21ES614 – Internet of Things

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Course Outcomes (COs)

- CO1:Understand the concepts and principles of IoT.
- CO2: Implement communication protocols related to IoT and machine to machine communication (M2M).
- CO3: Familiarize key technologies in an IoT framework.
- CO4: Develop IoT based solution for real world applications.

Syllabus (3-0-2-4)

Unit 1

Introduction to IoT - Definitions, frameworks and key technologies. Functional blocks of IoT systems: hardware and software elements- devices, communications, services, management, security, and application. Challenges to solve in IoT.

Unit 2

Basics of Networking & Sensor Networks - Applications, challenges - ISO/OSI Model, TCP/IP Model. Sensor network architecture and design principles. IoT technology stack -overview of protocols in each layer. Communication Protocols. Communication models, Application protocols for the transfer of sensor data. Infrastructure for IoT: LoRa-Wan, 6LoWPAN, 5G and Sigfox. Operating systems and programming environments for embedded units (Contiki).

Unit 3

Introduction to Cloud, Fog and Edge Computing- Modern trends in IoT – Industrial IoT, Wearable. Applications of IoT - Smart Homes/Buildings, Smart Cities, Smart Industry, and Smart Medical care, Smart Automation etc.

Literature I

- Computer Networks
  - Andrew S. Tanenbaum and David J. Wetherall
  - 5th Edition, Pearson Education, 2011

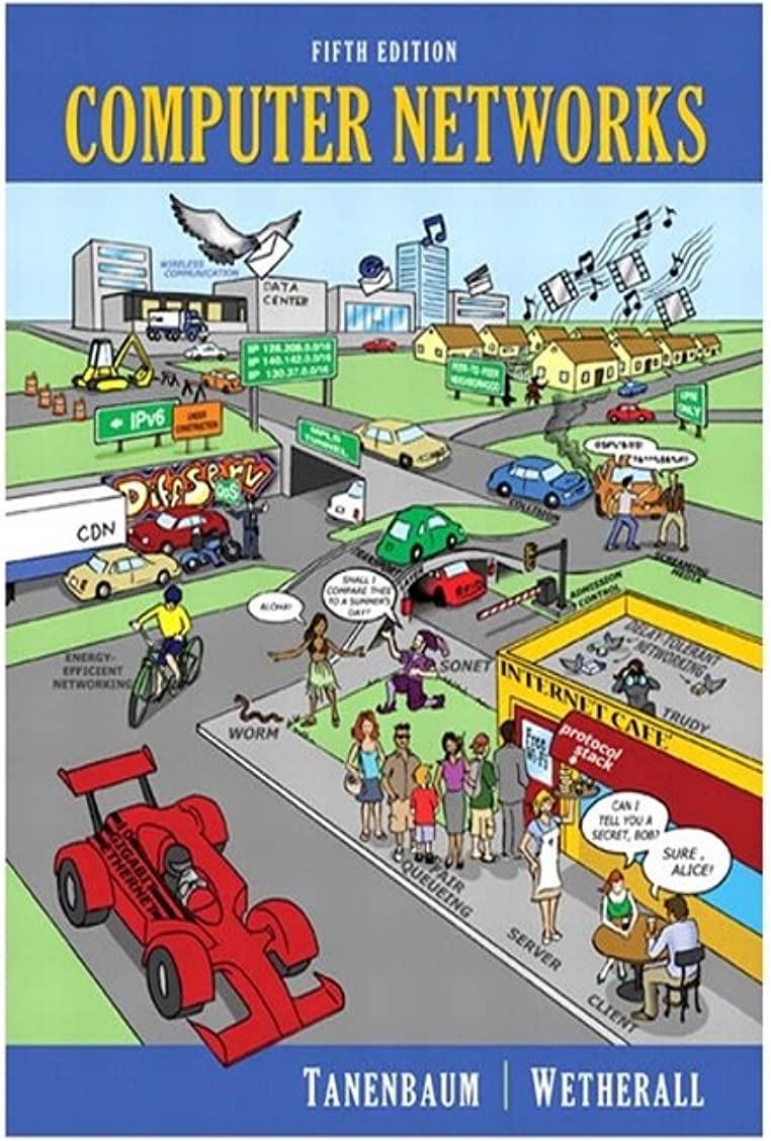

Image Courtesy: https://www.amazon.in/Computer-Networks-Andrew-S-Tanenbaum/dp/0132126958

Literature II

- Protocols and Architectures for Wireless Sensor Networks
  - Holger Karl and Andreas Willig
  - 1st Edition, Wiley, 2005

