Department of Computer Science and Engineering

COURSE HANDOUT

Academic Year	:	2026-27	**Course Name**	:	Internet of Things
Semester	:	7th	**Course Code**	:	BCS701
Scheme	:	2022	**L : T : P : S**	:	3:0:2:4
Total Contact hours	:	40 Hrs Theory + 8-10 Lab Slots	**CIE Marks**	:	50
Course Plan Author	:	Mrs. Manjushree G	**SEE Marks**	:	50
Date	:	21-06-2026	**Total Marks**	:	100

Course Prerequisites:

- A basic understanding of computer programming, preferably in Python or C/C++, is essential to grasp IoT device programming and system design.
- Prior knowledge of computer networks and operating systems will help in understanding IoT communication protocols and device management.
- Familiarity with data structures and basic data analytics concepts will aid in working with real-time and batch data processing using IoT platforms.

Learning Objectives:

- Understand 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 knowledge about the various cutting-edge technologies in the field of 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.

Course Outcomes:

CO		*At the end of the course, student should be able to . . .*	**Blooms' Level**
CO1	:	Explain the evolution of IoT, IoT networking components, and addressing strategies in IoT.	**L2**
CO2	:	Analyze various sensing devices and actuator types.	**L4**
CO3	:	Demonstrate the processing in IoT.	**L3**
CO4	:	Apply different connectivity technologies.	**L3**
CO5	:	Elaborate the need for Data Analytics and Security in IoT.	**L2**
CO6	:	Design, implement, and analyze embedded system applications using Arduino and various sensors to solve real-world problems related to automation, monitoring, and control systems.	**L3**

Blooms' Taxonomy:

L1	L2	L3	L4	L5	L6

Remembering	Understanding	Applying	Analyzing	Evaluating	Creating

Program Outcomes:

PO1	:	Engineering knowledge	**PO7**	:	Environment and sustainability
PO2	:	Problem analysis	**PO8**	:	Ethics
PO3	:	Design/development of solutions	**PO9**	:	Individual and team work
PO4	:	Conduct investigations of complex problems	**PO10**	:	Communication
PO5	:	Modern tool usage	**PO11**	:	Project management and finance
PO6	:	The engineer and society	**PO12**	:	Life-long learning

Program Specific Outcomes:

PSO1:	Accomplish the skills to design and develop computer applications in areas related to Computer and Networking Systems, Artificial Intelligence, Data Processing and IoT of varying complexity.
PSO2:	Dexterity to apply modern computing languages and platforms in creating career paths to be an entrepreneur and relish for higher studies.
PSO3:	Ability to use and enhance open-ended programming environments to deliver a quality product.

CO-PO-PSO Mapping Table:

Scale: 3 - High Correlation | 2 - Medium Correlation | 1 - Low Correlation | – No Correlation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	1	3	2	1
CO2	2	3	1	2	1	-	-	-	-	-	-	1	2	3	1
CO3	2	1	3	-	2	-	-	-	2	-	-	1	1	2	3
CO4	3	-	3	1	2	-	-	-	1	-	-	1	1	2	1
CO5	3	-	1	-	-	-	-	-	-	1	1	1	-	3	1
CO6	1	1	1	-	1	-	-	-	-	-	-	-	1	-	-
Target	**2.3**	**1.5**	**1.6**	**1.5**	**1.5**	**-**	**-**	**-**	**1.5**	**1**	**1**	**1**	**1.6**	**2.4**	**1.4**

Justification for CO-PO-PSO Mapping:

