Internet of Things		Semester	VII
Course Code	**BCS701**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/practical		

Course objectives:
- Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
- Understand the recent application domains of IoT in everyday life.
- Understand the protocols and standards designed for IoT and the current research on it.
- Understand the other associated technologies like cloud and fog computing in the domain of IoT.
- Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.
- Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.
1. Use of PowerPoint presentation
2. Think -pair and share techniques
3. Workshop on Arduino and Raspberry Pi
4. Usage of Tinker Cad tool
5. Overview of the real-world applications of IoT from the published papers

MODULE-1
Introduction to Internet of Things: Introduction, Physical design of IOT, Logical Design of IOT, IOT enabling technologies, IOT Levels & Deployment Templates. Textbook : Ch.1

MODULE-2
IOT and M2M: Introduction: M2M, Difference between IoT and M2M, SDN and NFV for IOT, IOT System Management with NETCONF-YANG, Need for IOT Systems Management, Simple Network Management Protocol (SNMP), Network operator requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG. Textbook: Ch. 3.1-3.4,4.1-4.6

MODULE-3
IoT Platforms Design Methodology: Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring, loT Systems - Logical Design using Python: Introduction, Installing Python, Python Data Types and Data structures, Control flow, Functions, Modules, Packages, File Handling, Operations, Classes, Python Packages of Interest for IoT. Textbook 1: Ch.5.1-5.3,6.2-6.11

MODULE-4
IoT Physical Devices & End points: What is a loT Device, Raspberry Pi, About the Board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Case Studies illustrating IoT design – Home Automation, Cities, Agriculture. Textbook : Ch. 7.1-7.6,9.2,9.3,9.5

MODULE-5

Data Analytics for IoT: Introduction, Apache Hadoop, Using Hadoop MapReduce for Batch Data Analytics, Apache Oozie, Apache Spark, Apache Storm, Using Apache Storm for Real-time Data Analysis.

Textbook: Ch.10

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Develop a program to blink 5 LEDs back and forth.
2	Develop a program to interface a relay with Arduino board.
3	Develop a program to deploy an intrusion detection system using Ultrasonic and sound sensors.
4	Develop a program to control a DC motor with Arduino board.
5	Develop a program to deploy smart street light system using LDR sensor.
6	Develop a program to classify dry and wet waste with the Moisture sensor (DHT22).
7	Develop a program to read the pH value of a various substances like milk, lime and water.
8	Develop a program to detect the gas leakage in the surrounding environment.
9	Develop a program to demonstrate weather station readings using Arduino.
10	Develop a program to setup a UART protocol and pass a string through the protocol.
11	Develop a water level depth detection system using Ultrasonic sensor.
12	Develop a program to simulate interfacing with the keypad module to record the keystrokes.

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
. At the end of the course, the student will be able to :
- Explain the evolution of IoT, IoT networking components, and addressing strategies in IoT. C
- Analyze various sensing devices and actuator types.
- Demonstrate the processing in IoT.
- Apply different connectivity technologies.
- Elaborate the need for Data Analytics and Security in IoT.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)
- IPCC means practical portion integrated with the theory of the course.

- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:
textbook
Arshdeep Bahga, Vijay Madisetti, " Internet of Things- A Hands On Approach", Universities press, 2014.

Reference Books
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017.

Web links and Video Lectures (e-Resources):
- https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
- https://docs.arduino.cc/
- https://www.arduino.cc/education/certification
- https://www.udemy.com/topic/arduino/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
- Mini projects by the students (2 to 4) using Arduino board and Raspberry Pi boards – 10 Marks
- Demonstration of projects using Tinker Cad tool.

PARALLEL COMPUTING		Semester	VII
Course Code	**BCS702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Examination nature (SEE)	Theory/Practical		

Course objectives:

This course will enable to,

- Explore the need for parallel programming
- Explain how to parallelize on MIMD systems
- To demonstrate how to apply MPI library and parallelize the suitable programs
- To demonstrate how to apply OpenMP pragma and directives to parallelize the suitable programs
- To demonstrate how to design CUDA program

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Programming assignment, which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

MODULE-1

Introduction to parallel programming, Parallel hardware and parallel software – Classifications of parallel computers, SIMD systems, MIMD systems, Interconnection networks, Cache coherence, Shared-memory vs. distributed-memory, Coordinating the processes/threads, Shared-memory, Distributed-memory.

MODULE-2

GPU programming, Programming hybrid systems, MIMD systems, GPUs, Performance – Speedup and efficiency in MIMD systems, Amdahl's law, Scalability in MIMD systems, Taking timings of MIMD programs, GPU performance.

MODULE-3

Distributed memory programming with MPI – MPI functions, The trapezoidal rule in MPI, Dealing with I/O, Collective communication, MPI-derived datatypes, Performance evaluation of MPI programs, A parallel sorting algorithm.

MODULE-4

Shared-memory programming with OpenMP – openmp pragmas and directives, The trapezoidal rule, Scope of variables, The reduction clause, loop carried dependency, scheduling, producers and consumers, Caches, cache coherence and false sharing in openmp, tasking, tasking, thread safety.

