Detailed Syllabus
Lecture-wise Breakup

Subject Code	17M11CS122	**Semester:** Even **(specify Odd/Even)**	**Semester** II **Session** 2022-2023 **Month from** Jan'23 **to** June'23
Subject Name	Performance Evaluation of Computing Systems		
Credits	3	**Contact Hours**	3-0-0

Faculty (Names)	**Coordinator(s)**	Dr. Kavita Pandey
	Teacher(s) (Alphabetically)	Dr. Kavita Pandey

COURSE OUTCOMES		**COGNITIVE LEVELS**
C114.1	Demonstrate the ability to describe the correct tools and techniques for computer system performance evaluation	Understand (level 2)
C114.2	Identify the probability distribution in a given stream of data that corresponds to a source of randomness in a system.	Apply (level 3)
C114.3	Design the appropriate model of a discrete, dynamic, stochastic system using the theory of random processes.	Apply (level 3)
C114.4	Inspect the mathematical modeling techniques, Markov chains, queuing theory for analyzing the system.	Analyze (level 4)
C114.5	Select the appropriate experiments and perform a simulation study of the given system.	Evaluate (level 5)

Module No.	**Title of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Overview of Performance Evaluation	Need for Performance Evaluation, Systematic approach to Performance Evaluation, Selection of evaluation techniques and performance metrics	5
2.	Random Variables and Probability distributions	Discrete and continuous random variable, Expectation and variance, Bernoulli random variable, Binomial distribution, Poisson distribution, Geometric distribution, Normal and Exponential distribution, Normal approximation and Poisson approximation to binomial distribution, hazard rate function, , Comparing systems using sample data, Confidence interval	10
3.	Markov Process	Introduction and classification of stochastic processes, Discrete time and Continuous time markov chains, Birth and death processes , Transition probabilities, Steady state solution, Performance measure in terms of time spent and expected reward	6
4.	Queuing models	Basics of Queuing theory, Kendall notation, Little's Law, Analysis of a single queue	8

		with one server and multiple servers, Analysis of finite buffers queuing systems	
5.	Simulation modeling	Introduction to simulation, Types of simulation, Random number generation, a survey of random number generators, seed selection, testing random number generators, random variate generation	6
6.	Measurement techniques and tools	The art of data presentation, Ratio Games	2
7.	Experimental design and analysis	Types of Experimental designs, 2^2 factorial designs, General 2^K factorial designs, 2^{K-p} fractional factorial designs	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance (10 Marks), Assignments / Quiz / Mini project (15 Marks)
Total	**100**

Project based Learning: Each student in a group of 2-3, study the research papers related to experimental designs and present their summary in the form of report. To make it application based, students select the recent articles which is applied on various contemporary domains. Understanding the research papers gives them the knowledge about applicability of experimental designs in identifying the important factors, their variations, etc.

Recommended Text books:

1.	Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", Wiley, Reprint Edition, © 2014.
2.	K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd Edition, Reprint Edition, © 2018.

Recommended Reference books:

1.	Ross, Sheldon M. "A First Course in Probability". Upper Saddle River, N.J.: Pearson Prentice Hall, 10th Edition, ©2019
2.	Obaidat, Boudriga, "*Fundamentals of Performance Evaluation of Computer and Telecommunication Systems* ", 2010, Wiley, ISBN 978-0-471-26983
3.	Ross, Sheldon M. "Introduction to Probability Models". Amsterdam: Academic Press, 12th Edition, ©2019
4.	Fortier, Michel, "Computer Systems Performance Evaluation and Prediction", 2003, Elsevier, ISBN 1-55558-260-5

Detailed Syllabus
Lab-wise Breakup

Course Code	17M15CS122	Semester: Even	Session: 2022 - 2023 Month from: Jan 23 to June 23
Course Name	Performance Engineering Lab		
Credits	2	Contact Hours	2 hrs
Faculty (Names)	Coordinator(s)	Dr. Adwitiya Sinha	
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha	

COURSE OUTCOMES		COGNITIVE LEVELS
C174.1	Experiment with Profilers to calculate the performance and statistics of a program in terms of call counts and timing information of functions.	Apply (level 3)
C174.2	Analyze performance of data mining algorithms on real world data sets using NetworkX, Weka tool.	Analyze (level 4)
C174.3	Compare the performance of different protocols by simulating various wired and wireless network scenarios in Python, Wireshark, NS2 Simulator	Analyze (level 4)
C174.4	Examining the performance using UNIX commands & filters	Analyze (level 4)
C174.5	Model computer systems using Markov Chain with Performance Evaluation Process Algebra, and Visualizing network performance	Analyze (level 4)

