or linked list of your choice) with the following operations a. Delete member with minimum priority b. Delete member with maximum priority c. Insert a member with arbitrary priority in appropriate position in the queue d. Print minimum priority element e. Print maximum priority element	**CO1**
3. Implement the single source shortest path algorithm with suitable structure definition for input and output. Test your algorithm for various test data (positive and negative distance values). 4. Implement the all pairs shortest path algorithm with suitable structure definition for input and output. Test your algorithm for various test data. 5. Implement **any one** of the hashing technique (mid square, division, folding, digit analysis) with **one** suitable overflow handling method (linear probing, quadratic probing, rehashing, random probing, chaining)	**CO2**
6. Write a Python Program to read a number and check whether the given number is in fibonacci sequence. 7. Write a python program to set and raise alerts. 8. Design a Website blocker to block unwanted sites using python. 9. Design a Contact book with a find and save facility with command line functions in Python. 10. Develop a simple interactive game using Python.	**CO3**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 60**	**Total Periods: 60**

Reference Books

1. S.Sahni, Data Structures, Algorithms and Applications in C++, 2nd Edition, Universities Press, 2005
2. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
3. Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Education, New Delhi, 2013.
4. ReemaTheraja, Data Structures Using C, Second edition, Oxford University Press, 2014.
5. Adam Drozdek, Data Structures and Algorithms in C++, Cengage Learning, USA, 2013.
6. Programming and Problem Solving with Python, Ashok NamdevKamthane and Amit Ashok Kamthane, McGraw Hill,2017.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	2	3	3	2	3
CO3	3	3	3	3	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **I**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
IT254	**Research Methodology and IPR**	**2**	**-**	**-**	**2**	**40**	**60**	**100**
Prerequisite								

Course Outcomes	**CO1**	Identify and formulate the research problem for a given engineering domain.
	CO2	Analyze the literature studies, plagiarism and ethics for the identified research problem.
	CO3	Develop the effective technical writing and presentation of a research proposal using a tool.
	CO4	Design and file the copyright of research work for trade as a product in the market.
	CO5	Apply the research for licensing and technology transfer as a product in world market.

UNIT I	**Introduction**	**Periods** : **9**
Definition of research problem, sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.		**CO1**
UNIT II	**Literature Review**	**Periods** : **9**
Effective literature review approaches, literature analysis, avoiding plagiarism, ethics in research, data collection, analysis, interpretation.		**CO2**
UNIT III	**Technical Writing and Presentation**	**Periods** : **9**
Effective technical writing, how to write report, paper developing a research proposal, format of research proposal, a presentation and assessment by a review committee.		**CO3**
UNIT IV	**Introduction & Justification of Intellectual Property Rights**	**Periods** : **9**
Introduction: Protection for ideas, means for protecting ideas, sources of intellectual property law, basic format to intellectual property issues. **Justifications:** objections to exclusive rights, justifications, justifications for patents, justifications for copyright, trade marks.		**CO4**
UNIT V	**Patent & Inventions**	**Periods** : **9**
Patent: The structure of patent law, patent terminology, patents act 1977, application for a patent, ownership of the patent, the proprietary right, patent licenses. **Patentable inventions:** inventions, excluded categories, industrial application, novelty, inventive step, disclosure, genetic engineering and patentability.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. C.R.Kothari, 'Research Methodology Methods & Techniques', 4th Edn., New Age International Publishers, 2019.
2. Catherine Colston, "Principles of Intellectual Property Law", Cavendish Publishing Ltd, 1999.
3. Sreenivasulu, Law Relating to Intellectual Property, Universal Law Publishing, 2nd edition, 2018.
4. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners", Pearson, 2005.
5. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction toResearch Methodology, RBSA Publishers.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	2	3	3	2	3
CO3	2	3	3	3	2
CO4	3	3	2	3	3
CO5	3	3	3	2	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **II**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT255	**Advance Algorithms**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	UG level course in Algorithms								
Course Outcome	**CO1**	Analyze algorithms							
	CO2	Determine algorithm correctness							
	CO3	Familiarize the student with good programming design methods, and program development							
	CO4	Design algorithms for problems from different domains							
	CO5	Identify various research strategies on algorithmic design							

UNIT I	**FUNDAMENTALS**	**Periods** : **9**
Properties of Big-oh Notation –Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – Introduction to NP-Completeness/NP-Hard – Recurrence Equations – Solving Recurrence Equations – Time-Space Trade off.		**CO1** **CO2**
UNIT II	**INTRODUCTION TO RANDOMIZED ALGORITHMS**	**Periods** : **9**
Review on Algebra, Number theory, Combinatorics and Probability theory, Randomness as a source of efficiency-designing a communication protocol, Models of Randomized Algorithms, Classification-Las Vegas, Monte-Carlo (one-sided error, bounded-error and unbounded-error), Classification of Randomized Algorithms for Optimization problems.		**CO3** **CO5**
UNIT III	**DESIGN PARADIGMS AND REPRESENTATION ALGORITHMS**	**Periods** : **9**
Foiling the Adversary, Abundance of Witnesses, Fingerprinting, Random Sampling, Amplification, Random Rounding. *Foiling the Adversary* – Universal Hashing, *Fingerprinting* – Communication protocols, Verification of Matrix Multiplication, Equivalence of Two polynomials, *Success Amplification and Random Sampling* – Min-Cut, Satisfiability and repeated random sampling, *Abundance of Witnesses and Optimization & random rounding* – Primality Testing, Max-SAT review, hybrid sampling & rounding, Derandomization Techniques.		**CO4** **CO5**
UNIT IV	**INTRODUCTION TO APPROXIMATION ALGORITHMS**	**Periods** : **9**
Review on Complexity theory, Performance Ratios for approximation algorithms, Cardinality vertex-cover problem, Well-characterized problems and min-max relations, Travelling Salesperson problem.		**CO3** **CO5**
UNIT V	**COMBINATORIAL ALGORITHMS**	**Periods** : **9**
Set Cover, Steiner Tree and Travelling Salesperson Problem, Multi-way Cut and k-Cut, Bin Packing.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Gilles Brassard, Paul Bratley, Algorithmics: Theory and Practice, Prentice Hall, 1988.
2. R.C.T Lee, S.S Tseng, R.C Chang and Y.T Tsai, Introduction to the Design and Analysis of Algorithms, Tata McGraw-Hill Edition, 2012.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009.
4. Vijay V. Vazirani, Approximation Algorithms, First edition, Springer, 2001.
5. JurajHromkovic, Design and Analysis of Randomized Algorithms, First edition, Springer, 2005.
6. David P. Williamson, David B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011.
7. Rajeev Motwani, PrabhakarRaghavan, Randomized Algorithms, Cambridge University Press, 1995.
8. Sara Baase, Computer algorithms: Introduction to Design and Analysis, Addison Wesley publication, 1998.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	1	1
CO2	3	1	3	1	2
CO3	2	2	1	2	3
CO4	1	2	1	3	3
CO5	1	3	2	1	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **II**			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT256	**Soft Computing**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	Basic knowledge of Mathematics and Artificial Intelligence								
Course Outcome	**CO1**	To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.							
	CO2	To give students knowledge on Machine learning techniques To implement soft computing based solutions for real-world problems.							
	CO3	To implement soft computing based solutions for real-world problems.							
	CO4	To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.							
	CO5	To provide student an hand-on experience on MATLAB to implement various strategies.							

