



Government of Karnataka

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

Program	Electronics & Communication Engineering	Semester	5
Course Code	20EC52I	Type of Course L:T:P	104 : 52 : 312
Specialization	Industrial Internet of Things (IIoT)	Credits	24
CIE Marks	240	SEE Marks	160

Rationale:

The industrial internet of things (IIoT) is the use of smart sensors and actuators to enhance manufacturing and industrial processes. Also known as the industrial internet or Industry 4.0, IIoT leverages the power of smart machines and real-time analytics to take advantage of the data that dumb machines have produced in industrial settings for years. The driving philosophy behind IIoT is that smart machines are not only better than humans at capturing and analysing data in real time, they are better at communicating important information that can be used to drive business decisions faster and more accurately.

Pre-requisite

Before the start of this specialization course, you will have prerequisite knowledge gained in the first two years on the following subjects:

1st year -Engineering Mathematics, Communication Skills, Computer Aided Engineering Graphics, Statistics & Analysis, Basic IT Skills, Fundamentals of Electrical and Electronics Engineering, Project Management skills, Digital Electronics

2nd year- Analog Electronics, Logic Design using Verilog, Communication Systems, Electronic Measurements and Testing Techniques, PCB Design & Fabrication, Wireless Communication, Embedded C Programming, Industrial Automation, in this year of study, you shall be applying your previous years learning along with specialized field of study into projects and real-world applications.

Instruction to course coordinator.

1. Each Specialized field of study is restricted to a Cohort of 20 students which could include students from other relevant programs.
2. One faculty from the Core Discipline shall be the Cohort Owner, who for teaching and learning in allied disciplines can work with faculty from other disciplines or industry experts.
3. The course shall be delivered in boot camp mode spanning over 12 weeks of study, weekly developmental assessments and culminating in a mini capstone.
4. The industry session shall be addressed by industry experts (in contact mode/online / recorded video mode) in the discipline only.
5. The cohort owner shall be responsible to identify experts from the relevant field and organize industry session as per schedule.

6. Cohort owner shall plan and accompany the cohort for industrial/mines/site/showroom/service Centre visits.
7. Cohort owner shall maintain and document the industrial assignments, weekly assessments, practices and mini project.
8. The cohort owner shall coordinate with faculties across programs needed for their course to ensure seamless delivery as per time table
9. The cohort owner along with classroom can augment or use for supplementally teaching on line courses available although reliable and good quality online platforms like Karnataka LMS, Infosys Springboard, NPTEL, Unacademy, SWAYAM etc.
10. Report should be maintained for industrial/field visit, such report shall be considered as industrial assignment.

Course outcomes:

On successful completion of the course, the students will be able to,

C01	Explain the concept of Industrial Internet of Things (IIoT), components and its known applications.
C02	Demonstrate use cases of IIoT systems, for any applications using protocols & networks.
C03	Build a cloud based IIoT system for a specific application & verify its output.
C04	Demonstrate the importance of IIoT data analytics & IIoT security in various industries/sectors.
C05	Design, test and troubleshoot a given IIoT system to meet defined operational specifications in real and simulated environment.

Detailed course plan

Week	C O	P O	Days	1 st session (9am to 1 pm)	L	T	P	2 nd session (1.30pm to 4.30pm)	L	T	P
1	1	1,5,7	Learning Outcomes 1. Introduction to IIoT. 2. Information technology (IT), Operational technology (OT) & convergence. 3. Simple application of wifi module: NODEMCU ESP8266								
			1	Industrial Revolutions 1,2, 3. Globalization and Emerging issues. Fourth Industrial Revolution. Industry 4.0 concepts, benefits. Applications of Industry 4.0 – video demonstration. Difference between IoT and IIoT, IoT node. Globalization and Emerging Issues of IIoT.	2		2	IIoT- Concept, definitions & Implementation Examples - Embedded Systems, Computer Networks, Internet of Everything (IoE).	1		2
			2	Interoperability, Identification, localization, Communication, Software Defined Assets. IIoT application in various sectors/industries: Agriculture, Energy, Finance, Healthcare, Manufacturing, hospitality, Transportation & Logistics. Retail, etc. Practise Demonstration & explanation of IIoT applications in various sectors.	1		3	Evolution of IIoT, IIoT Adoption. Information Technology (IT) & Operational Technology (OT)- introduction, convergence, connected factory, advantages.	1	1	1
			3	Operational Technology (OT) components: industrial control system, PLC, SCADA, DCS. IT Components (IT): Hardware, Software, People, Processes. Practise Demonstration of OT & IT components and processes in various domains.	2		2	Basics of wireless networking, introduction to ESP8266 Wi-Fi Module, study datasheet. Practise Introduction to NODEMCU ESP8266(WIFI module) & its simple implementation.			3