Module No.	Title of the Module	List of Experiments	CO
1.	GNU Profiler	Use the Gprof (GNU Profiler) to analyze the performance and statistics of a program	1
2.	Data Science Tools	Data analysis using WEKA tool	2
3.	Network Simulation	Introduction to Network simulator (NS2) and its various utilities NAM, XGraph etc. Creation of Wired and Wireless Network Scenarios and simulation of various protocols Wired and Wireless Network Performance Analysis using AWK and Python	3
4.	Queuing Analysis	Simulation of various queues in NS2 and analyzing their performances on various performance metrics such as throughput, average delay and packet loss	4
5	Performance Evaluation Process Algebra	Model computer systems using Markov Chain Theory and Perform Steady State Analysis, and Visualizing network performance using Open Source Tools	5

Evaluation Criteria

Components	*Maximum Marks*
Evaluation-1:	15
Lab Test-1:	20
Lab Test-2:	20
Evaluation-2:	15
Project:	15
Attendance:	15
Total	**100**

Project based Learning: Each student in a group of 3-4 will study the research papers related to performance analysis of software systems. The articles should be recent and in relation with the subject contents. Understanding and implementing the research paper(s) enhances the student's working experience towards studied tools and concepts.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1. Unix and Shell Programming by B. M. Harwani, Oxford University Press, 2013
2. Mastering Wireshark by Charit Mishra, Packt Publishing, 2016
3. Mastering Linux Shell Scripting, A Practical Guide to Linux Command-line, Bash Scripting, and Shell Programming, 2nd Edition By Mokhtar Ebrahim, Andrew Mallett, Packt Publishing, 2018
4. Modeling and Simulation in Python: An Introduction for Scientists and Engineers by Allen Downey, No Starch Press, 2023
5. Practical Packet Analysis Using Wireshark to Solve Real-world Network Problems by Chris Sanders, No Starch Press, 2007
6. Introduction to Network Simulator NS2 by Teerawat Issariyakul, Ekram Hossain, Springer, 2009
7. Predictive Analytics Applications with WEKA by Shuzlina Abdul Rahman & Sofianita Mutalib, 2021
8. Marc Greis Tutorial for the UCB/LBNL/VINT Network Simulator NS
9. GPROF Tutorial – How to use Linux GNU GCC Profiling Tool
10. The ns Manual, available at: isi.edu/nsnam/ns/doc/ns_doc.pdf

Detailed Syllabus
Lab-wise Breakup

Course Code	17M15CS123	**Semester** II	**Semester** ... **Session** 2022-2023 **Month from** Jan to July, 2023
Course Name	**IoT Systems Development Lab**		
Credits	1	**Contact Hours**	2 Hours

Faculty (Names)	**Coordinator(s)**	Dr Vikash
	Teacher(s) (Alphabetically)	Dr. Vikash

COURSE OUTCOMES		**COGNITIVE LEVELS**
C181.1	Explain Node-RED IDE platform for IoT application development and demonstrate I/O nodes, flows, third party palettes, import/export of flows in Node-RED.	Understand (level 2)
C181.2	Develop user defined functional nodes and deploy it in Node-Red.	Apply (level 3)
C181.3	Analyze various IoT Communication protocols using APIs with Arduino and Raspberry Pi along with sensors and actuators.	Analyze (level 4)
C181.4	Apply and evaluate the characteristics of different IoT devices.	Evaluate (level 5)
C181.5	Design and develop IoT based applications for various challenges and problems related to Sustainable Development, e.g., energy and waste management, water conservation, clean energy, improving public health, sustainable urbanization, smart agriculture etc.	Create (level 6)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Node-Red Installation and Use	Setup and Install Node.js and Node-RED as IDE platform for IoT application development.	CO1
2.		Demonstrate I/O nodes, flows, third party palettes, import/export of flows in Node-RED	CO1
3.		Develop Java Script based IoT applications using functional nodes , flows and dashboard on Node-RED platform	CO2
4.		Developing and implementation of user defined nodes for creating flows in Node-Red.	CO2
5.	Study and use of Arduino and Raspberry Pi, sensors and actuators.	Study and interface of Arduino and Rasberry Pi with different types of sensors and actuators	CO2
6.		Creation of various IoT based applications using Arduino and Rasberry Pi	CO3, CO4
7.	Developing IoT based systems applications using Arduino and Raspberry Pi	Developing smart applications for various challenges and problems related to Sustainable Development, e.g., energy and waste management, water conservation, clean energy, improving public health, sustainable urbanization, smart agriculture etc.	CO5

Evaluation Criteria

Components	**Maximum Marks**
Lab Test# 1	20
Lab Test# 2	20
Attendance	15
D2D	30
IoT System Development PBA	10
Report of Project	5
Total	**100**