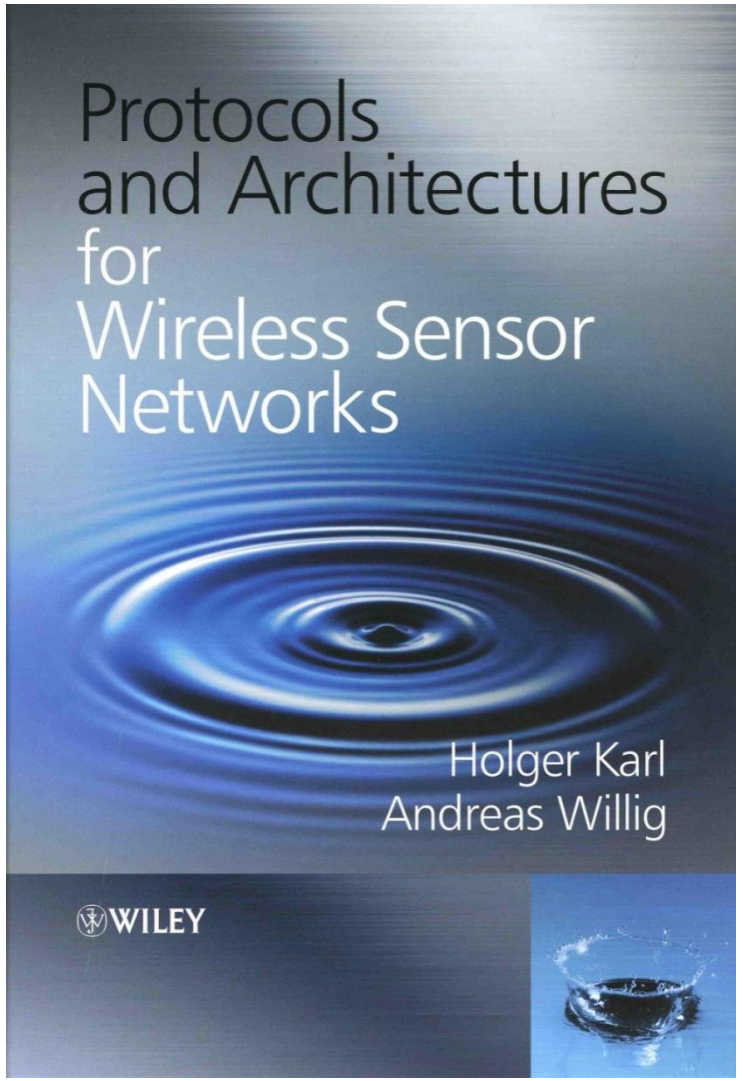

Image Courtesy: https://www.amazon.in/Protocols-Architectures-Wireless-Sensor-Networks/dp/0470519231

Literature III

- The Internet of Things: Key Applications and Protocols
  - Olivier Hersent, David Boswarthick and Omar Elloumi
  - 1st Edition, Wiley, 2012