			4	Smart factory applications and smart warehousing – concept, implementation, use case demonstration.	1	3	Predictive and remote maintenance –concept, implementation use case.	1	2
				Safety and health (conditions) monitoring of workers.			Demonstration of maintenance process.		
			5	Assess students for understanding of fundamental concepts – Developmental Assessment			Assessment Review and corrective action		3
			6	Industry Class on introduction to IIoT.	2	2	Weekly Assignment(1PM-2PM)		1
2	Learning Outcomes		Application of IIoT in different sectors- Use Cases						
	1,2	1,3,7	1	Tutorial (Peer discussion on Industrial assignment)		4	Smart metering and smart grid – concept, demonstration, use cases.	1	1
			2	Freight, goods and transportation monitoring - concept, implementation, use cases.	1	1	Industrial heating, ventilation and air conditioning (HVAC), Manufacturing equipment monitoring - concept, implementation, demonstration, use cases.	1	2
			3	Asset tracking and smart logistics. Ozone, gas and temperature monitoring in industrial environments - concept, implementation, demonstration, use cases.	1	3	Smart environment solutions - concept, demonstration, use cases.	1	2
				Remote service, field service, remote maintenance and control use cases.					
			4	Data, Information, Knowledge and Wisdom realization for an organisation. (DIKW) – concept, model & examples.	1	1	History and evolution of automation: Plants to Parts.	1	2
				DIKW pyramid and relevance with IoT. Explain with an example.			Comparison between IoT & automation. IIoT in automation.		
			5	Developmental Assessment			Assessment Review and corrective action		3
			6	Industry Class – Use cases of IIoT.	2	2	Weekly Assignment(1PM-2PM)		1

3	Learning outcomes		1. Automation concepts. 2. Industry visit.							
	1,2	1,3	1	Tutorial (Peer discussion on Industrial assignment)	4	Commercial microcontroller-based development boards- examples, selection criteria and trade-offs for automation.	1	2		
			2	Machine to Machine (M2M) networks- M2M towards IoT-the global context, concept, components, examples.M2M Value Chains, IoT Value Chains. Comparison between M2M & IoT. Industrial networks – concept, type, examples. Demonstration of M2M networks &Industrial networks	1	3	Human Machine Interface (HMI) in an automation process – concept, implementation, examples. Enterprise Resource Planning (ERP)- concept, implementation. Integration of IIoT with ERP systems. Manufacturing Execution System (MES) – concept, implementation, cloud MES	1	2	
			3	INDUSTRY VISIT: Visit nearby automation industry and see how IIoT is implemented there, Prepare a detailed report on the components used, the process, the data storage and analysis, etc of the respective industry.	4	INDUSTRY VISIT: Visit nearby automation industry and see how IIoT is implemented there. Prepare a detailed report on the components used, the process, the data storage and analysis, etc of the respective industry & demonstrate a presentation.		3		
			4	IIoT Protocols – need of protocols, types. Modbus protocol and Profibus protocol – introduction, working, applications. Communication Protocols: Near – field communication (NFC), RFID, Low Power Wide Area Network (LPWAN) technology - introduction, features.	1	3	Identify the list of protocols used across various industries/sectors and prepare a report. Practise Demonstration of LoRAWAN communication.	1	2	

			5	CIE 1 – Written and Practice Test			Assessment Review and corrective action			3
			6	Industry Class – M2M & industrial networks.	2	2	Weekly Assignment(1PM-2PM)			1
4	Learning Outcomes		IIoT Ecosystem: networks & protocols.							
	1,2	1,3,4	1	Tutorial (Peer discussion on Industrial assignment)		4	Practise IoT protocol stack - with hands-on such as Contiki-OS or any other IoT based stack.	1		2
			2	Industry standards communication technology: LoRAWAN, OPC unified architecture (UA), Message Queuing Telemetry Transport (MQTT) – introduction, features. Practise. Design/simulate/demonstrate a simple MQTT protocol-based system. The Cloud application should fetch data from a device using the MQTT protocol.	1	3	Practise Interfacing 4G GSM Modem to communicate b/w the devices using Arduino/raspberry Pi/Node MCU.			3
			3	Industrial Control System – Introduction, Fundamentals, Components, examples, advantages. How IIoT Enhances Industrial Control Systems, explain with examples (Oil & gas IIoT, Airports IIoT, etc)	1	3	Demonstration of IIoT networks & protocols Prepare a report on the networks and protocols used in various industries and demonstrate.			3
			4	Zigbee communication mechanism: device types, operation, network topologies, applications.	1	3	Practise – simulation of IIoT Networking models using	1		2

