KUMARAGURU COLLEGE OF TECHNOLOGY

(Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM

(REGULATIONS 2018)

Version-1

Applicable to 2018-19 admitted students

I to IV Semester

M.E (Computer Science and Engineering)

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Department of Computer Science and Engineering

Vision

To evolve as a centre of excellence with international reputation in the computer science and engineering field to serve the changing needs of industry and society.

Mission

- Computer Science and Engineering department is committed to bring out career oriented graduates who are industry ready by adopting best practices of teaching-learning process.
- To cultivate professional approach, strong ethical values and team spirit along with leadership qualities.
- To contribute towards techno-economic and social development of the Nation

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POs for ME CSE

PO1: An ability to independently carry out research /investigation and development work to solve practical problems

PO2: An ability to write and present a substantial technical report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: Learn concepts/technologies independently and practice in life-long learning

PEOs

After successful completion of the program, graduates of M.E.CSE will:

1. Demonstrate and excel in industry, academia, research and in their own enterprise
2. Pursue life-long learning and upgrade their knowledge on the latest technological developments
3. Exhibit professionalism, ethics, maintain team spirit and communicate effectively in their profession

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CURRICULUM FULL TIME SEMESTER WISE

Semester I							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P18MAT1107	Mathematics for Data Science	Theory	3	1	0	0	4
P18CST1001	Advanced Data Structures	Theory	3	0	0	0	3
P18CSI1202	IOT Architecture and Programming	Embedded	3	0	2	0	4
P18CSI1203	Data Science and Analytics	Embedded	3	0	2	0	4
P18CST1004	Research Methodology	Theory	3	0	0	0	3
						Total Credits	**18**
						Total Hours per week	**20**
SEMESTER-II							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P18CSI2201	Cloud Services and Virtualization	Embedded	3	0	2	0	4
P18CSI2202	Agile Software Development and Usability Engineering	Embedded	3	0	2	0	4
P18CSI2203	Web Programming	Embedded	3	0	2	0	4
P18CSE---*	Program Elective I	Theory	3	0	0	0	3
						Total Credits	**15**
						Total Hours per week	**18**
SEMESTER-III							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P18CSE---*	Program Elective II	Theory	3	0	0	0	3
P18CSP3701	Project Phase I / Industry Project	Project	0	0	0	30	15
						Total Credits	**18**
						Total Hours per week	**33**
SEMESTER-IV							
Course Code	**Course Title**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
P18CSP4701	Project Phase II/Industry Project	Project	0	0	0	30	15
						Total Credits	**15**
						Total Hours per week	**30**
						Total Number of Credits=66	

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List of Program Electives							
Code No.	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
P18CSE0001	Machine learning techniques	Theory	3	0	0	0	3
P18CSE0002	Security for Internet of Things.	Theory	3	0	0	0	3
P18CSE0003	SDN and NFV for IoT	Theory	3	0	0	0	3
P18CSE0004	Blockchain Technology	Theory	3	0	0	0	3
P18INT0002	Product Design and Development	Theory	3	0	0	0	3

Details	**Credits to be earned**
List of Core Course	30
Project work	30
List of Elective Courses	6
Total No of Credits	**66**

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SYLLABUS

P18MAT1107 **MATHEMATICS FOR DATA SCIENCE**
(Common to M.E.(CSE)and M.Tech.(Data Science))

L	T	P	PJ	C
3	1	0	0	4

COURSE OUTCOME
On the successful completion of the course, the students would be able to

CO1: Check linear dependency of vectors and identify eigen values, eigen vectors and derivative of a matrix, which will form the basis for Principal Component Analysis.
CO2: Apply the concept of probability and random variables, which will help in learning Bayesian classifiers.
CO3: Apply the concepts of two-dimensional random variables, central limit theorem and multivariate normal distribution, which lay the foundation for Machine Learning.
CO4: Fit curves to given data, analyze the correlation and regression and find the maximum likelihood estimate.
CO5: Learn and apply multivariate analysis necessary for Principal Component Analysis.
CO6: Determine the extreme values of functions without constraint, and with equality constraints.

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	S		S	M
CO2			M	M
CO3	S			M
CO4	S			M
CO5	S		S	M
CO6	M		M	

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-term test 2. Lab Assignment, Lab assessment, Open book test, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS

Matrices **5 + 2hours**

Linearly dependent and independent vectors - Eigenvalues and eigenvectors - Inner product and outer product of vectors - Derivative of a matrix - Jacobian matrix – Area differential.

Probability and Random Variables **9 + 3 hours**

Axioms of probability - Conditional probability – Statistical independence - Law of total probability – Baye's theorem - Random variable – Discrete and Continuous random variables - Probability mass function – Probability density function – Expected value of a random variable –Moments.