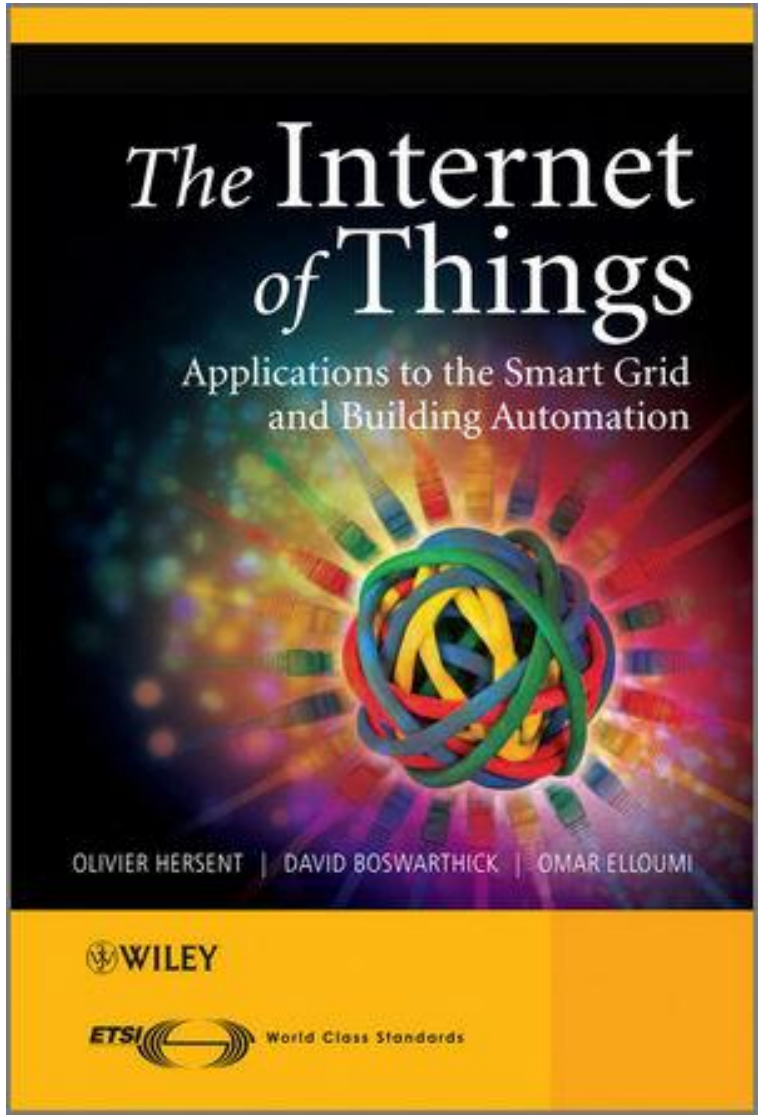

Image Courtesy: https://www.amazon.in/Internet-Things-Key-Applications-Protocols/dp/1119994357

Literature IV

- Internet of Things from Hype to Reality
  - Rayes, Ammar, Salam, Samer
  - 2nd Edition, Springer, 2018.

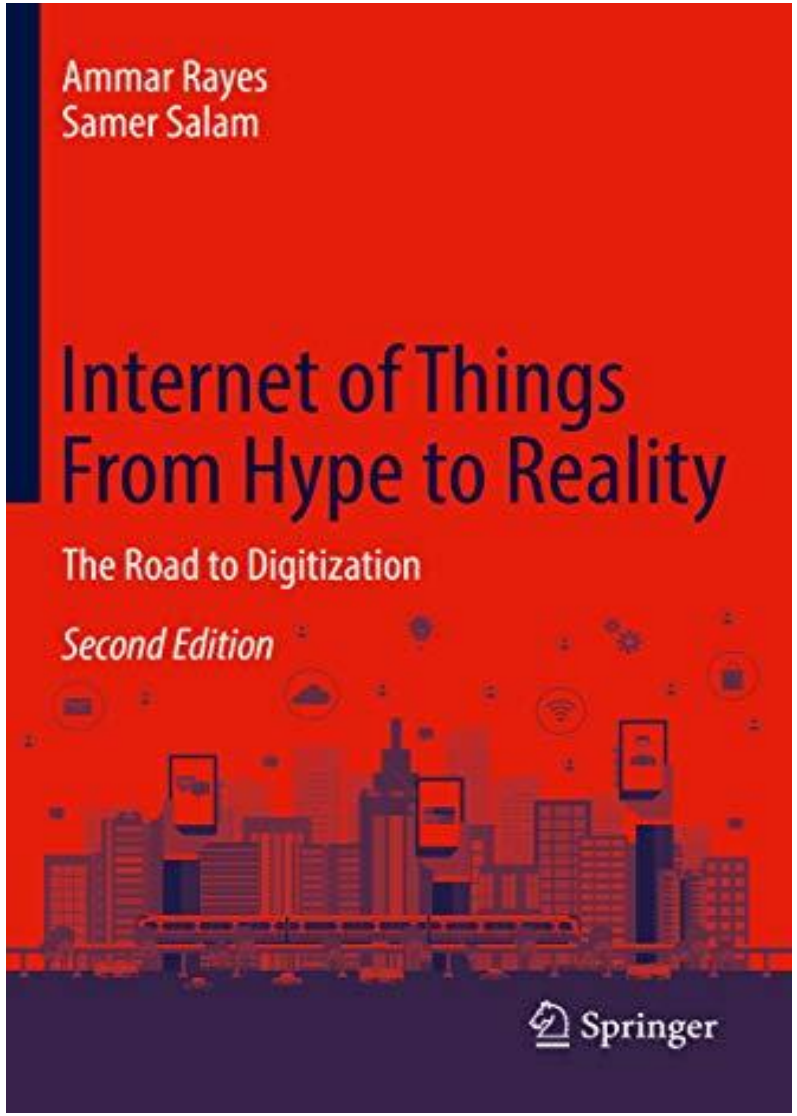

Image Courtesy: https://www.amazon.in/Internet-Things-Hype-Reality-Digitization-ebook/dp/B07FKJQJQ8

Literature V

- The Technical Foundations of IoT
  - Boris Adryan, Dominik Obermaier, Paul Fremantle
  - 2nd Edition, Artech House, 2017.

