

## MANIPAL UNIVERSITY JAIPUR

Department of IoT & Intelligent Systems

Course Hand-out

### A. Basic Details:

Programme Name:	B.Tech CSE (IoT & IS)
Course Name:	IoT Architecture and Design
Course Code:	IIS3201
LTPC ( <i>Lecture Tutorial Practical Credits</i> ):	3-1-0-4
Session:	January – May 2026
Class:	III Year / VI Semester
Course Coordinator:	<b>Dr Sunil Kumar</b>
Course Instructor(s):	Prof. Dinesh Kumar Saini, Dr Usha Choudhary, Dr Sunil Kumar and Dr Rajesh Kumar
Additional Practitioner(s) – if any ( <i>Industry Fellow/ Visiting Faculty/ Adjunct Faculty, etc.</i> ):	To be identified and appointed later/ or at the beginning of the semester

**B. Introduction:** The course IoT Architecture and Design introduces students to the architectural foundations, protocols, platforms, and system-level design of Internet of Things (IoT) solutions. It covers enabling technologies, standardized architectures, IoT communication protocols, embedded platforms, cloud services, and real-world application case studies. The course emphasizes design methodology, scalability, and analytics-driven decision making for modern IoT systems.

### C. Course Outcomes:

CO Statement	CO	Bloom's Level	Target Attainment %	Target Attainment level
CO1	Explain fundamentals, evolution, and architectures of IoT systems	Understand	≥70%	2
CO2	Analyze IoT protocols and networking technologies	Analyze	≥70%	2
CO3	Design IoT systems using embedded platforms and design methodology	Apply	≥80%	3
CO4	Evaluate cloud platforms and data analytics for IoT applications	Evaluate	≥70%	2

CO5	Develop IoT use-case solutions for real-world domains	Create	≥80%	3
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- Target Attainment Level: Tentative/ Estimated target attainment for each CO. Information about Target Attainment Levels is mentioned as follows:

Attainment (%)	Level
< 60 %	0
≥ 60% < 70%	1
≥ 70% < 80%	2
≥ 80	3

**D. Program Outcomes and Program Specific Outcomes:** Mention program outcomes and program specific outcomes of the program.

- [PO. 1] **Engineering knowledge:** apply the knowledge of mathematics, computer science, and communication engineering fundamentals to the solution of complex engineering problems.
- [PO. 2] **Problem analysis:** identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using basic principles of mathematics, computing techniques and communication engineering principles.
- [PO. 3] **Design/development of solutions:** design solutions for complex engineering problems and design system components or processes that meet the specified requirements with appropriate consideration for law, safety, cultural & societal obligations with environmental considerations.
- [PO. 4] **Conduct investigations of complex problems:** use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- [PO. 5] **Modern tool usage:** create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- [PO. 6] **The engineer and society:** apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- [PO. 7] **Environment and sustainability:** understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- [PO. 8] **Ethics:** apply ethical principles and commit to professional ethics, responsibilities and norms of the engineering practice.
- [PO. 9] **Individual and teamwork:** function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- [PO. 10] **Communication:** communicate effectively for all engineering processes & activities with the peer engineering team, community and with society at large. Clarity of thoughts, being able to comprehend and formulate effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- [PO. 11] **Project management and finance:** demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in varied environments.
- [PO. 12] **Life-long learning:** recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

- [PSO.1] **Apply** the fundamental knowledge of computer science and engineering in developing effective software/hardware for real world complex engineering problems by adapting advanced technologies.
- [PSO.2] **Analyze** and configure various IoT based innovative and smart applications using recent hardware and software tools.
- [PSO.3] **Design** industrial IoT based solutions for improving operational efficiency at home and industry automation systems.