CO1 - Justification

PO / PSO	Justification
PO1 (3 - High)	CO1 directly builds Engineering Knowledge by requiring students to understand the fundamental evolution of IoT, network architectures, and addressing strategies in IoT — the foundational knowledge of this course.
PO2 (1 - Low)	Basic problem analysis is lightly touched upon when students examine why specific addressing strategies (IPv6, 6LoWPAN) are adopted in constrained IoT environments.
PO3 (1 - Low)	Minimal design awareness is introduced as students understand how IoT networking components are organized and assembled into functional systems.
PO12 (1 - Low)	Understanding the evolution of IoT fosters awareness of how the field has grown rapidly and encourages students to pursue continuous learning in this dynamic domain.
PSO1 (3 - High)	Directly aligns with PSO1: IoT networking concepts and addressing strategies are central to designing and developing computer, networking, and IoT systems of varying complexity.
PSO2 (2 - Medium)	Awareness of modern IoT platforms and their networking mechanisms partially supports the ability to use modern computing platforms in career and entrepreneurship contexts.
PSO3 (1 - Low)	Basic familiarity with IoT component organization introduces students to open-ended technology environments relevant to product development.

CO2 - Justification

PO / PSO	Justification
PO1 (2 - Medium)	Analyzing sensing devices and actuators requires solid engineering knowledge of transducer principles, signal conditioning, and hardware interfacing fundamentals.
PO2 (3 - High)	Strongly maps to Problem Analysis — students critically examine different sensor/actuator types, their working principles, accuracy, range, and suitability for specific IoT problem contexts.
PO3 (1 - Low)	Selecting appropriate sensors for a problem domain introduces a basic design perspective: matching device characteristics to application requirements.
PO4 (2 - Medium)	Comparison of sensor and actuator characteristics involves investigative thinking to evaluate performance metrics, calibration needs, and operating conditions.
PO5 (1 - Low)	Students interact with sensor datasheets and basic measurement instruments, introducing awareness of modern instrumentation and diagnostic tools.
PO12 (1 - Low)	The rapidly evolving sensor market (MEMS, smart sensors, biosensors) encourages continued self-learning and awareness of emerging sensing technologies.
PSO1 (2 - Medium)	Knowledge of sensing devices and actuators is foundational for designing IoT and data processing systems, directly serving PSO1 goals.
PSO2 (3 - High)	Modern sensor technologies and IoT hardware platforms are directly relevant skills for career development and entrepreneurship in the IoT product space.
PSO3 (1 - Low)	Understanding sensor interfaces helps in developing quality IoT products through open-ended programming environments such as Arduino and Raspberry Pi.

CO3 - Justification

PO / PSO	Justification
PO1 (2 - Medium)	Demonstrating IoT processing requires knowledge of microcontrollers, embedded OS, data pipelines, and cloud integration — core engineering knowledge domains.
PO2 (1 - Low)	IoT processing pipelines require students to understand the challenge of transforming raw sensor data into meaningful, actionable outputs.
PO3 (3 - High)	Designing and demonstrating IoT processing solutions directly calls for developing functional system solutions — strongly aligned with the design/development of solutions PO.
PO5 (2 - Medium)	Students employ modern tools such as Python IDEs, embedded platforms (Raspberry Pi), and IoT simulators to demonstrate and validate processing capabilities.
PO9 (2 - Medium)	Lab demonstrations of IoT processing systems often involve collaborative team setups, supporting individual and team work skills.
PO12 (1 - Low)	IoT processing architectures (edge, fog, cloud) evolve rapidly; exposure to these concepts cultivates a habit of continuous learning.
PSO1 (1 - Low)	IoT data processing using Python is a fundamental component of building computer and networking system applications addressed in PSO1.
PSO2 (2 - Medium)	Hands-on processing demonstrations using Python and IoT platforms prepare students to leverage modern computing environments for career development.
PSO3 (3 - High)	Directly supports PSO3: students use and enhance open-ended programming environments (Python, Raspberry Pi) to deliver quality IoT processing solutions.

CO4 - Justification

PO / PSO	Justification
PO1 (3 - High)	Applying connectivity technologies (Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT, cellular) requires deep engineering knowledge of communication protocols, standards, and network stacks.
PO3 (3 - High)	Students design and implement communication layers for IoT systems (using Raspberry Pi), directly exercising the development-of-solutions competency.
PO4 (1 - Low)	Comparing connectivity options involves investigative analysis of trade-offs in range, power consumption, data rate, latency, and cost.
PO5 (2 - Medium)	Modern wireless analysis tools, network configuration utilities, and protocol analyzers are used in practical connectivity sessions.
PO9 (1 - Low)	Group lab activities during connectivity and case study experiments foster basic teamwork and collaborative problem-solving skills.