Two Dimensional Random Variables **11 + 3 hours**

Pairs of random variables - Marginal and conditional distributions – Expected values of functions of two variables– Central limit theorem - Normal distribution – properties - Fitting of Normal distribution - Bivariate Normal distribution - Multivariate Normal distribution

Regression Analysis and Estimation **10 + 3 hours**

Curve fitting by method of least squares - Correlation – Properties of correlation coefficient – Linear regression – Least square estimation of regression coefficients – Regression lines – Maximum Likelihood Estimation

Multivariate Analysis **5 + 2 hours**

Random vector – Mean Vector – Correlation Matrix - Covariance Matrix – Principal Components – Population Principal Components - Principal Components from standardized variables

Classical Optimization Theory **5 + 2 hours**

Unconstrained extremal problems – Equality constraints – Lagrange's method

REFERENCES

1. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007
2. Gupta S.C. & Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2007.
3. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Duxbury Press; 6 edition, 2003.
4. Veerarajan. T., "Probability, Statistics and Random Process", Tata McGraw Hill,2003
5. Richard A. Johnson and Dean W. Wichern, ―Applied Multivariate Statistical Analysis‖, 5th Edition, Pearson Education, Asia, 2012.
6. Anderson, T. W, An Introduction to Multivariate Statistical Analysis, John Wiley and Sons, 2003
7. Sharma J. K., "Operations Research", Macmillan India Ltd, Delhi, 2nd Edition, 2003

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WEBSITES

1. https://www.coursera.org/specializations/mathematics-machine-learning
2. www.coursera.org/learn/datasciencemathskills
3. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture31.pdf

LAB ASSIGNMENTS (Self-study)

1. Assignments will be given to the students on the following topics and their knowledge will be assessed through a lab practical test (which will be included in the internal assessment.
2. Determine determinants, inverse of a matrix, eigenvalues and eigenvectors using MATLAB
3. Graphical Representation (Simple Bar graphs and Pie charts) in R
4. Finding Mean, Median, Mode and SD using R.
5. Curve fitting, finding Correlation and Regression lines using R
6. Solving problems involving Normal distribution using R

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

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P18CST1001 **ADVANCED DATA STRUCTURES**

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students should be able to

CO1: Apply suitable data structure for the given problem(K3)

CO2: Analyze and predict suitable data structure for same problem. (K4)

CO3: Give reason for chosen algorithm performs better for given application. (K5)

CO4: Justify how the chosen data structures, algorithm is appropriate for a given problem. (K5)

PRE-REQUISITES: NIL

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1	M			
CO2	S			
CO3	S	S		M
CO4	S	S	M	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1(Theory component) 2. Assignments / Quiz/ Mini Project 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

ADVANCED DATA STRUCTURES **9 Hours**

Heaps: Binary heaps, Min-Max heap, Deaps, Leftist Trees, Skew heap

ADVANCED DATA STRUCTURES – II **9 Hours**

Trees: 2-3 Trees, Red Black Trees, Splay Trees

Text Processing: String Operations, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Tries.

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COMPUTATIONAL GEOMETRY **9 Hours**

One Dimensional Range Searching, Two-Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, k-D Trees.

GREEDY AND FLOW NETWORK **9 Hours**

Greedy: Introduction to greedy paradigm, An activity selection problem

Flow-Networks: Ford-Fulkerson method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

CASE STUDIES **9 Hours**

Case studies - Analyze real time data structures

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Ellis Horowitz, SartajSahni and Dinesh Mehta, Fundamentals of Data Structures in C++, Second Edition, Universities Press, Hyderabad, 2008.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India, New Delhi, 2009
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Design & Analysis of Computer Algorithms, 1st Edition, Pearson, 1974. (2002 latest edition)
4. Jon Kleinberg, Eva Tardos, Algorithm Design: Pearson New International Edition, First Edition, Pearson, 2014.
5. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, Pearson, 2014.

WEB REFERENCES:

1. https://www.coursera.org/learn/advanced-data-structures
2. http://www.nptel.ac.in/

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P18CSI1202 IOT ARCHITECTURE AND PROGRAMMING

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

ON SUCCESSFUL COMPLETION OF THE COURSE, THE STUDENTS SHOULD BE ABLE TO

CO1	Appreciate the evolution and applications of IoT	K2
CO2	Evaluate the available sensors for an application and understand circuits	K5,S2
CO3	Analyze different options for Embedded systems, connectivity and networking protocol and apply the appropriate one for a given application	K4, S3
CO4	Understand MGC Architecture and Arduino Programming	K2
CO5	Analyze major challenges for IoT and design innovative solutions for the same	K4

PRE-REQUISITES: COMPUTER NETWORKS

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1	S	M	M	M
CO2	S	M	M	M
CO3	S	M	M	M
CO4	S	M	M	M
CO5	S	M	M	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1(Theory component) 2. Assignments / Quiz 3. IoT Product/System Development / Lab Assessment / Mini Project 4. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS:

IoT – Motivation and Applications **9 Hours**

Importance of IoT. Motivating Applications of IoT:

Smart Cities-Smart Waste Management, Smart Street Lights, Smart Street Parking, Security without Surveillance, Connected Vehicles. Healthcare-Baby Monitoring, Elderly Monitoring, Mood Enhancing, Disease Treatment and Progression Monitoring, Enhance Adherence, Challenges. Agriculture-Precision Agriculture, Connected Livestock, Food Safety. Manufacturing and Logistics-Smart Manufacturing- Smart Packaging, Smart Label. Smart Electricity Grid- Managing Supply and Demand. Home Automation

Sensors and Circuits **7 hours**

Sensor –Introduction, Terminology, Behavior, Selection, Circuits –Overview and Applications, Battery Issue and Energy Management, Wireless Link, Digital and Analog –Digital Computing, Analog to Digital Interfaces

Embedded Systems, Connectivity and Networking **11 hours**

Embedded Systems – Overview, Technology Drivers, Energy, Microcontrollers, Software Connectivity and Networking –Introduction, Connectivity Challenges in IoT, Energy Harvesting Transmitters, Massive Multiple Access, Computation vs Communication

Architecture and Programming **9 hours**

IoT Architectures –embedded System, Gateway and Cloud (MGC) Architecture and other reference models and architectures Arduino vs Raspberry Pi vs Electric Imp – Key features and comparisons Arduino Interfaces – Arduino IDE - Programming

IOT Challenges **9 hours**

Technology Challenges – Security, Connectivity, Compatibility and Longevity, Standards, Intelligent Analysis and Actions Business Challenges–Consumer IoT, Commercial IoT, Industrial IoT Society Challenges–Privacy, Regulatory Standards

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley & Sons Ltd., UK, 2014.
3. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press)
4. David Boswarthick, Omar Elloumi and OlivierHersent, “M2M Communications: A Systems Approach”, John Wiley & Sons Ltd, UK, 2012.