				Practise – simulation of IIoT Networking models using Tools. (Cisco packet tracer, wireshark, netsim etc.)			Tools. (Cisco packet tracer, wireshark, netsim etc.)			
			5	Developmental Assessment			Assessment Review and corrective action			3
			6	Industry Class on networks and protocols.	2	2	Weekly Assignment (1PM – 2PM)			1
5	Learning Outcomes			1. Introduction to IoT platforms. 2. Gateways & Cloud concepts.						
	2,3	3,4,7	1	Tutorial (Peer discussion on Industrial assignment)		4	centralized vs distributed network architectures. Wireless Fidelity communication mechanism (Wi-Fi) - types, protocols, applications. Bluetooth communication mechanism: versions, components, operation and applications	1		2
			2	Narrow Band Internet of Things (NB-IoT) communication mechanism - components, operation and applications. Practise – simulation of IIoT communication models using Tools. (Cisco packet tracer, wireshark, netsim etc.)	1	3	IPv6 over Low-power Wireless Personal Area Networks(6lowpan) communication mechanism - operation and applications. Practise – simulation of IIoT communication models using Tools. (Cisco packet tracer, wireshark, netsim etc.)	1		2
			3	Practise Introduction to Blynk IoT platform – features, cloud, installation, steps to execute experiments.	1	3	Practise Design a simple IoT based application using Blynk IoT platform.			3
			4	Industrial Gateways – Concept, Types. Commercial Gateways solutions from Intel, Cisco –concept, features, advantages. Payment Gateway demonstration from any e commerce companies.	1	3	Cloud service models: Infrastructure as a service (IaaS) model, Software as a service (SaaS) model, Platform as a service (PaaS) model – concept, comparison, applications.	1		2

				Cloud – introduction, cloud computing: concept, benefits, types. Cloud demonstrations.			Cloud service models: demonstrations.			
			5	CIE 2 – Written and Practice Test			Assessment Review and corrective action			3
			6	Industry Class on gateways and cloud concepts.	2	2	Weekly Assignment (1 PM-2PM)			1
6	Learning Outcomes			Cloud services.						
	3	1,3,4,5	1	Tutorial (Peer discussion on Industrial assignment)		4	Cloud storage: working operation, benefits, challenges. deployment models – private cloud storage, public cloud storage, hybrid cloud storage, Community cloud storage – features, comparison, examples.	2		1
			2	Introduction to Arduino Cloud software. Explore its features like configuration of devices, connecting to network, writing code, uploading, dashboard creation, visualization. Practise Design Arduino IoT Cloud ESP8266 NodeMCU Alexa Home Automation system/Alexa class room automation system.	1	3	Practise Design Arduino IoT Cloud ESP8266 NodeMCU Alexa Home Automation system/Alexa class room automation system.			3
			3	cloud computing services: concept, types. Amazon Web Services (aws), Azure, Google Cloud Platform(gcp) - features. Practise Demonstration & explanation of AWS Service.	1	3	Amazon Web Services (AWS) – benefits, use cases (any 3), applications.	1		2

			4	EDGE Devices – Architecture, programming & Communication with other devices, Local database in the Edge device, examples. Edge computing: need, applications. demonstration of edge computing.	2	2	IoT architecture: smart devices, sensors/devices. connectivity, data processing, cloud platforms, user interface – demonstrate the flow of data in all the stages. Enterprise data for IIoT. Emerging descriptive data standards for IIoT.	2	1
			5	Developmental Assessment			Assessment Review and corrective action		3
			6	Industry Class on cloud services .	2	2	Weekly Assignment (1PM-2PM)		1
7	Learning Outcomes.		Design considerations & development of IIoT systems.						
	3,5	1,2,3,5	1	Tutorial (Peer discussion on Industrial assignment)		4	Industrial Internet Reference Architecture (IIIRA) from Industrial IoT Consortium (IIC) – concept, features, role of IIC in shaping IIOT's. Standardization initiatives. Interoperability issues.	2	1
			2	IIoT design considerations - architecture, device, network and cloud, explain with an example and demonstrate. Build partnerships. Clarify business outcomes and Return on Investment (ROI). Start small, Security first. design philosophy: IIoT for industrial processes, features of industrial process & its benefits.	1	1	2	components of futuristic industrial plant in industry 4.0 with block diagram. Suggest the requirements to develop a facial recognition door unlock IoT project for your home and prepare a report on the IoT architecture - development of the system and demonstrate in class.	3
			3	Introduction to ThingSpeak software – data aggregation & analysis, features, usage, applications.	1		3	Practise Show with a practical example with the use of Arduino uno and sensor of your choice how	3