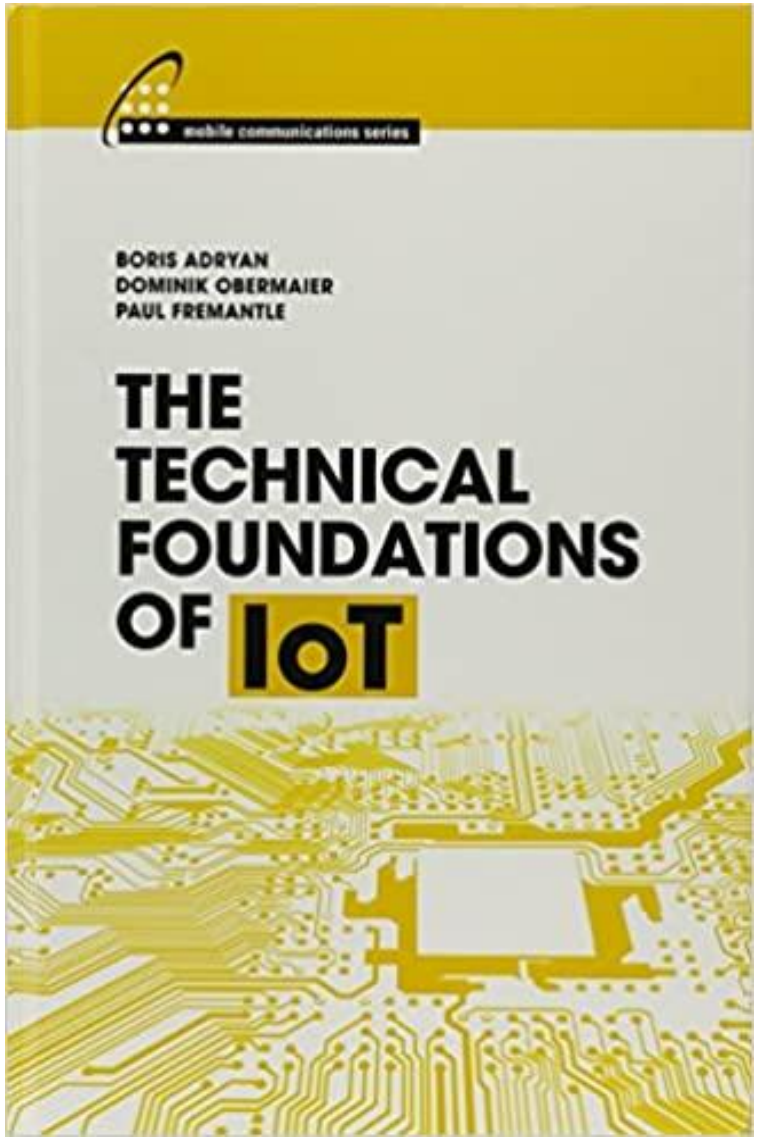

Image Courtesy: https://www.amazon.in/Technical-Foundations-IoT-Boris-Adryan/dp/163081251X

Similar Courses

1. https://nptel.ac.in/courses/106105166 or https://archive.nptel.ac.in/courses/106/105/106105166/
2. https://nptel.ac.in/courses/106105195

Evaluation Pattern – 60:40

- **Mid-Term – 30 marks** (Conducted out of 50 & converted to 30)
- **Lab Evaluations – 30 marks** (For 12 experiments)
- **Project – 40 marks** (Real word IoT solution)
- Total ----> **100 marks (Internal 60, External 40)**

Lab Experiments

No:	Experiment	Date	COs	Remarks
	Introduction	9 Dec 2024		
1	Familiarization of various communication networks in NetSim and Wireshark	14 Dec 2024	CO1 CO2 CO3 CO4	Practice
2	IoT end nodes with Ubidots, Adafruit, ThingSpeak	16 Dec 2024		Practice
3	Sensing – Data – Analog, Digital, via protocol; Processing; Actuation – On/Off,	23 Dec 2024		Practice
4	Continuous; Signal conditioning circuit; Communication. Platforms – Data display, control initiation.	30 Dec 2024		Evaluation
5	Simulation study on IEEE 802.3/802.11 networks using NetSim	6 Jan 2024		Practice
6	Simulation study on ZigBee/Wireless Sensor Networks using NetSim	20 Jan 2024		Practice
7	IoT networks simulation in NetSim & Wireshark packet data extraction	25 Jan 2024		Evaluation