#### E. Assessment Plan: C

Criteria	Description	Maximum Marks
Internal Assessment (Formative and Summative)	Mid-Term Examination (Close/ Open Book)	30
	<b>Class Work Sessional (CWS):</b> 1. Quiz: <b>5 Marks</b> 2. Video Assignment: <b>5 Marks</b> 3. Research and Project work: <b>20 Marks</b>	30
End Term Exam (Summative)	End Term Exam (Close/ Open Book)	40
	Total	100

- F. Syllabus:** Fundamentals of IoT: Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoT-WF) standardized architecture, simplified IoT architecture, functional blocks of an IoT ecosystem, sensors, actuators, smart objects and connecting Smart Objects. IoT Protocols: IoT access technologies: physical and MAC layers, topology and security of IEEE 802.15.4, 802.11ah and LoRaWAN, Network Layer: IP versions, constrained nodes and constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, application layer protocols CoAP and MQTT, ZigBee. Design And Development: Design methodology, embedded computing logic, microcontroller, system on chips, IoT system building blocks. IoT Platform: IoT supported hardware platforms such as: Raspberry pi and Arduino. Data Analytics: Introduction, structured v/s unstructured data, challenges. Supporting Services: Cloud computing platform for IoT/M2M applications/services, everything as a service and cloud service models. Case Studies: IoT applications in home, industries, agriculture, healthcare, and security.

#### Reference Books:

1. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key applications and Protocols", Wiley Publications 2nd edition, 2013
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015

3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
4. Raj Kamal, “Internet of Things – Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017
5. Internet of Things and Data Analytics, Hwaiyu Geng, P.E, Wiley Publications, 2017
6. Marco Schwartz, —Internet of Things with the Arduino Yunll, Packt Publishing, 2014
7. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley Publications 2012

**G. Lecture Plan:**

Lecture No.	Topic	Session Outcome	Corresponding CO	Mode of delivery	Mode of assessing CO
1	Evolution of IoT	Explain IoT growth	CO1	Lecture	Quiz/PPT
2	Enabling Technologies	Identify key enablers	CO1	Lecture	Quiz/PPT
3	M2M Communication	Explain M2M vs IoT	CO1	Lecture	Assignment
4	IoT-WF Architecture	Describe layers	CO1	Lecture	Quiz/PPT
5	Simplified IoT Architecture	Compare architectures	CO1	Lecture	Discussion
6	Functional Blocks	Identify components	CO1	Lecture	Quiz/PPT
7	Sensors & Actuators	Understand sensing	CO1	Demo	Assignment
8	Smart Objects	Explain smart objects	CO1	Lecture	Quiz/PPT
9	IEEE 802.15.4	Analyze PHY/MAC	CO2	Lecture	Quiz/PPT

10	Topology & Security	Evaluate security	CO2	Lecture	Assignment
11	IEEE 802.11ah	Explain LPWAN	CO2	Lecture	Quiz/PPT
12	LoRaWAN	Analyze LoRaWAN	CO2	Lecture	Quiz/PPT
13	IP Versions	Explain IPv4/IPv6	CO2	Lecture	Quiz/PPT
14	Constrained Networks	Understand constraints	CO2	Lecture	Assignment
15	6LoWPAN	Explain adaptation	CO2	Lecture	Quiz/PPT
16	SCADA	Industrial IoT	CO2	Lecture	Case Study
17	CoAP	Analyze protocol	CO2	Lecture	Quiz/PPT
18	MQTT	Publish-subscribe	CO2	Lecture	Assignment
19	ZigBee	Compare protocols	CO2	Lecture	Assignment
20	IoT Design Methodology	Explain design flow	CO3	Lecture	Research work

21	Embedded Logic	Understand logic	CO3	Lecture	Quiz/PPT
22	Microcontrollers	Analyze MCU	CO3	Demo	Assignment
23	System on Chip	Evaluate SoC	CO3	Lecture	Quiz/PPT
24	IoT Building Blocks	Identify blocks	CO3	Lecture	Quiz/PPT
Mid Term Examination					
26	Arduino Platform	Program Arduino	CO3	Lab Demo	Assignment
27	Raspberry Pi	Analyze Pi	CO3	Demo	Assignment
28	Platform Comparison	Arduino vs Pi	CO3	Discussion	Quiz/PPT
29	Data Analytics Intro	Understand data	CO4	Lecture	Quiz/PPT
30	Structured Data	Analyze data types	CO4	Lecture	Assignment
31	Unstructured Data	Big data basics	CO4	Lecture	Quiz/PPT
32	Analytics Challenges	Evaluate issues	CO4	Lecture	Research work