				Practise Show with a practical example with the use of Arduino uno and sensor of your choice how data can be sent to a thingspeak cloud and analyse the data.				data can be sent to a thingspeak cloud and analyse the data.			
			4	Practise Design an IoT based Water Level Indicator Model Using Ultrasonic Sensor, NodeMCU and display the water level on the webserver.			4	Data analytics for IoT - concept, types & applications. Benefits, Real time analytics.	2	1	
			5	CIE 3 – Written and Practice Test				Assessment Review and corrective action			3
			6	Industry Class on design of IIoT Systems	2		2	Weekly Assignment (1PM – 2PM)			1
8	Learning Outcomes.			IIoT Data Analytics.							
	4,5	1,2,3,5,7	1	Tutorial (Peer discussion on Industrial assignment)			4	IoT based data acquisition systems (DAS) – Concept, Components, Block Diagram, Tools, Storage. demonstration & explanation of an DAS application.	2		1
			2	Impact of data analytics on various industries/sectors - Smart Grids, Connected HealthCare System, Smart Farming, Smart Barcode Readers, Smart Supply Chain Management. Explain the importance of data analytics in each sector to gain operation efficiency. (Any 3 sectors with examples), demonstrations.	1	1	2	ThingSpeak IoT analytics platform – introduction, features, demonstration. Practise Design an IoT Based Temperature and Humidity Monitoring over ThingSpeak using Arduino UNO and ESP8266 at various times in a day.	1		2
			3	Edge analytics - Data Aggregation on Edge gateway. Practise Create the analytics report for the already designed - IoT Based Temperature and	1		3	Understanding fundamental nuances between IoT and Big data – use case & demonstration. Big data analytics role in IoT – concept, applications, benefits.	1		2

				Humidity Monitoring and analyze the data.						
			4	Smart Factory –application areas, Function blocks, interfaces, Top-down control and design Challenges for industrial processes in industry 4.0.	2	1	1	Practise Build an IoT Based Colour Sorting Machine using ESP8266 and ThingSpeak software.		3
			5	Developmental Assessment				Assessment Review and corrective action		3
			6	Industry class on IIoT data analytics.	2		2	Weekly Assignment (1PM-2PM)		1
9	Learning Outcomes.			Cyber-physical systems (CPS) & Cybersecurity.						
	4	1,3,5,7	1	Tutorial (Peer discussion on Industrial assignment)		4		Cyber physical systems – Scope, features, examples, applications. Demonstration of Cyber security awareness videos and an CPS application. Prepare a report on Do's and don'ts, general precautions to be taken while using the internet.	2	1
			2	Practise IoT simulation software /hardware -based activities/demonstration on cyber physical systems for any application. Prepare a report for the application considered with all the details.			4	Cybersecurity – security concerns, examples. CPS protection from Cyber Threats. Hacking as the biggest Threat, Types, Examples & Demonstration. Practise Demonstration/simulation of a cyber threat/hacking scenario & solutions on any sector/industry	2	1
			3	IoT Related Issues related to Security, Network Level Problems/Insecurities, Importance of Windows Firewall.	1		3	hardware & software solutions, open-source initiative.	2	1

				vulnerabilities – concept, types. attack surfaces – concept, types, reduction techniques, demonstration. Practise Demonstration/simulation of a vulnerability scenario (firewall/attack surfaces) using video/software.				Practice Demonstration/simulation of solutions to vulnerability scenario using video/software.			
			4	Next generation sensors in industry 4.0 (intelligent sensors)– limitations of smart sensors, need for next generation sensors, advantages, applications. Industrial Internet Systems – elements, applications, Examples. Impact of industrial internet on health care sector. Practise video demonstration of industrial internet systems for any application	1	3		Industrial Internet Systems – advantages, Use Cases. Practise video demonstration of industrial internet systems for any application	1		2
			5	CIE 4 – Written and Practice Test				Assessment Review and corrective action			3
			6	Industry class on cyber physical systems & cybersecurity.	2	2		Weekly Assignment(1PM-2PM)			1
10	Learning Outcomes			IIoT Testing & troubleshooting.							
	4,5	2,3,7	1	Tutorial (Peer discussion on Industrial assignment)		4		IoT device applications – examples. OS hardening – concept, methods. Demonstration.	2		1
			2	Network and protocol security – need, concept, types, features. Cloud security- need, concept, working	2	2		Practise Demonstration of cloud security process for any application. Explain the concept involved.			3