Project based learning: Students form group of size 2-3 members. Each group will identify several real life issues in various thrust areas like healthcare, industrial, education, smart city, logistics, environment, governance and etc. Once problem has been identified, the group will analyze the problem and synthesizeIoT system based solutions to the identified problem. Each group will apply different IoTbased approaches such as smart sensor and heterogeneous devices. This approach will enhance skills of each student and increase the understanding of IoT systems in distributed applications. Moreover, candidate will gain the enough knowledge to provide the IoT solution to enhance the quality of life in human/organization. After this course, a student will able to undertake any work in this area in the industry or research.	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Internet of Things: Architecture and Design Principles, Raj Kamal, McGrawHill.
2	“Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti
3	https://nodered.org/docs/getting-started
4.	https://www.arduino.cc/en/Tutorial/HomePage
5.	https://www.raspberrypi.org/documentation/

Detailed Syllabus

Project Based Learning I (17M17CS111)
MTech CSE/ DA/AIML/ IngtCSE, II Semester/ XI Sem (Ingt CSE)
Lab-wise Breakup

Subject Code	17M17CS111	**Semester** **EVEN 23**	Semester: II Session: 2022-23 Month: Jan - June 2023
Subject Name	Project Based Learning I (17M17CS111) Open Source Software Development		
Credits	**2**	**Contact Hours**	**0-0-4**

Faculty (Names)	**Coordinator(s)**	Dr. Suma Dawn
	Teacher(s)	Dr. Archana Purwar, Dr. Indu Chawla, Dr. Suma Dawn

COURSE OUTCOMES: At the completion of the course, students will be able to

S.NO	DESCRIPTION	COGNITIVE LEVEL (BLOOMS TAXONOMY)
C211.1	Conduct literature review to compare and contrast their project with existing work in the area and prepare a project proposal to be delivered to their peers and faculty members	Understanding Level (Level II)
C211.2	Develop an ability to function in task oriented team, divide role responsibilities to build a project on open data	Understanding Level (Level III)
C211.3	Understand professional and ethical responsibility & acquire ability to communicate effectively amongst team members, peers & evaluators	Analyzing Level (Level II)
C211.4	Analyze and identify various open data frameworks, RESTful APIs, Python libraries for project implementation; plan & submit project development timeline	Applying Level (Level IV)
C211.5	Appraise by giving milestone presentations to their peers and faculty about their current progress.	Evaluating Level (Level V)
C211.6	Prepare technical report detailing the problem statement, proposed methodology, software specification, design, test plan, and implementation details.	Creating Level (Level VI)

COURSE DESCRIPTION:

Module No.	Subtitle of the Module	Topics in the module	CO
1.	Conduct literature review	Conduct literature review to compare and contrast their project with existing work in the area and prepare a project proposal to be delivered to their peers and faculty members	CO1
2.	Role Mapping	Develop an ability to function in task-oriented team, divide role responsibilities to build a project on open data	CO2
3.	Coordination	Understand professional and ethical responsibility & acquire ability to communicate effectively amongst team members, peers & evaluators	CO3
4.	Submit Project Development Timeline	Analyze and identify various open data frameworks, RESTful APIs, Python libraries for project implementation; plan & submit project development timeline	CO4
5.	Presentation	Appraise by giving milestone presentations to their peers and faculty about their current progress.	CO4
6.	Prepare technical report	Prepare technical report detailing the problem statement, proposed methodology, software specification, design, test plan, and implementation details.	CO5

Project based learning: Project is an integral part of the lab. Students form a group (of size 3-4), and discuss their project ideas with their faculty before finalising their research areas. The project is done using Open-source software(s), which are easily available with applications ranging from development to research-based projects or mix of both. Students may use services like Google Colab's free-tier service for execution of code. This helps students in understanding the working of project development in companies and also broadens the spectrum for team work and procedural implementation of projects in hand to be delivered to clients as per the requirements.

Evaluation Criteria

Components		**Maximum Marks**
Fortnightly Assessment (6 * 8)		48
Report at the end of the semester	-	10
Semester end presentation	-	10
Viva-voce at the end of the semester	-	16
Peer group evaluation	-	8
Self-assessment by the student concerned	-	8
Total		**100**

Resources:

1. Overview of Project Based Learning (Stanford)
https://teachingcommons.stanford.edu/resources/learning/learning-activities/project-based-learning

2. Using Design Thinking in Higher Education (Educause)
http://er.educause.edu/articles/2015/1/using-design-thinking-in-higher-education

3. Design Thinking and Innovation (GSM SI 839)
https://www.bu.edu/academics/questrom/courses/qst-si-839/

4. Project Based Learning through a Maker's Lens (Edutopia)
https://www.edutopia.org/blog/pbl-through-a-makers-lens-patrick-waters

5. Practiced-Based Learning: Problems-Based Learning Applied to Medical Education, H.S. Barrows, Southern Illinois University School of Medicine, Springfield, IL, 1994.

Other resources would be proposed as per requirement.