PO12 (1 - Low)	New connectivity standards continually emerge (Matter, Wi-Fi 6, 5G NR-IoT); staying current requires life-long learning habits.
PSO1 (1 - Low)	Connectivity is a key pillar of IoT and networking systems design — a direct enabler of the skills described in PSO1.
PSO2 (2 - Medium)	Proficiency in IoT connectivity technologies enhances employability and supports building innovative products as an entrepreneur.
PSO3 (1 - Low)	Implementing connectivity in open-ended environments (Raspberry Pi, Python socket libraries) supports the delivery of quality end-to-end IoT products.

CO5 - Justification

PO / PSO	Justification
PO1 (3 - High)	Understanding data analytics and IoT security requires knowledge of big data frameworks (Hadoop, Spark, Storm), cryptographic principles, and threat modeling — all core engineering knowledge.
PO10 (1 - Low)	Elaborating on analytics pipelines and security concerns requires students to communicate findings clearly to technical and non-technical stakeholders.
PO11 (1 - Low)	Selecting and deploying analytics frameworks (Apache Oozie, Spark) involves basic resource planning and project scheduling considerations.
PO12 (1 - Low)	Cybersecurity threats and analytics frameworks evolve rapidly; this CO establishes the importance of continuous learning in data protection and processing technologies.
PSO2 (3 - High)	Data analytics and IoT security are among the most in-demand industry skills, directly supporting career development, higher studies, and entrepreneurship paths in PSO2.
PSO3 (1 - Low)	Security-aware and analytics-driven programming practices support the delivery of robust quality products in open-ended environments.

CO6 - Justification

PO / PSO	Justification
PO1 (1 - Low)	Implementing Arduino-based embedded systems requires foundational engineering knowledge of microcontroller architecture, GPIO interfacing, and sensor communication protocols.
PO2 (1 - Low)	Designing solutions for real-world automation and monitoring problems requires problem analysis to determine the right sensor/actuator combinations and control logic.
PO3 (1 - Low)	Students go through the complete design-to-implementation-to-testing cycle for embedded IoT applications, engaging directly with development of solutions.
PO5 (1 - Low)	Arduino IDE, breadboards, oscilloscopes, and various sensor modules are modern prototyping tools that students directly employ in every lab experiment.
PSO1 (1 - Low)	Building automation and monitoring IoT applications using Arduino directly supports PSO1's goal of designing and developing computer, networking, and IoT systems.

Target Value Justification:

The target values represent the average CO-PO/PSO correlation across all COs and reflect the overall emphasis this course places on each program outcome.

PO / PSO	Justification
PO1 - 2.3	CO1, CO2, CO4, and CO5 each carry a high (3) correlation to PO1. IoT is an engineering knowledge-intensive course covering hardware, protocols, platforms, and analytics. The weighted average of 2.3 reflects this strong overall alignment.
PO2 - 1.5	Problem analysis is addressed with medium (3) correlation in CO2 (sensor selection/comparison) and low (1) correlation in CO1, CO3, CO6, with gaps in CO4 and CO5. The average of 1.5 reflects moderate coverage.
PO3 - 1.6	Solution design/development is high (3) in CO3 and CO4 and low (1) in CO1, CO5, CO6. The target of 1.6 reflects that design is exercised significantly in the practical modules.
PO4 - 1.5	Investigation of complex problems is addressed in CO2 (2) and CO4 (1); other COs do not map. The active COs justify a moderate target of 1.5.
PO5 - 1.5	Modern tool usage is covered with medium (2) correlation in CO3 and CO4 and low (1) in CO2 and CO6. The average of 1.5 reflects consistent tool exposure across the course.
PO9 - 1.5	Individual and teamwork is exercised in CO3 (2) and CO4 (1) during lab-based collaborative sessions. Target of 1.5 reflects meaningful but limited team-based activity.