				principle, best practices. IoT Security challenges – Types.							
			3	Case study: two case studies on recent IoT/IIoT related security attack. Prepare a report on the vulnerabilities that were exploited by cyber criminals and how it affected a particular sector/organization, etc from the above case studies.	2		2	IoT Testing: introduction, testing areas – connectivity, compatibility, security, functionality, performance, exploratory features of any given application.	1		2
			4	IoT troubleshooting: concept, parameters, importance of troubleshooting steps - connectivity, compatibility, security, functionality, performance involved for an effective IIoT project. Practise Exercise Perform simulations/hardware-based optimization, test & troubleshoot to get the desired output for any application of your choice.]	1		3	Contd.			3
			5	Developmental Assessment				Assessment Review and corrective action			3
			6	Industry Class on testing, troubleshooting IIoT systems.	2		2	Weekly Assignment (1PM-2PM)			1
			Learning Outcomes		IIoT optimizations.						
11	4, 5	1,2,3,4,7	1	Tutorial (Peer discussion on Industrial assignment)			4	Collaborative Platform – concept, implementation. Product Lifecycle Management – concept, stages. Business objectives,	2		1
			2	Machine Learning & Artificial Intelligence in IoT-concept, applications, use case. Explanation and demonstration of Machine Learning & Artificial Intelligence.	1		3	Collect, study and prepare a report on the ways in which IoT is implemented in Agriculture & Livestock monitoring. Prepare models/prototypes to demonstrate the agricultural IoT in class.	1		2

			3	Augmented Reality and Virtual Reality role in IoT -concept, use case, comparison, applications. Explanation and demonstration of Augmented Reality and Virtual Reality.	2	2	Case study: Health monitoring using IoT. Demonstrate IoT Based Health Monitoring System using Raspberry Pi.	1	2
			4	Design & analyse of smart irrigation system using Blynk software, NodeMCU, and soil moisture sensors and demonstrate the output. (How to build a IoT Smart Irrigation System with Blynk software, NodeMCU, and Soil Moisture) - components, demonstration & explanation.		4	Contd.		3
			5	CIE 5 – Written and Practice Test			Assessment Review and corrective action		3
			6	Industry Class on optimizations in IIoT.	2	2	Weekly Assignment(1PM-2PM)		1
12	Learning Outcomes.			IIoT Applications.					
	3,4,5	2,3,5,7	1	Tutorial (Peer discussion on Industrial assignment)		4	Revisiting an IIoT system's architecture in general with the necessary and mandatory components required for the design of an application for any sector. Prepare a report on the design requirements of an IIoT system for an application in any sector/industry.	2	1
			2	IIoT based smart energy meter/ Smart Baggage Tracker/ Automation using controller via Bluetooth simulation/hands on/ demonstration of components, technology & process.	2	2	IIoT based smart energy meter/ Smart Baggage Tracker/ Automation using controller via Bluetooth/- simulation/hands on/ demonstration of components, technology & process.	1	2

		3	Design and analysis of IoT Based Smart Car Parking System Using Arduino, NodeMCU & Blynk app.		4	Contd.		3
		4	Design the Temperature based Touchless Attendance System using NodeMCU and MLX90614 Infrared Thermometer and display the results in the web server.		4	Contd.		3
		5	Developmental Assessment			Assessment Review and corrective action		3
		6	Industry Class on IIoT applications.	2	2	Weekly Assignment(1PM-2PM)		1
13								
		1	Internship a) Secondary research on various industries and their operations to identify at least 3 companies along with the areas of work interest and develop an internship plan that clearly highlights expectations from the industry during the internship.		4	Project a) Identification of the problem statement (from at least 3 known problems) the students would like to work as part of the project – either as provided by faculty or as identified by the student. Document the impact the project will have from a technical, social and business perspective.		3
		2			4			3
		3			4			3
		4			4			3
		5	b) Design and develop a cover letter for an internship request to all 3 identified companies and the resume to be submitted to potential companies.		4	b) Design and develop the project solution or methodology to be used to solve at least one of the problems identified.		3
		6	c) Prepare for an internship interview to highlight your interests, areas of study, career aspirations and personnel competence – including the areas of learning you expect to learn during internships Review		4	c) Prepare a project plan that will include a schedule, WBS, Budget and known risks along with strategies to mitigate them to ensure the project achieves the desired outcome		1