Detailed Syllabus

Subject Code	19M12CS211	**Semester odd**	**Semester M.Tech. CSE II sem Session EVEN 2023** **Month: From Jan to June**
Subject Name	Nature Inspired Computation and Applications		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr. Anuja Arora
	Teacher(s) (Alphabetically)	Dr. Anuja Arora

SNO	Description	Cognitive Level (Bloom Taxonomy)
C151.1	Identify the need of computational complexity, evolutionary, and approximate algorithms.	Apply Level (Level 3)
C151.2	Understand nature inspired algorithms, its strength, weakness, and suitability	Understand Level (Level 2)
C151.3	Make use of nature-inspired algorithms to design, learn and optimize problem	Apply Level (Level 3)
C151.4	Evaluate performance of Nature inspired algorithm in context of problem solving in optimized manner	Evaluate Level (Level 5)
C151.5	Create a real environment effective artificial system with the use of properties exhibited from nature.	Create Level (Level 6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Nature Inspired Computation Fundamental	Computational Complexity, NP-Hardness, Reductions, Approximation Algorithms vs. Heuristics, Newton Raphson Method, Characteristics of Natural Systems/Algorithms, Deterministic Vs Stochastic Algorithm,	3
2.	Optimization Algorithms and associated concepts	Monotonic Function, Convex Function, Contour Plot, Realization, Unimodal and Multimodal, Single Objective Vs. Multi Objective, Single and Multivariable: Maxima, Minima, & saddle point.	4
3	Evolutionary Algorithms	Genetic Algorithm, GA Encoding Techniques, Selection techniques, Variation(Crossover and Mutation) Techniques, Genetic Programming Differential Evolution Algorithm, sample problems, DE-Crossover and	8

		Mutation techniques	
4	Swarm Intelligence Algorithm	Theoretical, mathematical, Implementation foundation- BAT and Its variant, Ant Colony Optimization, Artificial Bee Colony Algorithm, Cuckoo Search, Firefly Algorithm	17
5	Other Optimization Algorithm	Gravitational Search Algorithm Teaching Learning Based Optimization AEFA Algorithm Forest Fire algorithm	8
11	NIC real time optimization applications and case studies	Constraint Handling, Parallelization and vectorization of Fitness Function. Case Studies: World Wide Web, Social Network, Modeling, Image Processing, Earthquake, routing & scheduling	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
	Attendance = 10
	Class Test/Quiz = 10
	Mini-Project = 5
Total	100

Project Based Learning: Students will form a group of 2-3 students. To design a problem statement, students read 4-5 research papers in which nature inspired computational algorithms have been used to handle real scenario problems. Theme and topic of project is chosen based on read research papers. Understanding usage of appropriate optimization technique, then implementation of the selected optimization algorithm and evaluating its effectiveness based on performance measure help students to know the concept of applying the optimization techniques in real life case scenario.

Text Books Books	
1.	Evolutionary Optimization Algorithms, D. Simon (2013), Wiley.
2.	Yang, X. S. (Ed.). (2017). Nature-inspired algorithms and applied optimization (Vol. 744). Springer.

Reference Books	
1.	Eberhart, Russell C., and Yuhui Shi. Computational intelligence: concepts to implementations. Elsevier, 2011
2.	Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, D.Floreano and C. Mattiussi

	(2008), MIT Press.
3.	Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
4.	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
5.	Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005
6.	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
7.	Coello, C. C., Dhaenens, C., & Jourdan, L. (Eds.). (2009). Advances in multi-objective nature inspired computing (Vol. 272). Springer.

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**19M13HS111**	**Semester: Even**	**Semester: M.Tech II & Dual degree VIIISession 2022-23** **Month from January to May 2023**
Subject Name	**English Language Skills for Research Paper Writing**		
Credits	**2**	**Contact Hours**	**2-0-0**
Faculty (Names)	**Coordinator(s)**	Dr. Ekta Singh	
	Teacher(s) (Alphabetically)	Dr. Ekta Singh	

Course Outcomes:

At the completion of the course, students will be able to,

COURSE OUTCOMES		**COGNITIVE LEVELS**
C204.1	Demonstrate an understanding of all the aspects of grammar and language needed to write a paper.	Understand Level (C2)
C204.2	Apply grammatical knowledge & concepts in writing and presentation.	Apply level (C3)
C204.3	Examine each section of a paper after careful analysis of Literature Review.	Analyze Level (C4)
C204.4	Determine the skills needed to write a title, abstract and introduction, methods, discussion, results and conclusion.	Evaluate Level (C5)
C204.5	Compile all the information into a refined research paper after editing and proofreading	Create Level (C6)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lecturesand Tutorials for the module**
1.	Grammar & Usage	Structure of English Language Voice, Aspect & Tense SVOCA Sense & Sense Relations in English Enhancing Vocabulary Connotation, Denotation & Collocation	**6**
2.	Elements of Paper Writing	Planning & Preparation Word Order Breaking Long Sentences Structuring Paragraphs Being Concise and RemovingRedundancy Avoiding Ambiguity and Vagueness	**4**
3.	Paraphrasing & Writing	Highlighting Your Findings Hedging andCriticising Paraphrasing and Plagiarism Sections of a Paper Abstracts; Introduction	**6**