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5. Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things”, Springer, NewYork, 2011.
6. Olivier Hersent, David Boswarthick and OmarElloumi, “The Internet of Things: Key Applications and Protocols”, John Wiley & Sons Ltd., UK, 2012.
7. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.
8. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3- 642-19156-5 e-ISBN 978-3-642-19157-2, Springer
9. Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things”, Springer, NewYork, 2011.
10. https://iot.ieee.org/newsletter/march-2017/three-major-challenges-facing-iot.html

Online Course Main

https://online.stanford.edu/courses/xee100-introduction-internet-things

Other Online Courses

1. https://onlinecourses.nptel.ac.in/noc17_cs22/course
2. https://www.coursera.org/specializations/internet-of-things
3. https://www.edx.org/micromasters/curtinx-internet-of-things-iot#courses

LAB COMPONENT CONTENTS: 30 Hours

1. Arduino Programming
    a. Basic Arduino Programming
    b. Controlling LED with Arduino
    c. Working with sensors and actuators
    d. Serial Port Programming
    e. Interfacing Arduino with modules and Shields
2. Raspberry Pi Programming
    a. Python Programming in Raspberry Pi
    b. Controlling LED with Raspberry Pi
    c. Working with sensors and actuators
    d. Interfacing with Camera, SMTP, HTTP.
3. Cloud Storage and Data Analytics
    a. Stream Data in public Cloud Storage
    b. Retrieval and Visualization of data
4. Each student to select an IoT Application / Product / System Requirement, that the student will develop during this course after due literature survey and analysis including feasibility and develop an IoT product.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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P18CSI1203 **DATA SCIENCE AND ANALYTICS**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

ON SUCCESSFUL COMPLETION OF THE COURSE, THE STUDENTS SHOULD BE ABLE TO

CO1 Understand roles and stages of Data science project and manage the size of data K2

CO2 Explain various machine learning algorithm for analytics project. K2, S2

CO3 Identify and design and write functions in R and implement simple iterative algorithms. K3, S2

CO4 Explain significance of Big Data analytics and technologies K2, S3

CO5 Demonstrate Map Reduce framework for simple dataset K3

CO6 Explain various delivering method for analysis process K2

PRE-REQUISITES: NIL

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1	M			M
CO2	M			M
CO3	M	M		
CO4	M		M	
CO5	M			M
CO6	M			M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1(Theory component) 2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product 3. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) 4. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION TO DATA SCIENCE **4 Hours**

Introduction to big data: Introduction to Big Data Platform – Challenges of Conventional Systems

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- Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.

DATA ANALYSIS USING R **11 Hours**

Introduction - Basic data types and operations – Manipulating Objects - Data summaries and Graphics - Statistical tests and models – Basic Analysis Techniques- ANOVA- Interactive Graphics- Interactive visualizations - Case studies- Understanding business scenarios - Scalable and parallel computing with Hadoop and Map-Reduce Case Study - Analyzing big data with twitter – Big data for E-Commerce – Big data for blogs.

MODELING METHODS **7 Hours**

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

MAP REDUCE **15 Hours**

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

HADOOP ECO SYSTEM

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Big SQL : Introduction

MINING DATA STREAMS **8 Hours**

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications – Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007
2. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
3. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
4. Mark Gardener, “Beginning R - The Statistical Pr ogramming Language”, John Wiley & Sons, Inc., 2012.
5. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.

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6. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
7. Eric Siegel, Thomas H. Davenport, “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, Wiley, 2013
8. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2012.
9. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier, 2007
10. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

E BOOKS AND ONLINE LEARNING MATERIALS

1. http://www.johndcook.com/R_language_for_programmers.html
2. http://bigdatauniversity.com/
3. http://www.michael-noll.com/tutorials/running-hadoop-on-ubuntu-linux-single-node-cluster/

LAB COMPONENT CONTENTS **30 Hours**

LIST OF EXPERIMENTS

1. Perform and setting up and installing Hadoop in single cluster and multiple cluster
2. Programming Examples- Combiner Functions - Distributed MapReduce Job
3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   - Find the number of occurrence of each word appearing in the input file(s)
   - Performing a MapReduce Job for word search count (look for specific keywords in a file)
4. Purchases.txt Dataset
   - Instead of breaking the sales down by store, give us a sales breakdown by product category across all of the stores
5. Implement Linear and Logistic regression
6. Implement Decision trees / Naïve Bayes
7. Implement K-means clustering and Association rules
8. Implement K-Nearest neighbors algorithm
9. Working with Hadoop Eco system
10. Working with Data visualization tools
11. Working with web based application using R

Theory: 0 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 30 Hours**

ONLINE COURSES AND VIDEO LECTURES:

https://www.coursera.org/specializations/jhu-data-science
https://www.kdnuggets.com/2016/10/top-10-data-science-videos-youtube.html
https://cse6242.gatech.edu/
https://people.cs.umass.edu/~ggrinstein/CS690V.pdf

