

**Experiment No. \_07**

**Title:** Virtual Lab on IoT

**SOMAIYA**  
VIDYAVIHAR UNIVERSITY

K J Somaiya College of Engineering

**Batch: B-1**

**Roll No.: 16010422234**

**Experiment No.:07**

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**Aim:** Virtual Lab on IoT

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**Resources needed:** Internet

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**Theory:**

Virtual Labs project is an initiative of Ministry of Human Resource Development (MHRD), Government of India under the aegis of National Mission on Education through Information and Communication Technology (NMEICT). This project is a consortium activity of twelve participating institutes and IIT Delhi is a coordinating institute. It is a paradigm shift in ICT-based education. For the first time, such an initiative has been taken-up in remote-experimentation. Under the Virtual Labs project, over 100 Virtual Labs consisting of approximately 700+ web-enabled experiments were designed for remote-operation and viewing.

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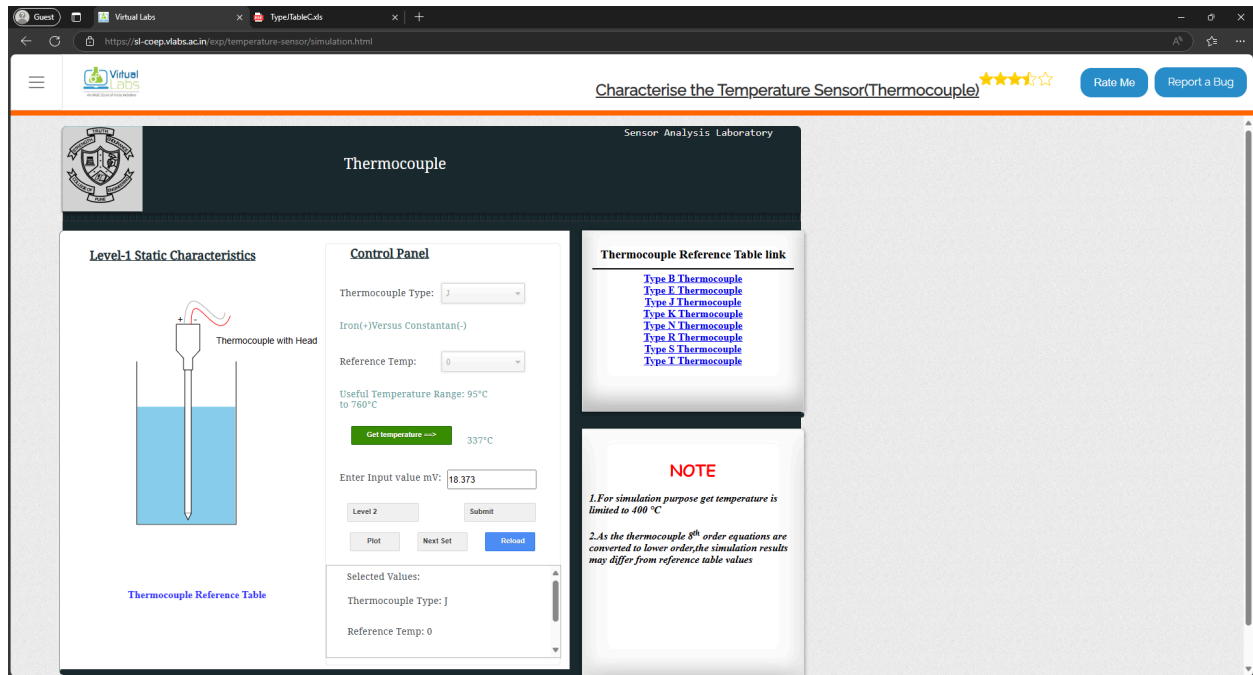
**Activity:**

Select any experiment of IoT / Embedded system from the given list of experiments on Virtual lab website.