4.	Process of Writing	Review of Literature Methods Results Discussion Conclusion The Final Check	**4**
5.	Key Skills Needed	Key skills needed when writing a Title Key skills needed whenWriting an Abstract Key skills needed when writing an Introduction Key skills needed when writing a Review of the Literature Key skills needed when writing Methods & Results Key skills needed when writing Discussion & Conclusion	**4**
6.	Refining the Paper	Incorporating useful phrases Editing Proofreading References Annexures Ensuring good quality in submission	**4**
		Total number of Lectures and Tutorials	**28**

Evaluation Criteria

Components	**MaximumMarks**
Mid Term	30
End Semester Examination	40
TA	30 (Project, Assignment/ Class Test/ Quiz, Class Participation)
Total	**100**

3. Employability/entrepreneurship/skill development

Researchers whose first language is not English write at least two-thirds of published scientific papers. Twenty percent of the comments referees make when reviewing papers for possible publication in international journals regard English language issues. In some disciplines, acceptance rate by journals of papers originating from the US/UK is 30.4%, and is higher than all other countries

Publishing your research in an international journal is key to your success in academia. This course is based on a study of some sample manuscripts and reviewers' reports revealing why papers written by non-native researchers are often rejected due to problems with English usage and poor structure and content. The course prepares the students on how to:

- prepare and structure a manuscript
- increase readability and reduce the number of mistakes you make in English by writing concisely, with no redundancy and no ambiguity
- write a title and an abstract that will attract attention and be read
- decide what to include in the various parts of the paper (Introduction, Methodology, Discussion etc)
- highlight your claims and contribution
- avoid plagiarism
- discuss the limitations of your research
- choose the correct tenses and style
- satisfy the requirements of editors and reviewers

Recommended Reading material:	
1.	Goldbort R. 'Writing for Science', Yale University Press (available on Google Books), 2006
2.	Day R. 'How to Write and Publish a Scientific Paper', Cambridge University Press, 2006
3.	Adrian Wallwork. 'English for Writing Research Papers', Springer, New York, Dordrecht Heidelberg, London, 2011
4.	Yadugari M.A. ' Making Sense of English: A Textbook of Sounds, Words & Grammar' Viva Books Private Limited, New Delhi, 2013, Revised Edition
5.	Strauss Jane. 'The Blue Book of Grammar and Punctuation, Josseybass, Wiley, San Francisco, 1999.
6.	Rizvi, A. R. 'Effective Technical Communication' 2nd edition, McGraw Hill Education Private Limited, Chennai, 2018
7.	Eckert, K. 'Writing Academic Paper in English:Graduate and Postgraduate Level', Moldy Rutabaga Books, 2017
8	Barros, L.O, 'The Only Academic Phrasebook You'll Ever Need: 600 Examples of Academic Language' Create Space Independent Publishing Platform; 1st edition,2016
9	Wallwork, A. 'English for Writing Research Papers (English for Academic Research)'.Springer; 2nd ed. 2016 edition.
10	Wallace,M&Wray,A. 'Critical Reading and Writing for Postgraduates (Student Success) SAGE Publications Ltd; Third edition, 2016
11	Butler, L. 'Longman Academic Writing Series 1: Sentences to Paragraphs, with Essential Online Resources', Pearson Education ESL; 2nd edition,2016
12	Saramäki, J. 'How to Write a Scientific Paper: An Academic Self-Help Guide for PhD StudentsIndependently published, 2018