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P18CST1004 RESEARCH METHODOLOGY

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

On the successful completion of the course, the students should be able to

CO1	Identify the framework for selecting the research problem	K3
CO2	Make use of different data collection method to formulate the raw data for research.	K3
CO3	Examine the different probability sampling methods for analysis	K4
CO4	Analyze major challenges for IoT	K4
CO5	Combine the writing ethics and IPR components for develop the research paper evaluate its quality	K4

PRE-REQUISITES: Nil

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	PROGRAMME OUTCOMES (POs)			
	PO1	**PO2**	**PO3**	**PO4**
CO1	S	M	M	M
CO2	M	S	M	M
CO3	M	S	M	M
CO4	M	S	M	M
CO5	S	S	S	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Open book test, Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

RESEARCH METHODOLOGY **9 Hours**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

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DATA COLLECTION METHODS **9 Hours**

Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data.

SAMPLING METHODS **9 Hours**

Scales – measurement, Types of scale – Thurstone's Case V scale model, Osgood's Semantic differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods –simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling.

HYPOTHESES TESTING **8 Hours**

Testing of hypotheses concerning means -One mean and difference between two means -One tailed and Two tailed tests, concerning variance – One Tailed Chi-square test.

REPORT WRITING & IPR **10 Hours**

Report writing- Types of Report, Guidelines to review report, typing instructions, Oral Presentation-Layout of research Paper-Ethical issues related to publishing, Plagiarism and Self Plagiarism. Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Kothari.C.R.,"Research Methodology -Methods and Techniques", New Age Publications,New Delhi,2009.
2. Panneerselvam, R., Research Methodology, Prentice-Hall of India, New Delhi, 2004.
3. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications.
4. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York
5. Donald Cooper, Pamela Schindler, Business Research Methods, Mc-Graw Hill Higher Education, 12th Edition,2010.

WEB REFERENCES:

1. https://research-methodology.net/
2. http://www.skillmaker.edu.au/online-research-methods/

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L	T	P	J	C
3	0	2	0	4

P18CSI2201 CLOUD SERVICES AND VIRTUALIZATION

COURSE OUTCOMES

On successful completion of the course, the students should be able to

CO1: Deploy legacy OSs on virtual machines. (K3)

CO2: Distinguish the intricacies of server, storage, network, desktop and application virtualizations. (K4)

CO3: Compare full and para virtualization. (K4,S1)

CO4: Producing cloud applications in virtual machine platforms. (K5,S3)

PRE-REQUISITES: NIL

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
Cos	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	S	M	M	M
CO2	S	M	M	M
CO3	S	M	M	M
CO4	S	M	M	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1(Theory component) 2. Assignments / Quiz / Group Presentation 3. Practical implementation / System Development / Lab Assessment / Mini Project 4. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

INTRODUCTION 9 Hours

Introduction - Essentials - Benefits - Business and IT Perspective - Cloud and Virtualization - Cloud Services Requirements - Cloud and Dynamic Infrastructure - Cloud Computing Characteristics - Cloud Adoption. Cloud Models - Cloud Characteristics - Measured Service - Cloud Models - Security in a Public Cloud - Public versus Private Clouds - Cloud Infrastructure Self Service.

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CLOUD SERVICES AND SOLUTIONS **9 Hours**

Principal Technologies - Cloud Strategy - Cloud Design and Implementation using SOA - Conceptual Cloud Model - Cloud Service Defined. Cloud Solutions - Introduction - Cloud Ecosystem - Cloud Business Process Management - Cloud Service Management - Cloud Stack - Computing on Demand (CoD) – Cloud sourcing.

CLOUD OFFERINGS AND CLOUD MANAGEMENT **9 Hours**

Cloud Offerings - Information Storage, Retrieval, Archive and Protection - Cloud Analytics - Testing under Cloud - Information Security - Virtual Desktop Infrastructure - Storage Cloud. Cloud Management - Resiliency - Provisioning - Asset Management - Cloud Governance - High Availability and Disaster Recovery - Charging Models, Usage Reporting, Billing and Metering

COUD ENABLIBNG TECHNOLOGIES **9 Hours**

Data center Technology – Virtualization Technology – Web Technology – Multitenant Technology – service technology – case study in AWS.

CLOUD VIRTUALIZATION **9 Hours**

Virtualization Defined - Virtualization Benefits - Server Virtualization - Virtualization for x86 Architecture - Hypervisor Management Software - Logical Partitioning (LPAR) - VIO Server - Virtual Infrastructure Requirements - Storage virtualization - Storage Area Networks - Network-Attached storage - Cloud Server Virtualization - Virtualized Data Center.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. James E. Smith, Ravi Nair, - Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, - Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.
3. Kumar Reddy, Victor Moreno, - Network virtualization, Cisco Press, July, 2006.
4. Chris Wolf, Erick M. Halter, - Virtualization: From the Desktop to the Enterprise, Apress 2005.
5. Danielle Ruest, Nelson Ruest - Virtualization: A Beginner‟s Guide, TMH, 2009
6. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, ―Cloud Computing: Concepts,Technology and Architecture‖, Prentice Hall Service Technology Series, 2013
7. Kenneth Hess, Amy Newman: Practical Virtualization Solutions: Virtualization from the Trenches Prentice Hall 2010
8. John Rittinghouse, James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010
9. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter - Cloud Computing: A Practical Approach,TMH, 2010
10. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas - Cloud Computing Synopsis and Recommendations NIST, May 2011