PO10 - 1	Communication skills are lightly addressed in CO5 when students elaborate analytics and security findings. The target of 1 reflects a low but present correlation.
PO11 - 1	Project management elements are lightly introduced in CO5 (analytics framework deployment) and CO6 (mini project planning). The target of 1 reflects minimal but non-zero engagement.
PO12 - 1	All six COs contribute minimally to life-long learning by exposing students to rapidly evolving IoT technologies — sensors, protocols, analytics, and security. A uniform target of 1 is justified.
PSO1 - 1.6	CO1 (3) and CO2 (2) carry high correlation; CO3, CO4, CO6 (1 each) and CO5 (–) contribute lower scores. The average of 1.6 reflects solid coverage of computer, networking, and IoT system design skills.
PSO2 - 2.4	CO2 (3), CO5 (3), CO1 (2), CO3 (2), CO4 (2) all show medium to high correlation. The strong overall alignment to career-enabling skills in modern IoT platforms yields the highest target of 2.4.
PSO3 - 1.4	CO3 (3) directly targets open-ended programming environments; CO1, CO2, CO4, CO5 show low (1) correlation. CO6 shows no mapping. The average of 1.4 reflects moderate but targeted coverage.

Course Content (Syllabus)

Module	CH
Module 1 - Introduction to Internet of Things *[Ch. 1] | RBT: as indicated in schedule* • Introduction to IoT • Physical Design of IoT • Logical Design of IoT • IoT Enabling Technologies • IoT Levels & Deployment Templates	**08**
Module 2 - IoT and M2M *[Ch. 3.1-3.4, 4.1-4.6] | RBT: as indicated in schedule* • Introduction to 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	**08**
Module 3 - IoT Platforms Design Methodology *[Ch. 5.1-5.3, 6.2-6.11] | RBT: as indicated in schedule* • Introduction and IoT Design Methodology • Case Study: IoT System for Weather Monitoring • IoT Systems - Logical Design using Python • Python: Data Types, Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Classes • Python Packages of Interest for IoT	**08**
Module 4 - IoT Physical Devices & End Points *[Ch. 7.1-7.6, 9.2, 9.3, 9.5] | RBT: as indicated in schedule* • What is an IoT Device? • Raspberry Pi: Board Overview, Linux, Interfaces, Programming with Python • Case Studies: Home Automation, Smart Cities, Agriculture	**08**
Module 5 - Data Analytics for IoT *[Ch. 10] | RBT: as indicated in schedule* • Introduction to Data Analytics for IoT • Apache Hadoop & Hadoop MapReduce for Batch Data Analytics • Apache Oozie, Apache Spark • Apache Storm for Real-Time Data Analysis	**08**

Schedule of Instruction:

Module 1: Introduction to Internet of Things

Class No.	Topic	Date	RBT	CO	Mode
1	Vision & Mission of the Institution	20-Jul-2026			
2	Introduction to IoT	21-Jul-2026	L1	CO1	ICT
3	Physical Design of IoT	22-Jul-2026	L2	CO1	Lecture
4	Logical Design of IoT	23-Jul-2026	L2	CO1	Lecture
5	Logical Design of IoT	27-Jul-2026	L2	CO1	ICT
6	IoT Enabling Technologies	28-Jul-2026	L2	CO1	ICT
7	IoT Enabling Technologies	29-Jul-2026	L2	CO1	ICT
8	IoT Levels & Deployment Templates	30-Jul-2026	L2	CO1	ICT
9	IoT Levels & Deployment Templates	03-Aug-2026	L2	CO1	ICT
10	Role Play + Revision - Module 1 Concepts	04-Aug-2026	L3	CO1	Role Play + Note book llm-Mindmap