<https://sl-coep.vlabs.ac.in/exp/temperature-sensor/simulation.html>

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**Results: (Program printout with output / Document printout as per the format)**

[illegible]

Virtual Labs

Type/TempCalc

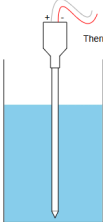
https://sl-coep.vlabs.ac.in/exp/temperature-sensor/simulation.html

Characterise the Temperature Sensor(Thermocouple)

★★★★☆

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Thermocouple with Head

Level-1 Static Characteristics

Thermocouple Reference Table

Control Panel

Thermocouple Type: 

J

Iron(+)Versus Constantan(-)

Reference Temp: 

0

Useful Temperature Range: 95°C to 760°C

Get temperature --> 270°C

Enter Input value mV: 

14.665

Level 2

Correct

Plot

Next Set

ExitSet

Selected Values:

Thermocouple Type: J

Reference Temp: 0

Thermocouple Reference Table link

[Type B Thermocouple](#)

[Type E Thermocouple](#)

[Type J Thermocouple](#)

[Type K Thermocouple](#)

[Type N Thermocouple](#)

[Type R Thermocouple](#)

[Type S Thermocouple](#)

[Type T Thermocouple](#)

NOTE

1. For simulation purpose get temperature is limited to 400 °C

2. As the thermocouple 9<sup>th</sup> order equations are converted to lower order, the simulation results may differ from reference table values

Virtual Labs

Type/TempCalc

https://sl-coep.vlabs.ac.in/exp/temperature-sensor/simulation/asset/Type/TempCalc.pdf

2 of 4

ISG, Inc.

ITS-90 Table for Type J Thermocouple (Ref Junction 0°C)

http://isginc.com

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
0	0.000	0.000	0.101	0.101	0.202	0.203	0.303	0.304	0.405	0.406	0.507
10	0.507	0.508	0.609	0.609	0.711	0.712	0.814	0.815	0.916	0.918	1.019
20	1.019	1.021	1.122	1.124	1.226	1.227	1.329	1.331	1.433	1.435	1.537
30	1.537	1.539	1.641	1.643	1.745	1.747	1.849	1.851	1.953	1.955	2.057
40	2.059	2.111	2.164	2.216	2.269	2.322	2.374	2.427	2.480	2.532	2.585
50	2.585	2.638	2.691	2.744	2.797	2.850	2.903	2.956	3.009	3.062	3.116
60	3.116	3.169	3.222	3.275	3.329	3.382	3.436	3.489	3.543	3.596	3.650
70	3.650	3.703	3.757	3.810	3.864	3.917	4.020	4.073	4.133	4.187	4.240
80	4.240	4.294	4.348	4.402	4.456	4.510	4.564	4.618	4.672	4.726	4.780
90	4.780	4.834	4.888	4.942	4.996	5.050	5.104	5.158	5.212	5.266	5.320
100	5.320	5.374	5.428	5.482	5.536	5.590	5.644	5.698	5.752	5.806	5.860
110	5.860	5.914	5.968	6.022	6.076	6.130	6.184	6.238	6.292	6.346	6.400
120	6.400	6.454	6.508	6.562	6.616	6.670	6.724	6.778	6.832	6.886	6.940
130	6.940	6.994	7.048	7.102	7.156	7.210	7.264	7.318	7.372	7.426	7.480
140	7.480	7.534	7.588	7.642	7.696	7.750	7.804	7.858	7.912	7.966	8.020
150	8.020	8.074	8.128	8.182	8.236	8.290	8.344	8.398	8.452	8.506	8.560
160	8.560	8.614	8.668	8.722	8.776	8.830	8.884	8.938	8.992	9.046	9.100
170	9.100	9.154	9.208	9.262	9.316	9.370	9.424	9.478	9.532	9.586	9.640
180	9.640	9.694	9.748	9.802	9.856	9.910	9.964	10.018	10.072	10.126	10.180
190	10.180	10.234	10.288	10.342	10.396	10.450	10.504	10.558	10.612	10.666	10.720
200	10.720	10.774	10.828	10.882	10.936	10.990	11.044	11.098	11.152	11.206	11.260
210	11.260	11.314	11.368	11.422	11.476	11.530	11.584	11.638	11.692	11.746	11.800
220	11.800	11.854	11.908	11.962	12.016	12.070	12.124	12.178	12.232	12.286	12.340
230	12.340	12.394	12.448	12.502	12.556	12.610	12.664	12.718	12.772	12.826	12.880
240	12.880	12.934	12.988	13.042	13.096	13.150	13.204	13.258	13.312	13.366	13.420
250	13.420	13.474	13.528	13.582	13.636	13.690	13.744	13.798	13.852	13.906	13.960
260	13.960	14.014	14.068	14.122	14.176	14.230	14.284	14.338	14.392	14.446	14.500
270	14.500	14.554	14.608	14.662	14.716	14.770	14.824	14.878	14.932	14.986	15.040
280	15.040	15.094	15.148	15.202	15.256	15.310	15.364	15.418	15.472	15.526	15.580
290	15.580	15.634	15.688	15.742	15.796	15.850	15.904	15.958	16.012	16.066	16.120
300	16.120	16.174	16.228	16.282	16.336	16.390	16.444	16.498	16.552	16.606	16.660
310	16.660	16.714	16.768	16.822	16.876	16.930	16.984	17.038	17.092	17.146	17.200
320	17.200	17.254	17.308	17.362	17.416	17.470	17.524	17.578	17.632	17.686	17.740
330	17.740	17.794	17.848	17.902	17.956	18.010	18.064	18.118	18.172	18.226	18.280
340	18.280	18.334	18.388	18.442	18.496	18.550	18.604	18.658	18.712	18.766	18.820
350	18.820	18.874	18.928	18.982	19.036	19.090	19.144	19.198	19.252	19.306	19.360