UNIT I	**INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS**	**Periods** : **9**
Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics		**CO1& CO2**
UNIT II	**NEURAL NETWORKS**	**Periods** : **9**
Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks		**CO3**
UNIT III	**FUZZY LOGIC**	**Periods** : **9**
Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.		**CO4**
UNIT IV	**GENETIC ALGORITHMS**	**Periods** : **9**
Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.		**CO4**
UNIT V	**Matlab/Python Lib**	**Periods** : **9**
Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. SarojKaushik and Sunita Tiwari, "Soft Computing-Fundamentals, Techniques and Applications", Tata McGraw Hill Publications, First Edition 2018.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, 3rd Edition, 2010.
3. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Editions, 2nd Edition, 2013.
4. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing,Prentice:Hall of India, 2003.
5. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications, Prentice Hall, 1995.
6. MATLAB Toolkit Manual

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	3	3	3	3	2
CO3	2	3	3	3	3
CO4	3	3	2	2	2
CO5	2	2	2	2	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: INFORMATION TEHNOLOGY			Programme: **M.Tech.(IoT)**						
Semester: II			Course Category Code:				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT257	**Sensor Networks & IoT**		3	-	-	3	40	60	100
Prerequisite	Wireless Networks								
Course Outcome	**CO1**	Able to understand the basics of Wireless sensor networks							
	CO2	Understand the IoT Network Architecture and design							
	CO3	Able to understand the wireless technologies for IoT							
	CO4	Able to understand the communication protocols for IoT							
	CO5	Illustrate the application of IoT in Manufacturing and Public safety and identify the Real World Design Constraints							

UNIT I	**Overview**	**Periods** : **9**
Sensors, Actuators, and Smart Objects: Sensors - Actuators - Micro-Electro-Mechanical Systems (MEMS) - Smart Objects: A Definition - Trends in Smart Objects. Sensor Networks: Wireless Sensor Networks (WSNs) Communication Protocols for Wireless Sensor Networks. IoT and M2M: Introduction - M2M - Difference between IoT and M2M - SDN and NFV for IoT- IoT System Management with NETCONF-YANG.		**CO1**
UNIT II	**IoT Network Architecture and Design**	**Periods** : **9**
Drivers Behind New Network Architectures-Comparing IoT Architectures: The oneM2M IoT Standardized Architecture -The IoT World Forum (IoTWF) Standardized Architecture-A Simplified IoT Architecture- The Core IoT Functional Stack-IoT Data Management and Compute Stack		**CO2**
UNIT III	**Connecting Smart Objects**	**Periods** : **9**
Communications Criteria -IoT Access Technologies: IEEE 802.15.4,IEEE 802.15.4g and 802.15.4e-IEEE 1901.2a-IEEE 802.11ah-LoRaWAN-NB-IoT and Other LTE Variations		**CO3**
UNIT IV	**IoT Communication Protocols**	**Periods** : **9**
IP as the IoT Network Layer: The Business Case for IP-The Need for Optimization-Optimizing IP for IoT-Profiles and Compliances **Application Protocols for IoT**:The Transport Layer-IoT Application Transport Methods-SCADA-Generic Web-Based Protocols -IoT Application Layer Protocols: CoAP, Message Queuing Telemetry Transport (MQTT), SMQTT-XMPP- AMQP		**CO4**
Unit V	**Case study**	
IoT in Industry: **Manufacturing**-An Introduction to Connected Manufacturing - An Architecture for the Connected Factory - Industrial Automation Control Protocols-Connected Factory Security-Edge Computing in the Connected Factory. **Public Safety:** Overview of Public Safety-An IoT Blueprint for Public Safety-Emergency Response IoT Architecture-IoT Public Safety Information Processing-School Bus Safety		**CO5**

Lecture Periods: 45	**1. Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things" Cisco Press,2017
2.Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach‖, Universities Press, 2015
3. Ajit Singh, DrAprajita Krishna " Internet of Things & Wireless sensor Network" SBN-10 : 1694912388, 2019.
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Wiely Publication
5. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
6. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012
7. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	1
CO2	3	2	2	2	1
CO3	3	3	2	3	1
CO4	3	3	2	3	1
CO5	3	3	2	3	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **II**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
IT258	**Advanced Software Laboratory II**		**-**	**-**	**4**	**2**	**40**	**60**	**100**
Prerequisite									
Course Outcome	**CO1**	Develop approximation, randomization, linear and non-linear algorithms for various problems like scheduling, graph, network, string and subsequence problems.							
	CO2	Analyze algorithms and determine its correctness							
	CO3	Design and Implement programs using Neural networks, Fuzzy logic and Genetic algorithms techniques							

List of Experiments :

1. Implement Crossword puzzles as Constraint Satisfaction problems 2. Solve the graph coloring problem by backtracking and constraint propagation (using heuristics) 3. Develop an algorithm for shortest path in multi-stage graph using dynamic programming 4. Solve Maximum Clique Problem using Branch and Cut Method 5. Implement the randomized quick sort using divide and conquer strategy for the given scenario.	**CO1, CO2**
6. WriteaMATLABprogramtoplotafewactivationfunctionsthatarebeingusedinneural networks. 7. Generate XOR function using McCulloch-Pittsneuron. 8. With a suitable example simulate the perceptron learning network and separate the boundaries.Plotthepointsassumedintherespectivequadrantsusingdifferentsymbols for identification. 9. WriteaMATLABprogramtoshowBackPropagationNetworkforXORfunctionwith Binary Input and Output. 10. Write a MATLAB program to illustrate ART neural network. 11. Development of logic for fuzzy relations 12. Verification of logic using fuzzy relations 13. Design of a fuzzy controller systems using fuzzy tool of Matlab 14. Genetic Algorithm Optimization Toolbox (GAOT) under Matlab. 15. Implementation of Simulated Annealing and TabuSearch	**CO3**