Detailed Syllabus
Lecture-wise Breakup

Course Code	23M12CS121	**Semester** 2nd Sem **(Even)**	**Semester** MTech II Sem **Session** 2022-23 **Month from** Jan to June
Course Name	Cryptography and Cybersecurity		
Credits	3	**Contact Hours**	3-0-0
Faculty (Names)	**Coordinator(s)**	Dr. Sangeeta Mittal	
	Teacher(s) (Alphabetically)	Dr. Sangeeta Mittal	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C187.1	Understand threats to cybersecurity and secure protocols	Understand Level (Level 1)
C187.2	Apply modern symmetric encryption algorithms for data confidentiality in cyberspace	Apply Level (Level 2)
C187.3	Analyze number theory and its usage in various modern asymmetric encryption algorithms for developing secure solutions	Analyze Level (Level 3)
C187.4	Apply proactive solutions for cybersecurity like Firewalls and IDS in real world systems	Apply Level (Level 3)
C187.5	Evaluate human aspects of cybersecurity like social engineering and password management	Evaluate Level (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	Introduction to Cybersecurity – Types of Attacks, Goals of cybersecurity, Security threats and vulnerabilities, Cybersecurity models (CIA triad, Star model), Role of Cryptography and Steganography	2 [CO1]
2.	Classical Cryptography	Types of Cryptography, Some classical cryptographic algorithms – Affine, Playfair, Vignere, Hill and Autokey Ciphers	3 [CO2]
3.	Symmetric Ciphers	Stream and Block Ciphers, Fiestel Cipher, Confusion and Diffusion, Groups & Fields, Modern Symmetric encryption: DES, AES and RC4, Modes of Encryption	8 [CO2]
4.	Asymmetric Ciphers	Number theory for modular mathematics, RSA, Elgamal Encryption, Diffe-Hellman Key Exchange, Elliptic-curve cryptography	9 [CO3]
5.	Cybersecurity Protocols	Cybersecurity protocols at different layers with respect to TCP/IP stack, IPSEC (IP Security – IP Authentication Header, Payload Encapsulation), PPTP and SSL	5 [CO1]
6.	Intrusion Detection and Response	Goals for Intrusion Detection Systems, Types of IDSs – Anomaly Based and Signature Based ,Intrusion Prevention Systems, Intrusion Response	5 [CO4]
7.	Firewalls	Design of Firewalls, Types of Firewalls, Personal Firewalls, Example Firewall Configurations, Network Address Translation (NAT), Data Loss Prevention	5 [CO4]

8.	Human Aspects of Cybersecurity	Social Engineering, Phishing and its types, Protection from phishing, Passwords – choosing passwords, password cracking, attacking systems via passwords, biometric authentication and error rates	5 [CO5]
		Total number of Lectures	**42**

Evaluation Criteria

Components	**MaximumMarks**
T1	20
T2	20
EndSemesterExamination	35
TA	25 (Assignments + PBL + Attendance)
Total	**100**

Project based learning:

Students form group of size 2-3 members. Each group will identify several issues in existing cryptographic algorithms and their applications. Once problem has been identified, the group will analyze the problem and synthesize solutions to the identified problem. Analysis and application of symmetric, asymmetric and hash algorithms. This approach will enhance the understanding of security issues in distributed applications. Moreover, they will gain enough knowledge to provide the cryptographic solution to enhance the security of any organization/company. After this course, a student will able to undertake any work in this area in the industry or research.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1. Cryptography & Network Security, Forouzan, Tata McGraw Hill
2. Introduction to Modern Cryptography (3rd edition) By Jonathan Katz and Yehuda Lindell, CRC Press, 2020
3. Cryptography and Network Security *Principles and Practice,* Sixth Edition, William Stallings, Pearson
4. Understanding Cryptography, Christofer Paar, Jen Pelzl, Springer , 2000
5. USENIX Security Symposium
6. ACM Transactions on Information and system security
7. IEEE Press Computer Security and Privacy

Detailed Syllabus
Lecture-wise Breakup

Course Code	23M22CS122	**Semester :II**	**Session : 2022-23**
Course Name	Statistics for Data Science		
Credits	3	**Contact Hours**	3

Faculty (Names)	**Coordinator(s)**	Dr. Niyati Aggrawal
	Teacher(s) (Alphabetically)	Dr. Niyati Aggrawal

COURSE OUTCOMES		**COGNITIVE LEVELS**
C184.1	Understand the basic principle of probability and statistics and its need in the context of data science	Understand Level (Level 3)
C184.2	Develop own statistical analyses and implement them with advanced statistical programming tools	Apply Level (Level 3)
C184.3	Compare the performance of multiple statistical methods and models and articulate the limitations and abuses of formal inference and modeling.	Analyze Level (Level 4)
C184.4	Evaluate statistical techniques for constructing learning models and can use different measures of model fit and performance to assess models.	Evaluate Level (Level 5)
C184.5	Create real world applications using statistical or data modeling techniques and test hypothesis.	Create Level (Level 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Probability and Statistical inference	Modern Statistics, Statistics and Engineering, Probability, Conditional Probability, The Axioms of Probability, Sampling, Randomness, Intro to Statistics: Mean and Variance, Covariance, Types of Convergence.	6
2.	Statistical Methods in Data Science	Data Distribution (Bernoulli, Uniform, Binomial, Normal, Poisson), Mathematical Statistics, Inferential Statistics, Descriptive Statistics, Random Variable, Gauss-Markov theorem, F-distribution	7
3	Hypothesis Testing	Hypothesis Testing, Difference of Means, Significance Level and P-Value, Z-test, ANOVA, T-Test, Redundancy Test, Chi-Square & F-test, Type-I and Type-II errors	7
4.	Data Modeling	Cross validation, Monte Carlo methods, Cluster analysis, Time Series Modeling	6
5.	Introduction to Bayesian Modeling	Bayes' Theorem, Conditional Statements, Bayesian Thinking: priors, posteriors, and Maximum Likelihood Estimation, Bayesian inference	5
6.	Correlation & Regression Models	Correlation Analysis, Linear regression methods, Ridge regression, LASSO Regression , Logistic regression	6
7.	Ensemble Learning	Bagging & Boosting, Random Forest, Adaboost	5
		Total number of Lectures	**42**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (**Attendance and Tut Performance (10), Quiz/ Mini-Project/Assignment (15)**)
Total	**100**