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11. Tom White - Hadoop: The Definitive Guide Storage and Analysis at Internet Scale O'Reilly Media Press May 2012
12. Dave Shackleford - Virtualization security- Protecting Virtualized Environments, Sybex Publishers, First Edition, 2012

LAB COMPONENT CONTENTS **30 Hours**

LIST OF EXPERIMENTS

1. Examples of Software-as- a-Service (SaaS), Platform-as- a-Service (PaaS), Infrastructure-as- a-Service (IaaS)
2. Creation of virtual Firewall
3. Implementation of virtual LAN
4. Creation of VM backup
5. Implementation of RAID in virtual machine
6. Deployment of VMs in Oracle Virtual box
7. Install storage controller and interact with it.
8. Hosting Web application in cloud.

. **Theory: 0** **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 30 Hours**

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P18CSI1202 **AGILE SOFTWARE DEVELOPMENT AND USABILITY ENGINEERING**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

On successful completion of the course, the students should be able to

CO1	Experiment the Agile development practice	K3
CO2	Perform development with unit tests using Test Driven Development	K5
CO3	Apply design principles and refactoring to achieve Agility	K3
CO4	Deploy and justify automated build tools, version control and continuous integration	K4, S2
CO5	Build testing activities within an Agile project	K5, S2

PRE-REQUISITES: COMPUTER NETWORKS

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1				M
CO2	S	S	M	M
CO3				M
CO4	M	M	S	M
CO5	M	S	S	M

COURSE ASSESSMENT METHODS

DIRECT

1. Mid-Term Test 1 (Theory component)
2. Assignments / Quiz
3. Agile Process/System Development / Lab Assessment / Mini Project
4. End Semester Examination

INDIRECT

1. Course-end survey

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THEORY COMPONENT CONTENTS

Fundamentals of Agile **9 Hours**

The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools

Agile Scrum Framework **9hours**

Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management

Agile Testing **9hours**

The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester

Agile Software Design and Development **9hours**

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control

Industry Trends **9 hours**

Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.

Theory:45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Agile Software Development with Scrum, Ken Schawber, Mike Beedle, Publisher: Pearson.
2. Agile Testing: A Practical Guide for Testers and Agile Teams, Lisa Crispin, Janet Gregory, Publisher: Addison Wesley
3. Agile Software Development, Principles, Patterns and Practices, Robert C. Martin, Publisher: Prentice Hall
4. Agile Software Development: The Cooperative Game, By Alistair Cockburn Publisher: Addison Wesley

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Other Online Courses

1. www.it-ebooks.info/tag/agile
2. http://martinfowler.com/agile.html

LAB COMPONENT CONTENTS: 30 Hours

1. Understand a given business scenario and identify product backlog, user stories and sprint tasks
2. Define user stories for a given feature
3. Fill user stories, sprint schedule and sprint tasks in an Agile tool such as AgileFant
4. Write unit tests aligned to xUnit framework for TDD
5. Refactor a given design for next sprint requirements
6. Execute continuous integration using a tool such as Jenkins

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

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P18CSI2203 **WEB PROGRAMMING**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOMES

After successful completion of this course the students should be able to

CO1: Apply HTML concepts to develop Webpages (K3, S2)

CO2: Build Web applications using Cascading Style Sheets. (K5, S3)

CO3: Choose JavaScript to develop Webpages. (K4)

CO4: Design Web application using JSP and Servlet. (K5, S2)

CO5: Develop PHP program to manipulation a database. (K5,S2)

PRE-REQUISITES: NIL

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
Cos	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	M	S	S	M
CO2	S	S	S	M
CO3	S	S	S	M
CO4	S	S	S	M
CO5	S	S	S	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz / Group Presentation. 3. Webpage creation /System Development / Lab Assessment / Mini Project 4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment. 5. End Semester Examination (Theory and lab components)
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

Programming HTML **8 Hours**

Overview of HTML- Using the HTML Canvas API- Working with HTML Audio and Video- Using the HTML Geolocation API- Using the Communication APIs- Using the HTML Forms API- Using the HTML Web Storage API.

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Cascading Style Sheets (CSS) **9 Hours**

Properties Table: Using the style Attribute, Creating Classes and IDs, Generating External Style Sheets, Typography, Consistency, Types of styles, specifying class within HTML document, Style placement: Inline style, Span & div tags, header styles, Text and font attributes: Font Vs CSS, changing fonts, text attributes, Advance CSS properties: Backgrounds, Box properties and Positioning.

JAVASCRIPT **9 Hours**

Client-Side Programming: Introduction to JavaScript – Functions – Objects – Arrays – Built - in Objects - JavaScript Debuggers.

Host Objects: Browsers and the DOM - Introduction to the Document Object Model DOM History and Levels - Intrinsic Event Handling - Modifying Element Style - The Document Tree -DOM Event Handling

JSP and SERVLETS **10 Hours**

JSP application Basics: Introducing Java Server Pages-HTTP and Servlet Basics-JSP Overview-Setting up the JSP Environment. JSP Application Development: Generating Dynamic Content-Using JavaBean Components in JSP Pages-Using Custom Tag Libraries and the JSP Standard Tag Library-Processing Input and Output-Error Handling and Debugging-Sharing Data between JSP Pages, Request, and Users-Accessing a Database.