Note:

1. Practice Exercises (Hands on) should be done using hardware development boards like Arduino/NODEMCU/Raspberry Pi along with the necessary sensors/jumper wires/breadboards/components, etc
2. Simulation exercises can be done using tools such as Netsim, Cisco packet tracer, Wireshark, etc.
3. Study the datasheets for various sensors and other new components mentioned in the practice exercises and learn how to use them.

REFERENCES.

Sl. No	Description
1	The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2	Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
3	Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor) Springer Publications.
4	Industry 4.0 The Industrial Internet of Things by Alasdair Gilchrist, Apress Publications.
5	Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication
6	Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed
7	Sudip Misra, Chandana Roy and Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press
8	G Veneri Antonio, "Hands-on Industrial Internet of Things", Packt Publication.
9	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCOPress, 2017
10	Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.
11	Richardson, M., & Wallace, S. (2012). Getting started with raspberry Pi. " O'Reilly Publisher Media, Inc
12	design a system using Arduino uno and esp 8266 wifi module to create a smart irrigation system for your home / college garden. design the whole system with proper block diagram, wiring and code.
13	Show with a practical example with the use of Arduino uno and sensor of your choice how data can be sent to a thingspeak cloud https://create.arduino.cc/projecthub/adhyoksh/iot-with-thingspeak-8d3848

14	IoT Based Temperature and Humidity Monitoring over ThingSpeak using Arduino UNO and ESP8266 https://iotdesignpro.com/projects/temperature-humidity-monitoring-over-thingspeak-using-arduino-esp8266
15	Arduino IoT Cloud ESP8266 NodeMCU Alexa Home Automation system. https://www.youtube.com/watch?v=UtReFcOLjx8 (week 6 day 2)
16	IoT based Home Automation project using NodeMCU ESP8266 and New Blynk app.]
17	AWS In 10 Minutes AWS Tutorial For Beginners AWS Training Video AWS Tutorial Simplilearn - YouTube (week 6 ,day 3)
18	What is edge computing? - YouTube (week 6, Day 4)
19	IoT Based Health Monitoring System using Raspberry Pi - YouTube (week 11, Day 3)
20	How to build a IoT Smart Irrigation System with Blynk, NodeMCU, and Soil Moisture - YouTube (Week 11,day 4)
21	Arduino Project: IOT Car Parking System using Nodemcu esp8266 wifi + Blynk (Tabs + led widgets) - YouTube (week 12, day3)
22	Temperature based Touchless Attendance System using NodeMCU and MLX90614 Infrared Thermometer https://iotdesignpro.com/projects/temperature-based-touchless-attendance-system-using-nodemcu-and-mlx90614-infrared-thermometer
23	https://iotdesignpro.com/projects/iot-based-colour-sorting-machine-using-esp8266-and-thingspeak

CIE and SEE Assessment Methodologies

CIE Assessment	Assessment Mode	Duration In hours	Max Marks
Week 3	CIE 1- Written and practice test	4	30
Week 5	CIE 2- Written and practice test	4	30
Week 7	CIE 3- Written and practice test	4	30
Week 9	CIE 4- Written and practice test	4	30
Week 11	CIE 5- Written and practice test	4	30
	On line Course work (Minimum 10 hours online course with certification from (SWAYAM/NPTEL/Infosys Springboard)		40
	Profile building for Internship / Submission of Synopsys for project work		20
Portfolio evaluation (Based on industrial assignments and weekly developmental assessment) *			30
TOTAL CIE MARKS (A)			240
SEE 1 - Theory exam (QP from BTE) Conducted for 100 marks 3 hrs duration reduced to 60 marks		3	60
SEE 2 - Practical		3	100
TOTAL SEE MARKS (B)			160
TOTAL MARKS (A+B)			400

* The industrial assignment shall be based on peer-to-peer assessment for a total of 10 marks (on a scale of 1 to 10) and in the event of a group assignment the marks awarded will be the same for the entire group, the developmental assessment will be for a total of 20 marks and based on MCQ/case study/demonstration and such other assignment methods

Assessment framework for CIE 3 (1 to 5)

Note : Theory to be conducted for 1 hour and practice for 3 hours, total duration of exam – 4 hours

Programme	Electronics & Communication Engineering	Semester	V
Course	Industrial Internet of Things (IIoT)	Max Marks	30
Course Code	20EC52I	Duration	4 hours
Name of the course coordinator			

Note: Answer one full question from each section.