Lecture Periods: -	**Tutorial Periods: -**	**Practical Periods: 60**	**Total Periods: 60**

Reference Books

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, MIT Press, 2009.
2. Vijay V. Vazirani, Approximation Algorithms, First edition, Springer, 2001.
3. JurajHromkovic, Design and Analysis of Randomized Algorithms, First edition, Springer, 2005.
4. David P. Williamson, David B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011.
5. Timothy J. Ross, Fuzzy logic with engineering applications, John Wiley and Sons,2010
6. S.RajasekaranandG.A.V.Pai,NeuralNetworks,FuzzyLogicandGenetic Algorithms, PHI,2003
7. Poli R., Langdon W.B., McPhee N.F.: A Field Guide to Genetic Programming,2008

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	1
CO2	1	2	2	1	2
CO3	2	3	3	2	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **II**		Course Category Code: **PAC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
IT259	**Mini Project and Seminar**	**-**	**-**	**4**	**2**	**40**	**60**	**100**
Prerequisite								
Course Outcome	Students able to work in groups and develop projects for real time problems.							

1. Preparing a project – brief proposal including
    - Problem Identification
    - Developing a model for solving the problem
    - A statement of system / process specifications proposed to be developed (Data Flow Diagram)
    - List of possible solutions including alternatives and constraints
    - Time line activities
2. A report highlighting the design finalization [based on functional requirements & standards]
3. A presentation including the following
    - Implementation phase (Hardware / Software / both)
    - Testing & Validation of the developed system
    - Learning in the project
4. Consolidated report preparation

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **III**		Course Category Code: **PAC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
IT260	**Dissertation-Phase I/ Industrial Project**	**-**	**-**	**20**	**10**	**150**	**150**	**300**
Prerequisite	Core subjects in Computer Science, Information Technology and IoT courses							
Course Outcome	Enable the students to carry out a detailed literature survey and design a research / Industrial project in the related domain							
To identify the solution to a problem, the students are to take up a literature survey, identify the problem space and to arrive at the solution for a specific problem with detailed standard specification.								

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **IV**		Course Category Code: **PAC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
IT261	**Dissertation-Phase II/ Industrial Project**	**-**	**-**	**32**	**16**	**200**	**200**	**400**
Prerequisite	IT260							
Course Outcome	Enable the students to design and implement research/ Industrial project in the related domain with skills of standard documentation, testing and reporting.							
To carry out detailed design and implementation of research/ industrial problem, identified during Phase I and submit the project report with standard documentation and complete testing for deployment.								

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

SYLLABUS
(Programme Specific Elective Subjects)

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **I**			Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ01	**WEB DATA MINING**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	**Basic Knowledge of Database & Data Warehouse**								
Course Outcomes	**CO1**	Build a sample search engine using available open source tools.							
	CO2	Identify the different components of a web page that can be used for mining.							
	CO3	Apply machine learning concepts in web content mining.							
	CO4	Design a system with wrapper generation to build Web Social Networks.							
	CO5	Analyze and build recommender system with web usage mining.							

UNIT I	**Introduction to Data mining**	**Periods** : **9**
Introduction –Getting to know data-Data Preprocessing-Basics of Data Warehousing and Online Analytical Process-Data Cube Technology-Mining frequent pattern, Association Rule Mining, Classification , Unsupervised Learning - Clustering - Hierarchical Clustering - Cluster Analysis – K-Means -Outlier detection- Data Mining trends and research Fortier.		**CO1**
UNIT II	**Introduction to Web Mining**	**Periods** : **9**
Introduction – Web Mining –Sequential Pattern Mining -Information retrieval and Web search – Information retrieval Models- Text and Web page Pre-processing – Inverted Index – Latent Semantic Indexing – Web Search – Meta-Search – Web Spamming.		**CO2**
UNIT III	**Web Content Mining and Web Link Mining**	**Periods** : **9**
Web Content Mining – Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines -Opinion Mining and Sentiment Analysis Web Link Mining – Hyperlink based Ranking – Introduction - Page Rank - Enhanced Techniques for Page Ranking - Web Crawling -A Basic Crawler Algorithm- Universal Crawlers- Focused Crawlers- Topical Crawlers - Crawler Ethics and Conflicts.		**CO3**
UNIT IV	**Structured Data Extraction**	**Periods** : **9**
Structured Data Extraction: Wrapper Generation –Wrapper Induction- Instance-Based Wrapper Learning ·- Automatic Wrapper Generation: - String Matching and Tree Matching - Introduction to Schema Matching - Schema-Level Match -Analyzing Web Social Networks.		**CO4**
UNIT V	**Web Usage Mining**	**Periods** : **9**
Web Usage Mining - Click stream Analysis -Web Server Log Files - Data Collection and Pre-Processing - Cleaning and Filtering- Data Modeling for Web Usage Mining-Discovery and Analysis of Web Usage Patterns – Modeling user interests –Applications-Recommender Systems – Web Recommender systems -PLSA and LDA Models.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Jiawei Han , MichelineKamber Jain Pei, " Data Mining: Concept and Techniques" Elsevier, Third Editions 2012
2. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; 2nd Edition 2011
3. GuandongXu, Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition.2012.
4. Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2007.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	3	2	2
CO3	2	3	3	3	2
CO4	2	3	3	3	2
CO5	2	3	3	3	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **I**		Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
ITZ02	**Wireless Access Technologies**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	Wireless Networks							

Course Outcome		
	CO1	To interpret basic terms and characteristics of Wireless LAN and PAN
	CO2	To understand Wireless Internet
	CO3	To analyzeAd-hoc Sensor Network
	CO4	To study about 3G Networks
	CO5	To study about 4G and 5G Networks