Module 2: IoT and M2M

Class No.	Topic	Date	RBT	CO	Mode
11	Introduction	05-Aug-2026	L1	CO2	Lecture
12	M2M and Difference between IoT and M2M	06-Aug-2026	L2	CO2	ICT
13	SDN and NFV for IoT	10-Aug-2026	L2	CO2	Lecture
14	IoT System Management with NETCONF-YANG	11-Aug-2026	L3	CO2	Lecture
15	Need for IoT Systems Management	12-Aug-2026	L2	CO2	ICT
16	SNMP	13-Aug-2026	L4	CO2	Lecture
17	Network Operator Requirements and NETCONF	17-Aug-2026	L4	CO2	ICT
18	YANG	18-Aug-2026	L4	CO2	ICT
19	IoT Systems Management using NETCONF-YANG	19-Aug-2026	L4	CO2	ICT
20	Role Play + Revision - Module 2 Concepts	20-Aug-2026	L3	CO2	Role Play + Note book llm-Mindmap

Module 3: IoT Platforms Design Methodology

Class No.	Topic	Date	RBT	CO	Mode
21	Introduction and IoT Design Methodology	24-Aug-2026	L2	CO3	Lecture
22	Case Study: Weather Monitoring System	25-Aug-2026	L3	CO3	Lecture
23	Logical Design using Python	27-Aug-2026	L3	CO3	Lecture
24	Python Introduction and Installation	31-Aug-2026	L2	CO3	Hands-on / Lecture
25	Python Data Types and Data Structures	01-Sep-2026	L3	CO3	Hands-on / Lecture
26	Revision – For first Internals	09-Sep-2026		CO3	Revision
27	Scheme Discussion	15-Sep-2026		-	Discussion
28	Control Flow, Functions and Modules	16-Sep-2026	L3	CO3	Hands-on / Lecture
29	Packages and File Handling	17-Sep-2026	L3	CO3	Hands-on / Lecture
30	Operations and Classes	21-Sep-2026	L3	CO3	Hands-on / Lecture
31	Python Packages for IoT	22-Sep-2026	L3	CO3	Hands-on / Lecture
32	Role Play + Revision - Module 3 Concepts	23-Sep-2026	L3	CO3	Role Play + Note book llm-Mindmap

Module 4: IoT Physical Devices and End Points

Class No.	Topic	Date	RBT	CO	Mode
33	What is an IoT Device?	24-Sep-2026	L2	CO4	Lecture
34	Raspberry Pi and Board Architecture	28-Sep-2026	L3	CO4	Lecture
35	Linux on Raspberry Pi	29-Sep-2026	L3	CO4	ICT
36	Raspberry Pi Interfaces	30-Sep-2026	L3	CO4	ICT
37	Programming Raspberry Pi with Python	01-Oct-2026	L3	CO4	ICT
38	Programming Raspberry Pi with Python	05-Oct-2026	L3	CO4	ICT
39	Case Studies: Home Automation, Smart Cities, Agriculture	06-Oct-2026	L3	CO4	ICT
40	Case Studies: Home Automation, Smart Cities, Agriculture	07-Oct-2026	L3	CO4	ICT
41	Role Play + Revision - Module 4 Concepts	08-Oct-2026	L3	CO4	Role Play + Note book llm-Mindmap

Module 5: Data Analytics for IoT

Class No.	Topic	Date	RBT	CO	Mode
42	Introduction	12-Oct-2026	L2	CO5	ICT
43	Apache Hadoop	13-Oct-2026	L2	CO5	ICT
44	Hadoop MapReduce for Batch Data Analytics	14-Oct-2026	L4	CO5	Hands-on / ICT
45	Hadoop MapReduce for Batch Data Analytics	15-Oct-2026	L4	CO5	Hands-on / ICT
46	Apache Oozie	19-Oct-2026	L2	CO5	ICT
47	Apache Oozie	22-Oct-2026	L2	CO5	ICT
48	Apache Spark	29-Oct-2026	L2	CO5	ICT
49	Apache Spark	02-Nov-2026	L2	CO5	ICT
50	Apache Storm	03-Nov-2026	L2	CO5	ICT
51	Apache Storm	04-Nov-2026	L2	CO5	ICT
52	Apache Storm for Real-Time Data Analytics	05-Nov-2026	L2	CO5	ICT
53	Apache Storm for Real-Time Data Analytics	09-Nov-2026	L2	CO5	ICT
54	Role Play + Revision - Module 5 Concepts	11-Nov-2026	L3	CO5	Role Play + Note book llm-Mindmap
55	Revision for Semester End Examination (All Modules)	TBD		CO1-CO6	Chat gpt