Qn.No	Question	CL L3/L4	CO	PO	Marks
Section-1 (Theory) – 10 marks					
1.a)	NASA (National Aeronautics and Space Administration) has always wondered about creating a library to present people with all its achievements through pictures and videos of space. Later on, it created such platforms, but because it had 10 different NASA centers, it couldn't provide the best experience for viewers. So, all it wanted was to create an easy-access platform for people to search for and view images and videos. How did NASA handle this situation. Which web services were used, mention its features.	L4	1,3	1,3,4,5	5
b)	'Insecure cloud services' is a type of cloud vulnerability. Do you agree? Justify your answer.	L3	1,3	1,3,4,5	5
2.a)	Lack of security support on devices deployed in production of a manufacturing plant, including asset management, update management, secure decommissioning, systems monitoring, and response capabilities: is security support on IoT devices essential? Justify your answer.	L4	3,5	1,2,3,5	5
b)	Vulnerabilities are a major and constant issue in the field of the IoT. It can come from any layer of IoT devices severely affecting the business operations of all the industries. As a systems engineer what steps would you take to secure the organisation from malwares, adwares, Trojans, etc. prepare a document for the best practices to be used by all the employees of an organization.	L4	3,5	1,2,3,5	5
Section-2 (Practical) - 20 marks					
3)	Design Arduino IoT Cloud ESP8266 NodeMCU Alexa Home Automation system/Alexa class room automation system.	L4	1,3	1,3,4,5	20
4)	Show with a practical example with the use of Arduino uno and sensor of your choice how data can be sent to a thingspeak cloud and analyse the data.	L3/L4	3,5	1,3,4,5	20

Note : Theory questions shall be aligned to practical questions

Assessment framework for SEE 1 (Theory)

Programme :	Electronics & Communication Engineering	Max Marks :	100	
Semester :	V	Duration :	3 Hrs	
Course :	Industrial Internet of Things (IIoT)			
Course Code :	20EC521			
Instruction to the Candidate: Answer one full question from each section.				
Q. No	Question	CL	CO	Marks
Section-1				
1.a)	Predictive maintenance is an effective solution to avoid unnecessary downtime in the production line. Do you agree? Justify your answer with an example from energy sector.	L3	1	10
b)	Given the breadth of operation technology (OT) in manufacturing, the modern factory often includes many machines, devices, and control mechanisms operating in relative isolation, and communicating using a variety of niche protocols. This has created silos, communication difficulties, and blindspots in processes. How can this condition be improved in IIoT to better work with the Information technology (IT) components.	L4		10
2.a)	Modern industrial machines equipped with “devices” continuously monitoring the status of each major components and it can detect any critical issues before the system is completely down. Who will trigger maintenance warning to the centralized system and what are the subsequent actions that are followed? Which technology is followed. Explain in detail.	L3/L4		10
b)	Explain the necessity of adopting IoT technology for a growing need to increase customer loyalty and deliver the best in-store experience by retail sector in the following sectors: (i) Inventory management (ii) Smart payments (iii) Smart vending machines.	L3/L4		10
Section-2				
3.a)	This protocol has formed the foundation of data communication over the web. It is the most common protocol that is used for IoT devices when there is a lot of data to be published. Which is this IoT network protocol? why is it not a preferred choice nowadays? Which protocol would you suggest for Additive manufacturing/3D printing process for an industry. List its features.	L4		10