MODULE-5

GPU programming with CUDA - GPUs and GPGPU, GPU architectures, Heterogeneous computing, Threads, blocks, and grids Nvidia compute capabilities and device architectures, Vector addition, Returning results from CUDA kernels, CUDA trapezoidal rule I, CUDA trapezoidal rule II: improving performance, CUDA trapezoidal rule III: blocks with more than one warp.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Write a OpenMP program to sort an array on n elements using both sequential and parallel mergesort(using Section). Record the difference in execution time.
2	Write an OpenMP program that divides the Iterations into chunks containing 2 iterations, respectively (OMP_SCHEDULE=static,2). Its input should be the number of iterations, and its output should be which iterations of a parallelized for loop are executed by which thread. For example, if there are two threads and four iterations, the output might be the following: a. Thread 0 : Iterations 0 — 1 b. Thread 1 : Iterations 2 — 3
3	Write a OpenMP program to calculate n Fibonacci numbers using tasks.
4	Write a OpenMP program to find the prime numbers from 1 to n employing parallel for directive. Record both serial and parallel execution times.
5	Write a MPI Program to demonstration of MPI_Send and MPI_Recv.
6	Write a MPI program to demonstration of deadlock using point to point communication and avoidance of deadlock by altering the call sequence
7	Write a MPI Program to demonstration of Broadcast operation.
8	Write a MPI Program demonstration of MPI_Scatter and MPI_Gather
9	Write a MPI Program to demonstration of MPI_Reduce and MPI_Allreduce (MPI_MAX, MPI_MIN, MPI_SUM, MPI_PROD)

Course outcomes (Course Skill Set):
At the end of the course, the student will be able to:
- Explain the need for parallel programming
- Demonstrate parallelism in MIMD system.
- Apply MPI library to parallelize the code to solve the given problem.
- Apply OpenMP pragma and directives to parallelize the code to solve the given problem
- Design a CUDA program for the given problem.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.

- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.

- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.

- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**

- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC
Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)
1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:
Textbook:
1. Peter S Pacheco, Matthew Malensek – An Introduction to Parallel Programming, second

edition, Morgan Kauffman.
2. Michael J Quinn – Parallel Programming in C with MPI and OpenMp, McGrawHill.

Reference Books:
1. Calvin Lin, Lawrence Snyder – Principles of Parallel Programming, Pearson
2. Barbara Chapman – Using OpenMP: Portable Shared Memory Parallel Programming, Scientific and Engineering Computation
3. William Gropp, Ewing Lusk – Using MPI:Portable Parallel Programing, Third edition, Scientific and Engineering Computation

Web links and Video Lectures (e-Resources):
1. Introduction to parallel programming: https://nptel.ac.in/courses/106102163

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignment at higher bloom level (10 Marks)

CRYPTOGRAPHY & NETWORK SECURITY		Semester	7
Course Code	**BCS703**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4:0:0:0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:
1. Understand the basics of Cryptography concepts, Security and its principle
2. To analyse different Cryptographic Algorithms
3. To illustrate public and private key cryptography
4. To understand the key distribution scenario and certification
5. To understand approaches and techniques to build protection mechanism in order to secure computer networks

Teaching-Learning Process
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
 8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
 9. Use any of these methods: Chalk and board, Active Learning, Case Studies

Module-1   10 hours

A model for Network Security, Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography.
Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.

Chapter 1: 1.8   Chapter 3: 3.1, 3.2, 3.5   Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5

Module-2   10 hours

Pseudorandom number Generators: Linear Congruential Generators, Blum Blum Shub Generator.

Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, Public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA.

Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography.

Chapter 8: 8.2   Chapter 9: 9.1, 9.2   Chapter 10: 10.1, 10.4

Module-3   10 hours

Applications of Cryptographic Hash functions, Two simple Hash functions,   Key management and distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key Infrastructures

Chapter 11: 11.1, 11.2   Chapter 14: 14.1, 14.2, 14.3, 14.4, 14.5

Module-4   10 hours

User Authentication: Remote user authentication principles**,** Kerberos**,** Remote user authentication using asymmetric encryption.
Web security consideration, Transport layer security.
Email Threats and comprehensive email security, S/MIME, Pretty Good Privacy.

Chapter 15: 15.1, 15.3, 15.4 Chapter 17: 17.1, 17.2 Chapter 19: 19.3, 19.4, 19.5

Module-5 10 hours

Domainkeys Identified Mail.
IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange.

Chapter 19: 19.9   Chapter 20: 20.1, 20.2, 20.3, 20.4, 20.5

Course outcome

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

CO1: Explain the basic concepts of Cryptography and Security aspects

CO2: Apply different Cryptographic Algorithms for different applications

CO**3:** Analyze different methods for authentication and access control.

CO4: Describe key management, key distribution and Certificates.

CO5: Explain about Electronic mail and IP Security.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Books

Text Books:

William stallings, "Cryptography and Network Security", Pearson Publication, Seventh Edition.

References:
1. Keith M Martin, "Everyday Cryptography", Oxford University Press
2. V.K Pachghare,"Cryptography and Network Security", PHI, 2nd Edition

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Group assignment (TWO) to implement Cryptographic Algorithms (15 + 10 marks)