PBL: In this course, students will create a Project in a group size of 3 to 4 for implementing the statistical concepts of data science. They will demonstrate proficiency with statistical analysis of data. Also execute statistical analyses with statistical tools & techniques. They can apply Standard Data Visualization and formal inference procedures and can comment on the results.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Arnold, T., Kane, M., & Lewis, B. W. (2019). A computational approach to statistical learning. CRC Press.
2.	James, G., Witten, D., Hastie, T., &Tibshirani, R. (2013). Statistical learning. In An Introduction to Statistical Learning (pp. 15-57). Springer, New York, NY.
3.	Gutierrez, D. D. (2015). Machine learning and data science: an introduction to statistical learning methods with R. Technics Publications.
4.	Lomax, R. G., &Hahs-Vaughn, D. L. (2013). An introduction to statistical concepts. Routledge.
5.	Grus, J. (2019). Data science from scratch: first principles with python. O'Reilly Media.
6.	Chatfield, C., & Xing, H. (2019). The analysis of time series: an introduction with R. CRC press.
7.	Afifi, A., May, S., Donatello, R., & Clark, V. A. (2019). Practical multivariate analysis. CRC Press.
8.	Zumel, N., & Mount, J. (2014). Practical data science with R. Manning Publications Co..
9.	Saltz, J. S., & Stanton, J. M. (2017). An introduction to data science. SAGE Publications.

Detailed Syllabus
Lab-wise Breakup

NOTE: All the entries (…) must be in Times New Roman 11.

Course Code	17M15CS121	**Semester – M. Tech CSE**	**Semester: II Session Even** 2023 **Month from: Jan-June, 2023**
Course Name	**Cloud and Web Services Lab**		
Credits	1	**Contact Hours**	2 Hrs/Week

Faculty (Names)	**Coordinator(s)**	Prakash Kumar
	Teacher(s) (Alphabetically)	Prakash Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C179.1	Demonstrate the architecture and layers of Cloud Service Models, Deployment models etc.	Understand (level 2)
C179.2	Understand the working of CloudSim and run different scheduling algorithms.	Apply (level 3)
C179.3	Analyze various Scheduling algorithms and compare their performances on Virtual Machines.	Analyze (level 4)
C179.4	Apply and evaluate the performance of various Cloud based Web Services	Evaluate (level 5)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	CloudSim installations and Use	Study of CloudSim, set up CloudSim environment, Virtual Machine (VM) creation, Running VMs on CloudSim.	CO1
2.		Allocate different Cloudlets to VMs and Data Centers using different Cloud based scheduling algorithms.	CO2
3.	Analyze various Scheduling algorithms in different scenarios on CloudSim	Create different Data Centers, VM allocation and provisioning on Data Centers, and analysis of outcomes.	CO3
4.		Assigning cloudlets and analysing the scheduling parameters for various scenarios. Creating and Running applications in Cloud Environments.	CO3
5.	Implement and Analyse Cloud Based Web Services	Apply and evaluate the performance of various Cloud based Web Services	CO4

Evaluation Criteria

Components	**Maximum Marks**
Lab Test# 1	20
Lab Test# 2	20
D2D work	60 (D2D: 40 marks, PBL: 20 marks)
Total	**100**

Project Based Learning: A group of maximum 2 students are formed. Each group chooses a Cloud and Web Services based project. The project shall be designed and/or modeled based on any Cloud and Web Services based Platform like AWS, Google cloud, Eucalyptus, CloudSim, SOAP, RESTful Services, UDDI, WSDL or any Cloud or Web Services based tools. The project shall function and run as per the objective of the project. Live demonstration of the project shall be shown during their presentation. The project evaluation shall be done based on the quality, innovation, relevance and creativity involved.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Rajkumar Buyya, Rajiv Ranjan and Rodrigo N. Calheiros, Modeling and Simulation of Scalable Cloud Computing Environments and the CloudSim Toolkit: Challenges and Opportunities, Proceedings of the 7th High Performance Computing and Simulation Conference (HPCS 2009, ISBN: 978-1-4244-4907-1, IEEE Press, New York, USA), Leipzig, Germany, June 21 - 24, 2009.
2	Rodrigo N. Calheiros, Rajiv Ranjan, Anton Beloglazov, Cesar A. F. De Rose, and Rajkumar Buyya, CloudSim: A Toolkit for Modeling and Simulation of Cloud Computing Environments and Evaluation of Resource Provisioning Algorithms, Software: Practice and Experience, Volume 41, Number 1, Pages: 23-50, ISSN: 0038-0644, Wiley Press, New York, USA, January 2011.
3	George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'REILLY publication.
4.	K. Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing- From Parallel Processing to the Internet of Things", Morgan Kauffman Publishers, Elsevier.
5.	
6.	
***m*.**	…