Lab Experiments

No:	Experiment	Date	COs	Remarks
8	Familiarization of socket connection using microcontroller board and PC/Laptop	27 Jan 2024	CO1 CO2 CO3 CO4	Practice
9	IoT edge node – Data aggregation and communication	17 Feb 2024		Practice
10	IoT edge node – Edge computing and communication	24 Feb 2024		Practice
11	Demonstration of IoT edge device – aggregation, edge computing & communication	3 March 2024		Evaluation
12	Implementation of UI for data visualization & remote control	10 March 2024		Practice
13	Implementation of database for edge/end node data storage	17 March 2024		Practice
14	Implementation of a server with database and UI	24 March 2024		Evaluation

Project

- An IoT solution for a real-world automation problem having the following,
  a. IoT end-to-end solution for a real-world problem
     i. Topic - Justice and compliance to the topic.
     ii. Component selection - Justification for component selection.
     iii. Demonstration - Operational results for selected automation problem.
  b. Minimum three nodes
     i. End (minimum two)/Edge (minimum one) nodes.
     ii. End nodes – Sensor/Actuator (or both) with µC and communication device.
     iii. Edge node – Interconnecting two networks – protocol conversion, edge computing – aggregation, averaging, etc.
  c. Server/Cloud facility with
     i. UI (Mobile/Web application),
     ii. Computing (at least minimal processing and decision making), and,
     iii. Database (data storage – structured or unstructured).
  d. Demonstration of IoT technologies
     i. Concepts - Communication models (publish-subscribe, request-response, etc.).
     ii. Tools/framework - Cloud/Rapid prototyping.
     iii. Comprehension - Alternate options/Scaling in terms of size and features.

Rubrics

	Components	Marks	Instrument	Guidelines/Remarks
1	Mid-Term Examination	30		
1.1	Mid-Term Examination	30	Pen & Paper	2 hours – 50 marks; converted to 30 marks.
2	Lab Experiment Evaluation	30		
2.1	Lab Evaluation 1	9	Lab/Kit/PC/Work table	Sensing – 2, Processing – 1, Actuation – 1, Signal Conditioning – 1, IoT Platforms – 3, Remote control - 1
	Development of IoT end nodes with Ubidots/Adafruit/ThingSpeak			
2.2	Lab Evaluation 2	6	Lab/Kit/PC/Work table	NetSim – 3 Wireshark – 3
	NetSim - IoT network simulation & Wireshark packet data extraction			
2.3	Lab Evaluation 3	7.5	Lab/Kit/PC/Work table	Aggregation – 2.5, Computing – 2.5, Communication – 2.5
	IoT edge device – aggregation, computing & communication			
2.4	Lab Evaluation 4	7.5	Lab/Kit/PC/Work table	Server – 2.5, UI – 2.5, Database – 2.5
	Implementation of a server with database and UI			
3	Project	40		
3.1	Project	40		
	IoT solution for Real world application	7.5	Lab/Kit/PC/Work table/Viva-voice	Topic – 2.5, Component Selection – 2.5, Demonstration – 2.5
	IoT nodes	7.5		End (min 2) / Edge (min 1) nodes – 2.5 marks each
	Server/Cloud with UI & database	7.5		UI – 2.5, Database – 2.5, Edge/Fog/Cloud Computing – 2.5
	IoT Technologies	7.5		IoT Concepts – 2.5, Tools/frameworks – 2.5, Comprehension – 2.5
	Report	10	Report	Format – 3, Technical Content - 7
	Total	100		

Course Plan

- Lectures
- Additional Support
  - Discussions in Lab
  - Offline discussions

Detailed course plan and materials shared via AUMS

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Areas of Interest: Smart Grid/City, IoT/Sensor Networks, Robotics, RTOS, Embedded Systems, Automotive Electronics, Electric Vehicle and AI/ML applications.

B.Tech. EEE (SAINTGITS College of Engineering, Mahatma Gandhi University)
M.Tech. Embedded Systems (Amrita School of Engineering, Amrita Vishwa Vidyapeetham)
PhD in Smart Grid Communication (Amrita Vishwa Vidyapeetham)

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Best of Luck !!!!!!!