PHP **9 Hours**

PHP: Introduction – Programming in Web Environment – Variables – Constants –Data; Types – Operators – Statements – Functions – Arrays – OOP – String Manipulation and Regular Expression – File Handling and Data Storage – PHP and SQL Database – PHP and LDAP – PHP Connectivity – Sending and Receiving E-mails – Debugging and Error Handling – Security – Templates.

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Peter Lubbers, Brian Albers, Frank Salim-Pro HTML5 Programming Powerful APIs for Richer Internet Application Development-Apress (2010)
2. Jeffrey C.Jackson, "Web Technologies-A Computer Science Perspective", Pearson Education, 2013. (Unit 2 &3).
3. Hans Bergsten, “JavaServerPages”, Second Edition, O’Reilly Publication, 2002.
4. Steven Holzner, “PHP: The Complete Reference”, Second edition, Tata McGraw-Hill, Indian Reprint, 2009.
5. Rasmus Lerdorf and Levin Tatroe, “Programming PHP”, O’Reilly, 2002.

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LAB COMPONENT CONTENTS **30 Hours**

LIST OF EXPERIMENTS

1. Create a HTML webpage to play/Pause a video and if the video is paused, resize it by small, normal and big.
2. Create a HTML webpage that contains a button to retrieve Latitude and Longitude.
3. Develop a webpage that consists of three types of CSS implementation
4. Develop a webpage that contains form validation using JavaScript.
5. Develop a webpage to perform mouse event handling.
6. Develop a webpage to add two numbers using JSP and servlet.
7. Develop a JSP program to use Java Bean component.
8. Develop a webpage to retrieve the database table using JSP
9. Develop a webpage to perform CRUD operation using PHP
10. Develop a PHP program to use the send mail configuration.

Theory: 0 **Tutorial: 0** **Practical: 30** **Project: 0** **Total: 30 Hours**

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P18CSP3701 Project Phase I / Industry Project

L	T	P	J	C
0	0	0	30	15

COURSE OUTCOMES

After successful completion of this course the students should be able to

CO1:	Identify a problem which addresses an emerging research issue	K3
CO2:	Analyze the literature survey carried out to gain in-depth understanding about the contemporary methodologies.	K4
CO3:	Identify the methodologies and modularize the entire proposed solution	K3
CO4:	Identify the required tools/software/hardware for implementation	K3

PRE-REQUISITES: NIL

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
Cos	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	S	M	S	S
CO2	S	S	S	S
CO3	S	M	S	S
CO4	S	M	S	M

COURSE ASSESSMENT METHODS

DIRECT
1. Review 1 2. Review 2 3. Review 3 4. End Semester Examination
INDIRECT
1. Course-end survey

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P18CSP4701 Project Phase II / Industry Project

L	T	P	J	C
0	0	0	30	15

COURSE OUTCOMES

After successful completion of this course the students should be able to

CO1:	Implement the methodologies using appropriate techniques identified during Phase-1	K4
CO2:	Analyze and evaluate the performance of the proposed work	K4
CO3:	Develop a dissertation report to summarize the research findings and publish it in a journal or conference	K3

PRE-REQUISITES: NIL

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
Cos	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	**S**	**M**	**S**	**S**
CO2	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**S**	**M**

COURSE ASSESSMENT METHODS

DIRECT
1. Review 1 2. Review 2 3. Review 3 4. End Semester Examination
INDIRECT
1. Course-end survey

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ELECTIVE COURSE

P18CSE0001 MACHINE LEARNING TECHNIQUES

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

On successful completion of the course, the students should be able to

CO1: Compare and Contrast various about regression methods.[K4]

CO2: Illustrate various supervised learning algorithms.[K4, S2]

CO3: Create and deploy deep neural network applications. [K5, S3]

CO4: Synthesize the usage of unsupervised learning algorithms.[K5, S2]

PRE-REQUISITES: NIL

CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	M	M		M
CO2	M	M		M
CO3	S	S	S	M
CO4	S	S		M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz/ Lab Assessment / Mini Project/ Group Presentation 3. End Semester Examination
INDIRECT
1. Course End Survey

THEORY COMPONENT CONTENTS

STATISTICAL THEORY AND REGRESSION **9 hours**

Linear methods for Regression – Gauss-Markov theorem – Multiple regression – Subset selection – Ridge regression – Principal components regression – Partial least squares - Linear discriminant analysis – Logistic regression.

SUPERVISED LEARNING **9 hours**

Decision Tree Learning - Bayesian Learning - Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm.

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DEEP LEARNING **9 hours**

Neural Network Representation – Problems – Perceptron – Multilayer Networks and Back Propagation Algorithms - Convolutional neural networks - Recurrent neural networks – Create and deploy neural networks using Tensor Flow and Keras.

UNSUPERVISED LEARNING **9 hours**

Association rules – Cluster analysis – Self organizing maps – Principal components, curves and surfaces – Non-negative matrix factorization – Independent component analysis – Multidimensional scaling – Ensemble learning.

REINFORCEMENT LEARNING **9 hours**

Introduction - Single State Case - Elements of Reinforcement Learning – Model Based Learning - Temporal Difference Learning – Q Learning Algorithm – Generalization - Partially Observable States.