Virtual Labs

https://sl-coep.vlabs.ac.in/exp/temperature-sensor/simulation.html

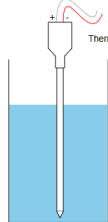
Characterise the Temperature Sensor(Thermocouple) ★★★★★

Rate Me Report a Bug

### Thermocouple

Sensor Analysis Laboratory

#### Level-1 Static Characteristics



Thermocouple with Head

Thermocouple Reference Table

#### Control Panel

Thermocouple Type:

Iron(+)Versus Constantan(-)

Reference Temp:

Useful Temperature Range: 95°C to 760°C

Get temperature -> 333°C

Enter Input value mV:

Level 2

Selected Values:

Thermocouple Type: J

Reference Temp: 0

#### Thermocouple Reference Table link

- Type B Thermocouple
- Type E Thermocouple
- Type J Thermocouple
- Type K Thermocouple
- Type N Thermocouple
- Type R Thermocouple
- Type S Thermocouple
- Type T Thermocouple

#### NOTE

1. For simulation purpose get temperature is limited to 400 °C

2. As the thermocouple 8<sup>th</sup> order equations are converted to lower order, the simulation results may differ from reference table values

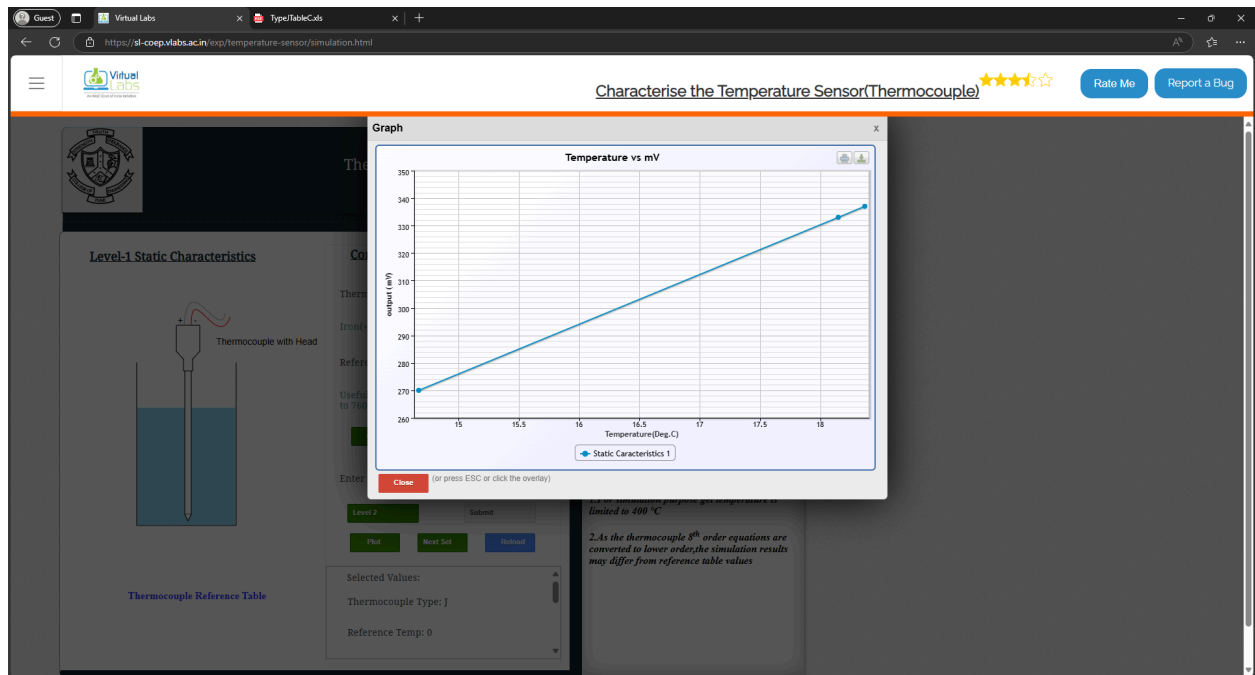
Virtual Labs

https://sl-coep.vlabs.ac.in/exp/temperature-sensor/simulation/asset/Type/TypeTableCpdf