Detailed Syllabus

Subject Code	17M22CS115	**Semester: Even**	**Semester: M.Tech. II** **Session: 2022-2023** **Month from: Jan to June**
Subject Name	Large Scale Graph Algorithms and Analytics		
Credits	**3**	**Contact Hours**	**3**
Faculty (Names)	**Coordinator(s)**	Dr. Adwitiya Sinha	
	Teacher(s) (Alphabetically)	Dr. Adwitiya Sinha	

S.No.	Description	Cognitive Level (Blooms Taxonomy)
C161.1	Understand the characteristics & significance of large-scale graphs over complex structures	Understanding Level (Level III)
C161.2	Analyze several techniques to yield and process information from large-scale real-world data sources	Analyzing Level (Level II)
C161.3	Apply the concept of random network theory to large graphs	Applying Level (Level IV)
C161.4	Evaluate the heterogeneous behavior in large-scale graphs with hyper-graphs and multi-graphs for recommendation	Evaluating Level (Level V)
C161.5	Design algorithmic frameworks for large-scale complex interconnected structures	Creating Level (Level VI)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1	Introduction to Large-scale Graphs	Basics of Graph, Multi-Graph, Hypergraph & its Duality, Introduction & Application of Large-scale Graph, Characteristics, Challenges	6
2	Data Sources & Categorization	Complex Data Sources (Social Networks, Simulations, Bioinformatics), Categories – Social graphs (Facebook, Twitter, Google+), Endorsement graphs (Web Link Graph, Paper Citation Graph), Location graphs (Map, Power Grid, Telephone Network), Co-occurrence Graphs (Term-Document Bipartite, Click-through Bipartite)	7
3	Basic Large-scale Graph Analysis	Basic Large-scale Graph Analysis (Efficient Search – Graph Traversal and Search Algorithms; Pattern Discovery -Matching Algorithms, Centrality Computing Algorithms, List Ranking Algorithms; Partitioning – Connected Component Algorithms, Graph-Cut Algorithms)	7

4	Advanced Large-scale Graph Analysis	Advanced Large-scale Graph Analysis (Graph indexing and ranking – Link Analysis Algorithms, Web Crawling, Page Ranking Personalized Page Rank, Page Rank Axioms, HITS; Data Based Approaches – Clustering and Classification Algorithms	7
5	Computation for Massive Data Sets	Large scale Graph Clustering: Spectral Clustering, Modularity-based Clustering, Random Walks, Social Balance Theory	5
6	Large Graph Representation, Analysis & Implementation	Adjacency Matrix Representation, Adjacency List Representation, Graph Implementation Strategies & Softwares (PowerBI, Python, NetworkX, Pajek, MapReduce, GraphLab, Orange)	5
7	Advanced Research Topics	Power Law Distribution in Social Networks, Models of Power Law Random Graphs, Game-Theoretic Approach to Modeling Network Creation, Rank Aggregation and Voting Theory, Recommendation Systems	5
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	Attendance (15 Marks), Assignment/Quiz/Mini-project (10 Marks)
Total	**100**

Project based learning: Each student in a group of 3-4 will extract data from real-world domains using data streaming, web crawling, application programming interfaces (APIs), or from standard repositories that are globally recognized. For conducting application-based research, the students are encouraged to analyze social/political/financial/disease related data and generate underlying networked structure based on activity and topology. Analysing the real-world data for providing link prediction, community detection, security enhancements, commercial decision making, cost-benefit analysis, etc. using network science algorithms, tools, and analytics.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Deo, Narsingh. *Graph theory with applications to engineering and computer science*. Courier Dover Publications, 2017.
2.	Gross, Jonathan L., and Jay Yellen, eds. *Handbook of graph theory*. CRC press, 2003.
3.	Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
4.	Bondy, John Adrian, and Uppaluri Siva Ramachandra Murty. *Graph theory with applications*. Vol. 290. London: Macmillan, 1976.
5.	West, Douglas Brent. *Introduction to graph theory*. Vol. 2. Upper Saddle River: Prentice hall, 2001.
6.	Bollobás, Béla. *Modern graph theory*. Vol. 184. Springer Science & Business Media, 2013.