Theory: 45 Hours **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer; Second Edition, 2009.
3. Alpaydin Ethem, "Introduction to Machine Learning", MIT Press, Second Edition, 2010.
4. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "An Introduction to Statistical Learning: with Applications in R", Springer; First Edition 2013

ONLINE COURSES AND VIDEO LECTURES:

1. https://www.coursera.org/learn/machine-learning
2. https://www.coursera.org/specializations/statistics
3. http://cs229.stanford.edu/notes/

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P18CSE0002 SECURITY FOR INTERNET OF THINGS

L	T	P	J	C
3	0	0	0	3

COURSE OUTCOMES

On successful completion of this course, the students should be able to

CO1	Discover the security requirements in IoT	K4
CO2	Examine the cryptographic fundamentals for IoT	K4
CO3	Choose the Block chain protocols for IOT networks	K5,S3
CO4	Illustrate the authentication credentials and access control for IoT	K3
CO5	Conduct a research project in the domain of IOT security and building on recent results from literature	K6,S3

PRE-REQUISITES: IOT Architecture and Programming **(**P18CSI1202)

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	M	S		
CO2		M		S
CO3	S	S		S
CO4			S	
CO5	S	S	S	S

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz/ Lab Assessment / Mini Project/ Group Presentation 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS

GENERAL OVERVIEW **9 Hours**

IoT and cyber-physical systems, IoT security (vulnerabilities, attacks and countermeasures), security engineering for IoT development, IoT security lifecycle.

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CRYPTO FOUNDATIONS **9 Hours**

Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms.

BLOCKCHAINS **9 Hours**

Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, scripts and smart contracts, wallets: hot and cold storage, anonymity, altcoins.

CREDENTIAL MANAGEMENT FOR CONNECTED DEVICES **9 Hours**

Security credential management system (SCMS), Vehicle Based Security System (VBSS), PKI design, certification provisioning, pseudonyms (privacy-by design), misbehavior detection, revocation.

CLOUD SERVICES AND IOT **9 Hours**

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren
2. B. Rusell and D. Van Duren, “Practical Internet of Things Security,” Packt Publishing, 2016.
3. Narayanan et al., “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction,” Princeton University Press, 2016.
4. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations
5. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies,” O’Reilly, 2014.
6. T. Alpcan and T. Basar, “Network Security: A Decision and Game-theoretic Approach,” Cambridge University Press, 2011.

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P18CSE0003 **SDN AND NFV FOR IOT**

L	T	P	J	C
3	0	0	0	3

CO1	Make use of Modern Network approaches such as SDN NFV to solve emerging network problems.	K3
CO2	Apply data center topologies and virtualized environment	K3
CO3	Identify various components for building an IoT application	K3
CO4	Build algorithms for virtualization over multi-tenant environments.	K3
CO5	Choose appropriate security features for the SDN and NFV	K3

PRE-REQUISITES: NIL

CO/PO MAPPING

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1	S			
CO2	S	M	S	M
CO3	M	M	S	
CO4	M	S		M
CO5	M			

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz/ Lab Assessment / Mini Project/ Group Presentation 3. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COURSE CONTENT

MODERN NETWORKING **9 hours**

Internet of Things - Types of Network and Internet Traffic - Demand: Big Data, Cloud Computing, and Mobile Traffic - Requirements: QoS and QoE – Routing Congestion Control - SDN and NFV - Modern Networking Elements

SOFTWARE DEFINED NETWORKS **9 hours**

Network Requirements - The SDN Approach - SDN- and NFV-Related Standards – SDN

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Data Plane - OpenFlow Logical Network Device - OpenFlow Protocol - SDN Control Plane Architecture - REST API - SDN Application Plane Architecture

VIRTUALIZATION **9 hours**

Background and Motivation for NFV - Virtual Machines - NFV Concepts – NFV Reference Architecture - NFV Infrastructure - Virtualized Network Functions – NFV Management and Orchestration - NFV Use Cases - SDN and NFV

THE INTERNET OF THINGS: COMPONENTS **9 hours**

The IoTEra - Scope of the Internet of Things - Components of IoT-Enabled Things – IoT World Forum Reference Model - ITU-T IoT Reference Model - IoTivity - Cisco IoT System - ioBridge - SDN and NFV over IoT Deployment

SECURITY **9 hours**

Security Requirements - SDN Security - NFV Security - ETSI Security Perspective – IoT Security - The Patching Vulnerability - IoT Security and Privacy Requirements Defined by ITU-T - An IoT Security Framework - The Impact of the New Networking on IT Careers.

Case Study: A study about Defense4All security SDN application

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”, Pearson Education, 2015.
2. Jim Doherty, “SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization”, First Edition, Pearson Education, 2016.
3. Paresh Shah, Syed Farrukh Hassan, Rajendra Chayapathi, “Network Function virtualization with a touch of SDN”, Addison-Wesley, Pearson Education, 2016.
4. Paul Goransson, Chuck Black, “Software Defined Networks: A Comprehensive Approach”, First Edition, Elsevier Inc, 2014.