33	Cloud Computing	IoT cloud	CO4	Lecture	Quiz/PPT
34	XaaS Models	Explain service models	CO4	Lecture	Quiz/PPT
35	Cloud Platforms	AWS/Azure basics	CO4	Lecture	Assignment
36	Security in IoT	Security challenges	CO4	Lecture	Research work
37	Smart Home Case Study	Analyze use case	CO5	Case Study	Case Study
38	Industrial IoT	Factory IoT	CO5	Lecture	Research work
39	Smart Agriculture	IoT farming	CO5	Lecture	Quiz/PPT
40	Healthcare IoT	Medical IoT	CO5	Lecture	Research work
41	Security Systems	Surveillance IoT	CO5	Lecture	Quiz/PPT
42	Smart Cities	Urban IoT	CO5	Lecture	Assignment
43	System Integration	End-to-end design	CO5	Discussion	Project

44	Mini Project Review	Evaluate design	CO5	Presentation	Evaluation
45	Future Trends	AI & IoT	CO5	Lecture	Quiz/PPT
46	Revision	Consolidate learning	All	Discussion	Quiz/PPT
47	Doubt Clearing	Address gaps	All	Tutorial	Interaction
End Term Examination					

Outside class engagement activities (To complete the 30 Notional hours for each credit as per NCrf guidelines):

Type of Activity	Difficulty Level	Hours Engaged
PPT Presentation	Medium	10
Research and Mini Project	High	12
Case Study Analysis	Medium	8

### **Pedagogical Approaches:**

1. Course coordinators should include at least 5 pedagogical approaches from the following list and mention the same in respective lecture under “Mode of delivery”:
  - I. Lecture based teaching-learning
  - II. Group- teaching and learning
  - III. Individual learning/ self-study
  - IV. Technology based learning
  - V. Peer teaching
  - VI. Learning through problem-solving
  - VII. Flipped Classroom, etc.
2. Some lectures should be marked as \* that indicates the lectures to be covered by additional practitioners (Industry Fellow/ Visiting Faculty/ Adjunct Faculty, etc.)

### **H. Learner centric activities:**

#### **Sample activities at low-difficulty level:**

- One-on-one remedial sessions or tutorials
- Peer-assisted learning or buddy systems
- Quizzes with immediate feedback for concept reinforcement
- Step-by-step problem-solving exercises
- Use of visual aids or concept maps for better comprehension
- Simplified handouts or summarized notes
- List out the online video tutorial for learning few complex concepts of the course.

#### **Sample activities at high-difficulty level:**

- Assignments involving real-life application or case studies
- Mini research projects or presentations
- Participation in technical clubs, hackathons, or competitions
- Encouragement to explore MOOCs or online certifications related to the course
- Mentoring peers or leading study groups
- Higher-order thinking assignments (analysis, evaluation, creation)
- List out the online study materials on the subjects from top experts in the domain

### **I. Outside Class Engagement Activities:**

#### **Sample Outside Class Engagement Activities:**

- Participating in academic clubs, technical competitions, or seminars
- Collaborating with faculty or peers on research ideas or innovative prototypes
- Attending faculty-guided doubt-clearing or reinforcement sessions
- Watching recommended video lectures, tutorials, or educational webinars

- Participating in group study circles or peer-learning sessions
- Visiting laboratories or project labs for extended hands-on practice
- Exploring relevant online courses, MOOCs, or certification programs
- Writing short reflective summaries or maintaining learning journals
- Engaging in mini-projects, case studies, or problem-solving exercises
- Contributing to departmental blogs, newsletters, or student magazines

**J. Course Articulation Matrix:**

Here value 0 indicates no correlation, 1 as low correlation, 2 as moderate correlation, and 3 as substantial / strong correlation.

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1						1				1	3		
CO2	3	2	1	1	3			1				1		3	2
CO3	3	1	1	1				1				1	3	1	2
CO4	3	1	1					1				1	2	1	
CO5	3	3	3	2	3	2	1	1	2	2	1	1		3	3