UNIT I	**Introduction to WIRELESS LAN and PAN**	**Periods** : **9**
Introduction: Necessity for wireless terminals connectivity and networking, Wireless networking advantages and disadvantages, Overview of wireless access technologies fundamentals of WLAN – technical issues, network architecture, IEEE 802.11- physical layer, Mac layer mechanism, CSMA/CA,RTS/CTS, Polling, Bluetooth-User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3.		**CO1**
UNIT II	**WIRELESS INTERNET**	**Periods** : **9**
Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless, TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility		**CO2**
UNIT III	**AD-HOC SENSOR NETWORK**	**Periods** : **9**
Wireless Sensor Network – Applications, design Challenges, Protocol stack, comparisons with MANET node architecture, network architecture, MAC protocols-requirements, IEEE 802.15.4 MAC protocol, Routing Protocol –energy aware routing, Location based routing, clustering, aggregation, QoS, security protocol, Zigbee standard.		**CO3**
UNIT IV	**3G NETWORKS**	**Periods** : **9**
Evolution from GSM, 3G Services and Applications - UMTS network structure - Core network - UMTS Radio access - HSPA – HSUPA- HSDPA- CDMA 1X - EVDO Rev -0, RevA, Rev-B, Rev-C Architecture- Protocol stack, Cognitive Radio network, Spectrum Sensing.		**CO4**
UNIT V	**4G – LTE and 5G Networks**	**Periods** : **9**
Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE :- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling- Introduction to 5G Networks – 5GPP and NGMN.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, LTE, LTE Advanced and Wimax towards IMT-advanced networks‖ John Wiley & Sons, 2012.
2. HarriHolma and AnttiToskala, —HSDPA/HSUPA for UMTS‖, John Wiley & Sons, 2006.
3. Holger Karl and Andreas Willing, —Protocols and Architecture for Wireless Sensor Network‖, John Wiley & Sons, 2007.
4. Jochen Schiller, —Mobile Communication‖, Pearson education, 2nd edition 2005.
5. JuhaKorhonen, —Introduction to 3G Mobile Communication‖, Artech House, 2003.
6. Larry J. Greenstein, Andrea J. Goldsmith, —Principles of Cognitive Radio‖, Cambridge University press, 2013.
7. Vijay. K. Garg, —Wireless Communication and Networking‖, Morgan Kaufmann Publishers, 2007

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	3
CO2	3	3	2	2	2
CO3	3	3	2	3	3
CO4	3	3	3	3	3
CO5	3	3	3	2	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **I**		Course Category Code: **PSE**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
ITZ03	**Mobile Application Development**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisites	Modern Operating Systems, Mobile Technologies							

Course Outcome		
	CO1	Describe the requirements for Mobile applications
	CO2	Design mobile applications with specific requirements
	CO3	Implement the design using Android SDK
	CO4	Implement the design using Objective C and iOS
	CO5	Develop mobile web Applications and Tools

UNIT I	**INTRODUCTION**	**Periods** : **9**
Introduction to mobile applications – History of mobile devices and mobile operating systems –Modern mobile operating systems and their architecture – Software distribution systems for mobile devices – Preparing programming tools for a mobile application developer – Publishing and delivery of mobile applications.		**CO1**
UNIT II	**ADVANCED DESIGN**	**Periods** : **9**
Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.		**CO2**
UNIT III	**TECHNOLOGY I – ANDROID**	**Periods** : **9**
Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.		**CO3**
UNIT IV	**TECHNOLOGY II – IOS**	**Periods** : **9**
Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.		**CO4**
UNIT V	**DEVELOPING MOBILE WEB APPLICATIONS**	**Periods** : **9**
Mobile Web App Development Tools – JavaScript Mobile Web App Framework – Responsive Frameworks – Debugging and Testing Mobile Web Apps – Mobile App Development Tools – Game Engines – Corona – Case Studies: Buddy, HeadSpin, App Watch, Appcelerator, PhoneGap, Sencha.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
2. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013.
4. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.
5. Beginning Windows Phone 7 Development - Henry Lee, Eugene Chuvyrov – Apress 2010.
6. Mobile Computing: Technology, Applications, and Service Creation – Asoke K. Talukder, Roopa R. Yavagal - McGraw-Hill Communications Engineering 2007.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	3	2	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **I**			Course Category Code: **PSE**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ04	**Machine Learning**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite									
Course Outcome	**CO1**	Understand the basic concepts, leaning design and classification of machine learning techniques.							
	CO2	Understand the key concepts, tools and approaches for classification and regression supervised models.							
	CO3	Understand the key concepts, tools and approaches for clustering and auto encoder unsupervised models.							
	CO4	Understand the basics, structure and approaches for multilayer neural networks.							
	CO5	Understand the basic concepts of Reinforcement learning and real-time applications of machine learning.							

UNIT I	**Introduction to Machine Learning**	**Periods** : **9**
Introduction – Types of learning – Supervised Learning – Unsupervised Learning – Reinforcement Learning – Learning Bias, Learning performance – Designing a Learning System – Data – Feature Selection – Model Selection – Learning – Evaluation – Density Estimation.		**CO1**
UNIT II	**Supervised Learning**	**Periods** : **9**
Regression – Linear Regression – Non-linear Regression - Gradient-descent – Logistic Regression – Decision Trees - Classification – k-Nearest Neighbors (KNN) – Support Vector Machines (SVMs) – Decision Trees: building trees – splitting nodes – controlling overfitting - Naïve Bayes - Discriminant Analysis - ensembles: voting – bagging – random forests – extra trees – boosting – Adaboost.		**CO2**
UNIT III	**Unsupervised Learning**	**Periods** : **9**
Clustering – Similarity / Dissimilarity analysis - K-means – Hierarchical - Noise Reduction - Dimensionality Reduction – Principal Component Analysis – Gaussian Mixture - Hidden Markov Models - **Autoencoders:** introduction – the simplest autoencoder – convolutional autoencoders – denoising - variational autoencoders.		**CO3**
UNIT IV	**Feed-Forward Networks**	**Periods** : **9**
Neural Network Graphs – weight initialization; activation functions: linear – stair-step – piecewise-linear – smooth functions; Back propagation - a tiny neural network – the learning rate; Optimizers: error as geometry – adjusting the learning rate – updating strategies - gradient descent variations.		**CO4**
UNIT V	**Introduction to Reinforcement Learning**	**Periods** : **9**
immediate rewards – delayed rewards – Exploration – Exploitation – Markov Decision Process – Model based / free learning – Q learning; **Applications:** Medical Imaging – Speech Recognition – Credit Scoring – Electricity load forecasting – Algorithmic trading – Gene sequence analysis – Market Research – Object Recognition – Gambling.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Andrew Glassner, Deep Learning: From Basics to Practice, Volumes 1, The Imaginary Institute, Seattle,WA, 2018.
2. Judith Hurwitz and Daniel Kirsch, Machine Learning, IBM Ltd. Edn., 2018.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, 2nd Edn., Springer, 2008.

4. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2004.
6. Richard Dudda, Peter Hart and David Stork, Pattern Classification, 2nd Edn., John Wiley and Sons, 2001.
7. Richard Sutton and Andrew Barto, Reinforcement Learning: An Introduction, MIT Press, 1998.
8. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	3	3
CO5	1	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M.Tech. (IoT)**						
Semester: **I**			Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ05	**Internet of Things and Python Programming**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	Embedded systems and basic knowledge of programming								
Course Outcome	**CO1**	To introduce the terminology, technology and its applications							
	CO2	To introduce the Python Scripting Language which is used in many IoT devices							
	CO3	To learn advanced concepts in Python programming							
	CO4	To introduce the Raspberry PI platform, that is widely used in IoT applications							
	CO5	To introduce the implementation of web based services on IoT devices							

UNIT I	**Introduction to Internet of Things**	**Periods** : **9**
Definition & Characteristics of IoT, Physical Design of IoT Logical Design of IoT, IoT Enabling Technologies, IoT Levels & Deployment Templates Domain Specific IoTs: Home, Cities, Environment, Energy systems, Logistics, Agriculture, Health & Lifestyle		**CO1**
UNIT II	**Introduction to Python programming**	**Periods** : **9**
Logical Design using Python ,Installing Python , Python Data Types & Data Structures ,Control Flow , Functions, Modules, Packages		**CO2**
UNIT III	**Advanced concepts in Python programming**	**Periods** : **9**
File Handling , Date/Time Operations , Classes , Exception handling Python packages - Interfaces (serial, SPI, I2C) Programming		**CO3**
UNIT IV	**IoT interfacing: Case study-Interfacing with Raspberry PI**	**Periods** : **9**
Introduction to Raspberry PI-– Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.		**CO4**
UNIT V	**IoT Physical Servers & Cloud Offerings**	**Periods** : **9**
Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Internet of Things, A.Bahgya and V.Madisetti, Univesity Press, 2015
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014
3. Programming and Problem Solving with Python, Ashok NamdevKamthane and Amit Ashok Kamthane, McGraw Hill,2017.

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	1	1
CO2	3	3	2	2	1
CO3	2	3	2	3	3
CO4	3	3	2	3	3
CO5	2	3	3	2	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M.Tech. (IoT)**						
Semester: **I**			Course Category Code: **PSE**				Semester Exam Type:**TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ06	**Logic and Functional Programming**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	Computer Programming, Mathematical Logic								
Course Outcome	**CO1**	To further the state of the art on the theoretical and practical aspects of developing declarative programming tools in logic programming for IOT data analysis .							
	CO2	To introduce basics of functional programming and constraint logic programming for nodes in IOT.							
	CO3	Introduction into formal concepts used as a theoretical basis for both paradigms, basic knowledge and practical experience.							
	CO4	The ability to write functional and logic programs for nodes in IOT.							
	CO5	The ability to solve problems in and using functional and logic programming							

UNIT I	**Proposition Logic**	**Periods** : **9**
Introduction of logic and Functional Paradigm, Propositional Concepts, Semantic Table , Problem Solving with Semantic Table.		**CO1**
UNIT II	**Natural Deduction and Axiomatic Propositional Logic**	**Periods** : **9**
Rules of Natural Deduction, Sequent Calculus, Axiomatic Systems, Meta theorems, Important Properties of AL, Resolution, Resolving Arguments		**CO2**
UNIT III	**Introduction to Predicate Logic**	**Periods** : **9**
Objects, Predicates and Quantifiers, Functions, First Order Language, Quantifiers, Scope and Binding, Substitution, An Axiomatic System for First Order Predicate Logic, Soundness and Completeness, Axiomatic Semantic and Programming		**CO3**
UNIT IV	**Semantic Tableaux & Resolution in Predicate Logic**	**Periods** : **9**
Semantic Tableaux, Instantiation Rules, Problem-solving in Predicate Logic, Normal forms, Herbrand Universes and H-interpretation, Resolution, Unification, Resolution as a computing Tool, Nondeterministic Programming, Incomplete Data Structure, Second Order Programming in Prolog, Logic Grammars: Definite Clause Grammar, A Grammar Interpreter.		**CO4**
UNIT V	**Lazy and Eager Evaluation strategies**	**Periods** : **9**
Evaluation Strategies, Lazy Evaluation: Evaluation Order and strictness of function, Programming with lazy evaluation, Interactive functional program, Delay of unnecessary Computation, Infinite Data Structure, Eager Evaluation and Reasoning		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. John Paul Mueller, "Functional Programming For Dummies", First Edition, JohnWiley and Sons, 2019
2. Bramer, Max, "Logic Programming with Prolog", Springer 2013.
3. Simon Thompson, Haskell, " The craft of functional programming",3rd edition, Pearson Addison Wesley 2011.
4. SarojKaushik, "Logic and Prolog Programming", New Age International ltd,2007
5. John Kelly, "The Essence of Logic", Prentice-Hall India, 1997

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	2	2
CO2	3	2	2	2	2
CO3	3	3	2	3	3
CO4	3	3	3	2	3
CO5	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M. Tech. (IoT)**						
Semester: **II**		Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
ITZ07	**Advanced Machine Learning**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	ITZ04							

Course Outcome		
	CO1	Understand the basic concepts, leaning design and detailed structure of deep learning techniques.
	CO2	Understand the structure and key functional modules of convolutional neural networks.
	CO3	Understand the structure and key functional modules of recurrent neural networks.
	CO4	Understand the depth knowledge on reinforcement learning and generative adversarial networks in deep learning.
	CO5	Methods of applying various deep learning techniques in various real-time applications.

UNIT I	**Introduction to Deep Learning**	**Periods** : **9**
Overview: tensors – input layer – output layer – deep learning layer survey: fully-connected layer – activation functions – dropout – batch normalization – convolution – pooling layers – recurrent layers – utility layers – layer and symbol summary - building a deep learner.		**CO1**
UNIT II	**Convolutional Neural Networks (CNN)**	**Periods** : **9**
introduction – depth – sum of scaled values – weighted sharing – local receptive field – kernel; convolution – filters – hierarchies of filters – padding – stride; high-dimensional convolution – filters with multiple channels – striding for hierarchies – 1D convolution – 1x1 convolution - convolution layer – transposed convolution.		**CO2**
UNIT III	**Recurrent Neural Networks (RNN)**	**Periods** : **9**
introduction – state - structure of an RNN Cell – organizing inputs – training an RNN – Long Short-Term Memory – RNN structures – Deep RNN – Bidirectional RNN – Deep Bidirectional RNN.		**CO3**
UNIT IV	**Reinforcement Learning (RL**)	**Periods** : **9**
structure of RL – flippers – Lousy learning – Quality learning – SARSA – applications; **Generative Adversarial Networks (GAN):** Metaphor – Implementing GANs – Deep Convolutional GANs.		**CO4**
UNIT V		**Periods** : **9**
Applications: Speech recognition - Visual object recognition – Face detection – Pedestrian detection – Drug detection – Deep genomics – Google understanding - Google neural machine translation – Speech synthesis – Game playing.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Andrew Glassner, Deep Learning: From Basics to Practice, Volumes 2, The Imaginary Institute, Seattle,WA, 2018.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, MIT Press, 2017.
3. John D. Kelleher, Brian Mac Namee and Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics, MIT Press, 2015.
4. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning, Springer, 2013.