Online references

1. https://www.udemy.com/sdn-openflow-nfv-introduction/
2. https://www.coursera.org/learn/sdn

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L	T	P	J	C
3	0	0	0	3

P18CSE0004 BLOCKCHAIN TECHNOLOGY

COURSE OUTCOMES

AFTER SUCCESSFUL COMPLETION OF THIS COURSE, THE STUDENTS SHOULD BE ABLE TO

CO1	Discover the secure and efficient transactions with crypto currencies	K4
CO2	Experiment with cryptocurrency trading and crypto exchanges	K3
CO3	Develop private blockchain environment and develop a smart contracton Ethereum	K3, S2
CO4	Build the Hyperledger architecture and the consensus mechanism applied in the Hyperledger	K5,S2

PRE-REQUISITES: **Cryptography and Network Security**

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	M	M	M	M
CO2	M	M	M	M
CO3	M	M	M	M
CO4	S	S	S	M

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz /Group presentation 3. Practical Assessment / Mini Project 4. End Semester Examination
INDIRECT
1. Course-end survey

THEORY COMPONENT CONTENTS:

Cryptocurrency and Blockchain- Introduction (9 Hours)

Cryptography and Cryptocurrency- Anonymity and Pseudonymity in Cryptocurrencies-Digital Signatures-Cryptocurrency Hash Codes. Distributed networks-Blockchain- An Introduction-Distinction between databases and Blockchain- Distributed ledger-Blockchain ecosystem-Blockchain structure- Blockchain technology- Working -Permissioned and permission-less

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Blockchain

Bitcoin and Block chain **(9 hours)**

Bitcoin – history- Bitcoin- usage, storage, selling, transactions, working- Invalid Transactions- Parameters that invalidate the transactions- Scripting language in Bitcoin- Applications of Bitcoin script- Nodes and network of Bitcoin- Bitcoin ecosystem

Bitcoin mining **(9 hours)**

Purpose of mining- Algorithm used in mining- Mining hardware- Bitcoin mining pools- cloud mining of Bitcoin -Mining incentives-Security and centralizations

Ethereum **(9 hours)**

The Ethereum ecosystem, DApps and DAOs - Ethereum working- Solidity- Contract classes, functions, and conditionals- Inheritance & abstract contracts- Libraries- Types & optimization of Ether- Global variables- Debugging- Future of Ethereum- Smart Contracts on Ethereum- different stages of a contract deployment- Viewing Information about blocks in Blockchain- Developing smart contract on private Blockchain- Deploying contract from web and console

Hyperledger **(9 hours)**

Hyperledger Architecture- Consensus- Consensus & its interaction with architectural layers- Application programming interface- Application model -Hyperledger frameworks- Hyperledger Fabric -Various ways to create Hyperledger Fabric Blockchain network- Creating and Deploying a business network on Hyperledger Composer Playground- Testing the business network definition- Transferring the commodity between the participants

Theory:45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

REFERENCES

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas M Antonopoulos 2018
2. Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations-2016

Other Online Courses

1. https://www.coursera.org/learn/ibm-blockchain-essentials-for-developers
2. https://www.coursera.org/learn/blockchain-basics.

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P18INT0002 PRODUCT DESIGN AND DEVELOPMENT

L	T	P	J	C
3	0	0	0	3

(Common to all branches)

Course Objectives

- Understand the basic concepts of product design and development.
- Know the implications in product architecture and the importance of industrial design.
- Understand prototyping basics and influence of diverse factors on project success.

Course Outcomes

After successful completion of this course, the students should be able to

CO1	Apply concepts of product development and outline product planning process	K3
CO2	Apply relative importance of customer needs in establishing product Specifications	K3
CO3	Identify concept generation activities and summarize the methodology involved in concept selection and testing	K2
CO4	Outline supply chain considerations in product architecture and understand the industrial design process	K2
CO5	Apply design for manufacturing concepts in estimating manufacturing costs	K3
CO6	Apply principles of prototyping in product development economics and highlight importance of managing projects	K3

Pre-requisite: Nil

CO/PO MAPPING				
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak				
COs	**PROGRAMME OUTCOMES (POs)**			
	PO1	**PO2**	**PO3**	**PO4**
CO1	M		M	M
CO2			M	M
CO3	M	M	M	
CO4		M	S	
CO5			S	M
CO6	M		M	M

COURSE ASSESSMENT METHOD

DIRECT
1. Mid-Term Test 1 (Theory component) 2. Assignments / Quiz 3. System Development / Lab Assessment / Mini Project 4. End Semester Examination
INDIRECT
1. Course-end survey

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THEORY COMPONENT CONTENTS:

INTRODUCTION - DEVELOPMENT PROCESSES AND ORGANIZATIONS

PRODUCT PLANNING **9 Hours**

Characteristics of successful product development to Design and develop products, duration andcost of product development, the challenges of product development.
A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization. The product planning process, identify opportunities.
Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning,reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATIONS **9 Hours**

Gathering raw data from customers, interpreting raw data in terms of customer needs, organizingthe needs into a hierarchy, establishing the relative importance of the needs and reflecting on theresults and the process. Specifications, establish specifications, establishing target specifications setting the final specifications.

CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING 9 Hours

The activity of concept generation clarify the problem search externally, search internally, exploresystematically, reflect on the results and the process, Overview of methodology, concept screening, concept scoring, caveats. Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING **9 Hours**

Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Assessing the need for industrial design, the impact of industrial design, industrial design process,managing the industrial design process, is assessing the quality of industrial design. Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGINGPROJECTS

9 Hours

Prototyping basics, principles of prototyping, technologies, planning for prototypes, Elements ofeconomic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis. Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

Theory:45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Hours**

Signature of BOS chairman, CSE

REFERENCES

1. Karl Ulrich,T, Steven Eppinger, D, “Product Design and Development”, McGrawHill,2015.

2. Chitale, AK, Gupta, RC, “Product Design and Manufacturing” PHI, 2013.

3. Timjones, “New Product Development:An Introduction to a multifunctional process”,Butterworth-Heinemann, 1997.

4. Geoffery Boothroyd, Peter Dewhurst and Winston Knight,A, “Product Design forManufacture and Assembly”, CRC Press, 2011.

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