Self-study hours:

For 3 Credits: Self-study hours = 90 hours – Course delivery planned hours = 90 – 55 = 35 hours

SL#	Self-study content	Hours
1.	Mini project: Literature survey	10 hours
2.	Study of Components/Sensors/Modules required for the Mini Project	15 hours
3.	Report	10 hours
	Total hours	**35 hours**

Laboratory Schedule (IPCC):

Exp. No.	Experiment	Date (B1)	Date (B2)	RBT	CO	Mode
1	Blink 5 LEDs back and forth	28-Jul-2026	29-Jul-2026	L3	CO6	Lab
2	Interface Relay with Arduino	04-Aug-2026	05-Aug-2026	L3	CO6	Lab
3	Intrusion Detection using Ultrasonic and Sound Sensors	11-Aug-2026	12-Aug-2026	L3	CO6	Lab
4	DC Motor Control using Arduino	18-Aug-2026	19-Aug-2026	L3	CO6	Lab
5	Smart Street Light using LDR Sensor	01-Sep-2026	02-Sep-2026	L3	CO6	Lab
6	Dry/Wet Waste Classification using Moisture Sensor	08-Sep-2026	09-Sep-2026	L3	CO6	Lab
7	pH Measurement of Milk, Lime and Water	15-Sep-2026	16-Sep-2026	L3	CO6	Lab
8	Gas Leakage Detection System	22-Sep-2026	23-Sep-2026	L3	CO6	Lab
9	Weather Station using Arduino	29-Sep-2026	30-Sep-2026	L3	CO6	Lab
10	UART Communication Protocol	06-Oct-2026	07-Oct-2026	L3	CO6	Lab
11	Water Level Detection using Ultrasonic Sensor	13-Oct-2026	14-Oct-2026	L3	CO6	Lab
12	Keypad Interfacing and Keystroke Recording	03-Nov-2026	04-Nov-2026	L3	CO6	Lab

Textbooks & Reference books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

T1	Arshdeep Bahga, Vijay Madisetti, "Internet of Things - A Hands-On Approach", Universities Press, 2014.
R1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
R2	Srinivasa K G, "Internet of Things", CENGAGE Learning India, 2017.

Web links and Video Lectures (e-Resources):

1	https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2	https://docs.arduino.cc/
3	https://www.arduino.cc/education/certification
4	https://www.udemy.com/topic/arduino/
5	https://sites.google.com/view/manjujshree-coursewebsite/course-material/internet-of-things-iot

Assessment Schedule:

S.N	Assessment Type	Content	CO	Duration	Marks	Date
1	CIE 1 (Theory)	Module 1, Module 2 & Module 3 (half)	CO1,CO2,CO 3	90 mins	15	
2	CIE 2 (Theory)	Module 3 (half), Module 4 & Module 5	CO3,CO4,CO 5	90 mins	15	
3	CIE (Lab) - Record	Program 1 to 12	CO6	-	10	
4	CIE (Lab) - Test	Program 1 to 12	CO6	2 hrs	10	
5	Mini Project	Arduino/Raspberry Pi based projects	CO6	-	10	
6	Semester End Examination	Module 1, 2, 3, 4, 5	1,2,3,4,5,6	3 hrs	50	

Total Marks: 100

RB - Textbook/Reference Book | L - Lecture | V - Videos or any other mode | RBT - Revised Blooms' Taxonomy | L:T:P:C - Lecture:Tutorial:Practical:Credits | SEE - Semester End Examination | CIE - Continuous Internal Evaluation

Weightage: CIE - 50% | SEE - 50%. Minimum passing marks: CIE - 40% (20/50), SEE - 35% (18/50). A student earns credits upon securing a minimum of 40% in the sum total of CIE and SEE (40/100).

Faculty In-charge **Course Coordinator** **HoD**