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	2
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	2	3	2	3
CO5	1	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: I			Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
ITZ08	**Software Defined Networks**		L	T	P		CA	SE	TM
			3	-	-	**3**	**40**	**60**	**100**
Prerequisite	PG level course in Data Communication Networks								
Course Outcome	**CO1**	Understand the key benefits of SDN by the separation of data and control planes							
	CO2	Interpret the SDN data plane devices and Open flow Protocols							
	CO3	Operation of SDN Control plane with different controllers							
	CO4	Understand the techniques that enable applications to control the underlying network using SDN							
	CO5	Network Functions Virtualization and components and their roles in SDN							
UNIT I	**SDN BACKGROUND AND MOTIVATION**								**Period**
Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.									**CO1**
UNIT II	**SDN DATA PLANE AND OPENFLOW**								**Period**
SDN data plane: Data plane Functions, Data plane protocols, Openflow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- Open flow Protocol.									**CO2**
UNIT III	**SDN CONTROL PLANE**								**Period**
SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers.									**CO3**
UNIT IV	**SDN APPLICATION PLANE**								**Period**
SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface-Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring- Security- Data Center Networking- Mobility and Wireless.									**CO4**
UNIT V	**NETWORK FUNCTIONS VIRTUALIZATION**								**Period**
Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration.									**CO5**
Lecture Periods: 45	**Tutorial Periods: -**		**Practical Periods: -**						**Total**

Reference Books

1. William Stallings, "Foundations of Modern Networking", Pearson Ltd.,2016.
2. Paul Goransson and Chuck Black , "Software Defined Networks: A Comprehensive Approach",Morgan Kaufmann Publications, 2014
3. Thomas D. Nadeau & Ken Gray , SDN - Software Defined Networks , O'Reilly, 2013

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	1	-	-	-	-
CO2	1	-	-	-	-
CO3	1	2	2	1	-
CO4	1	2	-	-	-
CO5	1	2	2	2	-

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M.Tech. (IoT)**						
Semester: **II**			Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ09	**RFID AND MICROCONTROLLERS**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite									
Course Outcome	**CO1**	Understands the basics of RFID							
	CO2	Understands the basics of 8051							
	CO3	Able to Interface RFID with microcontrollers							
	CO4	Able to develop real time applications based on microcontrollers							
	CO5	Able to analyze different case studies							

UNIT I	**BAR CODES AND RFID**	**Periods** : **9**
Bar codes and RFID basics- Components of an RFID system-Data -Tags-Antennas-Connectors- Cables-Readers- encoder/ printers for smart labels- Controllers software- RFID advantages over Bar codes.		**CO1**
UNIT II	**MICROCONTROLLERS**	**Periods** : **9**
Intel 8051 - architecture- memory organization- special function registers- timing and control- port operation- memory interfacing - I/O interfacing- Programming the 8051 resources- interrupts- Measurement of frequency, period and pulse width of a signal power down operation.		**CO2**
UNIT III	**INTEL 8051 MICROCONTROLLER- INSTRUCTION SET AND PROGRAMMING**	**Periods** : **9**
Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions.- 8051 Interfacing and applications		**CO3**
UNIT IV	**RFID APPLICATIONS**	**Periods** : **9**
Short range RFID applications- access control - personal identification - Transportation ticketing- blood, tissue and organ identification- fleet management personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping- Clothing Tags.		**CO4**
UNIT V	**CASE STUDIES**	**Periods** : **9**
Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment- smart shipping containers fleet monitoring and management.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Dennis E. Brown , " RFID implementation" Tata McGraw - Hill, 2007
2. Steven Shepard, "RFID: Radio frequency and Identification", Tata McGraw – Hill, 2010
3. GhoshalSubrata," 8051 Microcontrollers - Internals, Instructions, Programming and Interfacing "Pearson Education India; 2 edition,2014

CO – PO Mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	2	1
CO2	3	3	2	2	1
CO3	2	3	3	3	1
CO4	2	3	3	3	3
CO5	2	3	3	2	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **II**			Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ10	**Big Data Analytics**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite									
Course Outcomes	**CO1**	Categorize and Summarize Big Data with its importance.							
	CO2	To store, integrate and Map for predictive Analytics and crowd sourcing.							
	CO3	Apply Hadoop Map reduce technique as HDFS.							
	CO4	Design and Implementation of real time Big Data Analytics System with research perspective.							
	CO5	Analyse and Apply latest Big Datatools and techniques for appropriate Applications.							

UNIT I	**Introduction to Big Data Analytics**	**Periods** : **9**
Big Data and its Importance – Four V's of Big Data – Drivers for Big Data –Introduction to Big Data Analytics– Big Data Analytics Applications-Hadoop's Parallel World – Data discovery Open Source Technology for Big Data Analytics –Predictive Analytics – Crowd Sourcing Analytics.		**CO1**
UNIT II	**Processing Big Data**	**Periods** : **9**
Integrating Disparate Data Stores - Mapping Data to Programming Framework- Connecting and Extracting Data From Storage - Transforming Data for Processing - Subdividing Data in Preparation for Hadoop Map Reduce.		**CO2**
UNIT III	**Hadoop Map Reduce**	**Periods** : **9**
Employing Hadoop Map Reduce - Creating Components Of Hadoop Map Reduce Jobs - Distributing Data Processing Across Server Farms –Executing Hadoop Map Reduce Jobs - Monitoring Progress of Job Flows - The Building Blocks Of Hadoop Map Reduce - Distinguishing Hadoop Daemons - Investigating Hadoop Distributed File System.		**CO3**
UNIT IV	**Advanced Analytics Platform**	**Periods** : **9**
Real-Time Architecture – Orchestration and Synthesis Using Analytics Engines– Discovery using Data at Rest – Implementation of Big Data Analytics – Big Data Convergence – Analytics Business Maturity Model.		**CO4**
UNIT V	**Big Data Tools And Techniques**	**Periods** : **9**
Installing and Running Pig – Comparison with Databases – Pig Latin – User Defined Functions – Data Processing Operators – Installing and Running Hive– Hive QL – Tables – Querying Data – User-Defined Functions – Oracle Big Data.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Michael Minelli, Michehe Chambers, Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, 1st Edition, AmbigaDhiraj, Wiely CIO Series, 2013.
2. ArvindSathi, Big Data Analytics: Disruptive Technologies for Changing the Game, 1st Edition, IBM Corporation, 2012.
3. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, 1st Edition, Wiley and SAS Business Series, 2012.
4. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'reilly, 2012.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	2	2
CO2	2	3	3	2	2
CO3	2	3	3	2	2
CO4	2	3	3	2	2
CO5	2	3	3	2	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M.Tech. (IoT)**						
Semester: **II**			Course Category Code: **PSE**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ11	**IoT Security**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisites	Information Security, Internet-of-Things								
Course Outcome	**CO1**	Describe the Authentication requirements for IoT Security							
	CO2	Design IoT Network for communication authentication							
	CO3	Implement the IoT User level authentication							
	CO4	Implement the IoT Device level authentication							
	CO5	Develop IoT Security Applications							