b)	The cloud architect of ABB company has informed you to select the best communication protocol to be used in smart cities, where there are millions of devices that function with less power and memory. Which protocol would you suggest and why? Which protocol is used for smart street lighting in a smart city.	L3	2	10
4.a)	Which is the most preferred protocol for IoT devices, say for example fire detectors? It should support remote monitoring and used in devices which are economical and requires less power and memory. Explain its working principle.	L4		10
b)	In an SBI ATM, a customer needs to withdraw Rs 15000/- cash. On entering the details, the ATM Kiosk asks for the PIN as it is over Rs 10,000/- withdrawal The customer does get the OTP message from the bank, enters the data, collects the receipt with the updated balance. However, the ATM KIOSK does not ask for an OTP for transactions below Rs 10,000/-? Where is the checkpoint happening in the communication between SBI and customer. Elaborate your answer with details.	L3/L4		10
Section- 3				
5.a)	An organization debating whether to install a private cloud or to use a public cloud, e.g., the AWS, for its computational and storage needs, asks your advice. What information will you require to base your recommendation on? list the requirements that needs to be considered for using the cloud services.	L3	3	10
b)	Overprovisioning is the reliance on extra capacity to satisfy the needs of a large community of users when the average-to-peak resource demand ratio is very high. Give an example of a large-scale system using overprovisioning and discuss if overprovisioning is sustainable in that case and what are the limitations of it. Is cloud elasticity based on overprovisioning sustainable? Give the arguments to support your answer	L4		10
6.a)	SAP is a really big company, so much so that its offerings span multiple service models. Among them is their Cloud PaaS which is an open business platform. It was designed to help developers build applications more easily, offering both breadth and depth of service. What features are offered by PaaS model which is beneficial to SAP company. Explain its features.	L4		10
b)	In financial sector, the E – payments made by the customer are failing repeatedly. What could be wrong? Explain how gateways are used for data management, local applications and device management in IoT.	L3		10
Section-4				
7.a)	Illustrate the role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments for Logistics & Supply Chain Optimization in manufacturing sector?	L3		10
b)	Siemens is a German multinational conglomerate company. The company builds automated machines for the likes of BMW. Siemens introduced an operating system called Mindsphere, the cloud-based IoT unit from Siemens which basically aggregates the data from all the different vital components of a factory and then processes them through rich analytics to produce useful results. Suddenly, the	L4		10

	operating system was behaving weirdly and started to give inaccurate data / links were popping up , as if the system was hanging and it was noticed by the system engineers. What could have gone wrong? how to control the situation.		4	
8.a)	Fanuc is one of the largest suppliers of industrial automation equipment in the world. The company had developed FIELD System (Fanuc Intelligent Edge Link & Drive System), an open platform that enables the execution of various IIoT applications that focus on heavy devices like robots, sensors, and machine tools. How are supervisors in Fanuc able to anticipate any failure in the mechanism and keep up with the schedule and reduce costs. Elaborate on the methods being used.	L4		10
b)	In the healthcare industry (Medical IoT) IoT devices are already being utilized to remotely monitor patients' vital signs and has proven very helpful since the pandemic . what are the possible consequences of IoT security attacks in Medical IoT.	L4		10
Section-5				
9.a)	Heavy-equipment maker Caterpillar has long been an IoT projects pioneer. It wants to give the machine operators an at-a-glance view of everything from fuel levels to when air filters need replacing. If an old filter expires, the company can send basic instructions for how to replace it via an AR app. Recommend the technology can be adopted by Caterpillar to meet its desired requirements and improve the efficiency.	L4	5	10
b)	Amazon is already using the smart warehouse at the beginning stage. Explain the deployment and operational view, resources, services, virtual entities, users in an IoT system by considering a smart warehouse as an example.	L3		10
10.a)	Netflix is an entertainment platform that started in the United States, but eventually, it expanded to many countries and soon became popular. How could Netflix confront the scalability problem with the sudden increase in viewers. What kind of databases were used and what were the other services offered by the solution to the scalability problem. Compare this with Disney Hotstar and list the differences.	L4		10
b)	McDonald's is the world's largest fast-food company that serves around 64 million people per day. The growth of this company has gone to another level when it started home deliveries. McDonald's created a platform that integrates local restaurants with delivery partners such as Uber Eats, Swiggy & Zomato. McDonald's platform can scale 20,000 orders per second and integrate with the global partners easily. How can McDonald's manage such a higher number of orders every day?	L4		10

Scheme of Evaluation for SEE 2

Sl. No	Description	Marks
	Problem statement: Design a IIoT system for a given application with cloud interfacing and show the output. (Any development board NODEMCU ESP 8266/ Arduino/raspberry pi can be used). troubleshoot if required to get the desired output.	
1	Components required & assembly of circuit diagram in hardware.	20
2	Writing code for Cloud interfacing and initialization. (Programming Arduino for Sending data to cloud)	30
3	Conduction of the experiment.	20
4	Troubleshooting steps taken/ Results	20
5	Viva voce	10
Total		100

Equipment / Software List with specification for a batch of 20 students.

Sl No	Equipment's	Quantity
1	Arduino Boards	5
2	NODEMCU Esp8266	5
3	Raspberry Pi Boards	2
4	Jumper Wires.	As per requirement
5	Related Sensors /components to Practise Exercises.	As per requirement