UNIT I	**INTRODUCTION**	**Periods : 9**
Introduction to IoT Security – Attacks and Countermeasures – Authentication and Authorization – Authentication at IoT Layers – Privacy – Risk Mitigation – Blockchain – 5G – Fog and Edge Computing – Quantum Security – AI and Predictive Data Analytics – Network Slicing.		**CO1**
UNIT II	**IoT NETWORK AND COMMUNICATION AUTHENTICATION**	**Periods : 9**
Symmetric Key-Based Authentication with an Application to Wireless Sensor Networks: Design Goals – Attack Model. Authentication – Authentication by CN – Authenticated Broadcast by the CH – Authenticated Broadcast by the BS. Security Analysis – Impersonation Attack – Replay Attacks. Lattice-Based Cryptography: Digital Signatures without Trapdoors – Homomorphic Encryption – Lattice-Based Cryptography for IoT.		**CO2**
UNIT III	**IoT USER LEVEL AUTHENTICATION**	**Periods : 9**
Biometric-Based Robust Access Control Model: Network Model – Threat Model and Security Requirements – Access Control Model in IIoT – Authentication and Key Establishment – Security and Performance Evaluations – Informal Security Analysis – Performance Analysis. Gadget Free Authentication: Registration – Installation – Request – Answer – Update. Security Analysis for Accountability – Replay Attacks – Insider Attacks – HW/SW Attacks and Identity Privacy.		**CO3**
UNIT IV	**IoT DEVICE LEVEL AUTHENTICATION**	**Periods : 9**
PUF-Based Authentication and Key Exchange: Key Agreement from IoT Device to Server – Key Agreement between Two IoT Devices – System Architecture, Attack Model – Cryptographic Operations – Proposed Authentication System: Registration – Security Association – Authentication and Key Agreement – Security Evaluation – Performance Analysis.		**CO4**
UNIT V	**IoT SECURITY APPLICATIONS**	**Periods : 9**
Healthcare – Remote Patient Monitoring Architecture – Security Related to eHealth – IoT Authentication – Remote Patient Monitoring Security – Mobile Application Security – Communication Security – Data Integrity – Cloud Security – Audit Logs. Case study: Blockchain-Based CPTS.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. MadhusankaLiyanage, An Braeken, Pardeep Kumar, Mika Ylianttila, IoT Security: Advances in Authentication, Wiley Publishers, 2020..
2. David Etter, IoT Security: Practical guide book (Kindle Edition).
3. Brian Russell, Drew Van Duren, Practical Internet of Things Security (Kindle Edition).
4. Securing the Internet of Things, Elsevier.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	3
CO2	3	3	2	2	2
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **II**			Course Category Code: **PSE**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ12	**Computational Models of Social Mining**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite									
Course Outcome	**CO1**	Understand a broad range of social network concepts and theories.							
	CO2	Examine the ways in which networks can contribute towards interactions in communities							
	CO3	Perform effective link analysis							
	CO4	Comprehend the various aspects of Social Mining Applications							
	CO5	Analyze and present results social media platforms like Twitter							

UNIT I	**ESSENTIALS**	**Periods** : **9**
Graph Basics -Graph Representation-Types of Graphs - Connectivity in Graphs - Special Graphs- Network Measures- Centrality- Transitivity and Reciprocity - Balance and Status - Similarity - Network Models- Properties of Real-World Networks - Random Graphs – Small World Model - Preferential Attachment Model		**CO1**
UNIT II	**COMMUNITIES AND INTERACTIONS**	**Periods** : **9**
Community Analysis-Community Detection-Community Evolution-Community Evaluation- Information Diffusion in Social Media - Herd Behavior - Information Cascades - Diffusion of Innovations - Epidemics		**CO2**
UNIT III	**INFORMATION NETWORKS AND THE WORLD WIDE WEB**	**Periods** : **9**
Structure of Web - World Wide Web - Information Networks, Hypertext, and Associative Memory - Web as a Directed Graph -Bow-Tie Structure of the Web - Emergence of Web - Link Analysis and Web Search - Searching the Web: Problem of Ranking-Link Analysis using Hubs and Authorities - PageRank -		**CO3**
UNIT IV	**APPLICATIONS**	**Periods** : **9**
Influence and Homophily - Measuring Assortativity - Influence – Homophily- Distinguishing Influence and Homophily- Recommendation in Social Media - Challenges – Classical Recommendation Algorithms - Recommendation Using Social Context - Evaluating Recommendations - Behavior Analytics - Individual Behavior - Collective Behavior		**CO4**
UNIT V	**CASE STUDY**	**Periods** : **9**
Mining Twitter: Exploring Trending Topics, Discovering What People Are Talking About, and More - Why Is Twitter All the Rage?- Exploring Twitter's API - Analyzing the 140 (or More) Characters - Mining Facebook: Analyzing Fan Pages, Examining Friendships		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Abbasi, Mohammad Ali, Zafarani, Reza, Social Media Mining: An Introduction, Cambridge University Press,2014
2. Matthew A. Russell, Mikhail Klassen , Mining the Social Web, 3rd Edition, O'Reilly Media Publisher,2019
3. David Easley , Jon Kleinberg , Networks, Crowds, and Markets: Reasoning about a Highly Connected World , Cambridge University Press, 2010

Stanley Wasserman and Katherine Faust, Social Network Analysis – Methods and Applications, Cambridge University Press, 1994.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	1	-	-	-	-
CO2	1	-	1	-	-
CO3	1	2	2	-	-
CO4	1	-	-	2	-
CO5	1	2	2	2	3

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**			Programme: **M. Tech. (IoT)**						
Semester: **III**			Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ13	**Cloud Architecture and Computing**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite									
Course Outcomes	**CO1**	Define and describe various concepts of Cloud Computing with its benefits and challenges.							
	CO2	Identify specialised Cloud Computing Architecture for appropriate real time application.							
	CO3	To analyse the best performance long term costs efficient cloud services.							
	CO4	To understand the difference between traditional Deployment and cloud computing.							
	CO5	Apply real-time services for Cloud utility.							

UNIT I	**Cloud computing fundamentals**	**Periods** : **9**
Cloud Computing definition, private, public and hybrid cloud. Cloud types Basic definition: IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture, next generation Cloud Applications.		**CO1**
UNIT II	**Specialised Cloud Architecture**	**Periods** : **9**
Client – Server Computing, Peer-to-Peer Computing, Distributed Computing, Collaborative Computing, Cloud Architecture, Cloud Storage, Cloud Services, Workload distributed Architecture, Dynamic Scalability, cloud bursting.		**CO2**
UNIT III	**Cloud Services and Applications**	**Periods : 9**
Exploring the Cloud Computing Stack, Connecting to the Cloud, Infrastructure as a Service, Platform as a Service Exploration, Saas Vs. Paas, Using PaaS Application Frameworks, Software as a Service, Identity as a Service, Compliance as a Service		**CO3**
UNIT IV	**Could Development and Deployment**	**Periods : 9**
Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO).		**CO4**
UNIT V	**Case-Studies**	**Periods : 9**
Development environments for service development: Amazon, Azure, Google App. Using Google Web Services, Using Amazon Web Services, Using Microsoft Cloud Services. Case-Studies: Latest deployments Tools for Real-Time Could applications.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing : Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Sosinsky B., "Cloud Computing Bible", First Edition, Wiley Edition, 2011.
3. Anthony J. Velte, Toby j.Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; Copyright © 2010 ISBN: 978-0-07-162695-8 MHID: 0-07-162695-6.
4. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).
5. Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.
6. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539],2010
7. Thomas Erl, ZaighamMahmood, and Ricardo Puttini, Cloud Computing Concepts, Technology & Architecture, PRENTICE HALL,2013

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	2
CO2	3	3	3	3	2
CO3	3	3	3	3	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2

Score: **3** – High; **2** – Medium; **1** – Low

Department: INFORMATION TEHNOLOGY			Programme: **M.Tech.(IoT)**						
Semester: III			Course Category Code:				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P		CA	SE	TM
ITZ14	**Smart Sensors for Internet of Things**		3	-	-	3	40	60	100
Prerequisite	Wireless Networks								
Course Outcome	**CO1**	1. Understand the importance of sensors in IoT 2. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints. 3. Understand different sensor architectures 4. Develop different types of applications by using sensors							
	CO2	Able to understand the different types of sensors for real time applications							
	CO3	Able to understand the important Characteristics of Sensors							
	CO4	Able to understand the architecture of smart sensors							
	CO5	Able to understand the challenges for Interfacing the Smart Sensor							

UNIT I	**Periods** : **9**	
Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IoT		**CO1**
UNIT II	**Periods** : **9**	
Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications, Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.		**CO2**
UNIT III	**Periods** : **9**	
Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors		**CO3**
UNIT IV	**Periods** : **9**	
Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapour, Anodization, Sol-gel		**CO4**
Unit 5		
Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor and Future scope of research in smart sensor		

Lecture Periods: 45	**2. Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing, ISBN 978-3-319-55345-0, 2017

2.Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, ISBN 978-3-319-14711-6

Springer International Publishing, 2015

3.Gerard Meijer, MichielPertijs, Kofi Makinwa, " Smart Sensor Systems: Emerging Technologies and Applications" ISBN:9780470686003 John Wiley & Sons, Ltd, 2014

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	1
CO2	3	2	2	2	1
CO3	1	1	1	1	1
CO4	2	1	1	2	1
CO5	2	2	1	2	1

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Information Technology**		Programme: **M.Tech. (IoT)**						
Semester: **III**		Course Category Code: **PSE**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P		CA	SE	TM
ITZ15	**Real-time Systems Design**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite								

Course Outcome	**CO1**	Understand the basic concepts, and classification of real-time systems
	CO2	Understand and apply the software requirements engineering for real-time system design
	CO3	Understand the key concepts and approaches for Inter-task communication and memory management of real-time system
	CO4	Understands the need for real-time databases and its design concepts
	CO5	Understand need for real-time communication and able to design real-time communication protocols

UNIT I	**REAL TIME SPECIFICATION AND DESIGN TECHNIQUES**	**Periods** : **9**
Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uni processor scheduling algorithms –Fault Tolerant Scheduling.		**CO1**
UNIT II	**SOFTWARE REQUIREMENTS ENGINEERING**	**Periods** : **9**
Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design – organizing the requirements document – organizing and writing documents – requirements validation and revision.		**CO2**
UNIT III	**INTERTASK COMMUNICATION AND MEMORY MANAGEMENT**	**Periods** : **9**
Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion –Protocols to solve priority inversion problem – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.		**CO3**
UNIT IV	**REAL-TIME DATABASES**	**Periods** : **9**
Applications – Design issues – Characteristics of Temporal Data – Concurrency control Issues – Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems - Commercial Real-time Databases		**CO4**
UNIT V	**REAL-TIME COMMUNICATION**	**Periods** : **9**
Examples of Real-time Communication in Applications – Soft and Hard Real-time Communication in LAN – Bounded Access Protocol –Real-time Communication over Internet – Routing and Multicasting - Real-Time Communications over Packet Switched Networks – QoS Models		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Rajib Mall, Real Time Systems: Theory and Practice, Pearson Education India, 2009
2. C.M. Krishna, Kang G. Shin, Real Time Systems, McGraw Hill International Editions, 2010
3. Stuart Bennett, Real Time Computer Control – An Introduction, PHI, 1998
4. Peter D. Lawrence, Real time Micro Computer System Design – An Introduction, McGraw Hill, 1987
5. S.T. Allworth and R.N. Zobel, Introduction to real time software design, Macmillan, 1987
6. R.J.A Buhur, D.L. Bailey, An Introduction to Real Time Systems, PHI, 2001
7. Philip. A. Laplante, Real Time System Design and Analysis, PHI, 2013

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	3	3	2	2
CO3	2	3	3	3	3
CO4	2	3	2	2	2
CO5	3	2	2	2	2

Score: **3** – High; **2** – Medium; **1** – Low