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ITS-90 Table for Type J Thermocouple (Ref Junction 0°C)												
°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	
	0	0.000	0.050	0.101	0.151	0.202	0.253	0.303	0.354	0.405	0.456	0.507
10	0.507	0.558	0.609	0.660	0.711	0.762	0.814	0.865	0.916	0.968	1.019	
20	1.019	1.071	1.122	1.174	1.226	1.277	1.329	1.381	1.433	1.485	1.537	
30	1.537	1.589	1.641	1.693	1.745	1.797	1.849	1.902	1.954	2.006	2.059	
40	2.059	2.111	2.164	2.216	2.269	2.322	2.374	2.427	2.480	2.532	2.585	
50	2.585	2.638	2.691	2.744	2.797	2.850	2.903	2.956	3.009	3.062	3.116	
60	3.116	3.169	3.222	3.275	3.329	3.382	3.436	3.489	3.543	3.596	3.650	
70	3.650	3.703	3.757	3.810	3.864	3.918	3.971	4.025	4.079	4.133	4.187	
80	4.187	4.240	4.294	4.348	4.402	4.456	4.510	4.564	4.618	4.672	4.726	
90	4.726	4.781	4.835	4.889	4.943	4.997	5.052	5.106	5.160	5.215	5.269	
100	5.269	5.323	5.378	5.432	5.487	5.541	5.595	5.650	5.705	5.759	5.814	
110	5.814	5.868	5.923	5.977	6.032	6.087	6.141	6.196	6.251	6.306	6.360	
120	6.360	6.415	6.470	6.525	6.579	6.634	6.689	6.744	6.799	6.854	6.909	
130	6.909	6.964	7.019	7.074	7.129	7.184	7.239	7.294	7.349	7.404	7.459	
140	7.459	7.514	7.569	7.624	7.679	7.734	7.789	7.844	7.900	7.955	8.010	
150	8.010	8.065	8.120	8.175	8.231	8.286	8.341	8.396	8.452	8.507	8.562	
160	8.562	8.618	8.673	8.728	8.783	8.839	8.894	8.949	9.005	9.060	9.115	
170	9.115	9.171	9.226	9.282	9.337	9.392	9.448	9.503	9.559	9.614	9.669	
180	9.669	9.725	9.780	9.836	9.891	9.947	10.002	10.057	10.113	10.168	10.224	
190	10.224	10.279	10.335	10.390	10.446	10.501	10.557	10.612	10.668	10.723	10.779	
200	10.779	10.834	10.889	10.945	11.001	11.056	11.112	11.167	11.223	11.278	11.334	
210	11.334	11.389	11.445	11.501	11.556	11.612	11.667	11.723	11.778	11.834	11.889	
220	11.889	11.945	12.000	12.056	12.111	12.167	12.222	12.278	12.334	12.389	12.445	
230	12.445	12.500	12.556	12.611	12.667	12.722	12.778	12.833	12.889	12.944	13.000	
240	13.000	13.056	13.111	13.167	13.222	13.278	13.333	13.389	13.444	13.500	13.556	
250	13.556	13.611	13.666	13.722	13.777	13.833	13.888	13.944	13.999	14.055	14.110	
260	14.110	14.166	14.221	14.277	14.332	14.388	14.443	14.499	14.554	14.609	14.665	
270	14.665	14.720	14.776	14.831	14.887	14.942	14.998	15.053	15.109	15.164	15.219	
280	15.219	15.275	15.330	15.386	15.441	15.496	15.552	15.607	15.663	15.718	15.773	
290	15.773	15.829	15.884	15.940	15.995	16.050	16.106	16.161	16.216	16.272	16.327	
300	16.327	16.383	16.438	16.493	16.549	16.604	16.659	16.715	16.770	16.825	16.881	
310	16.881	16.936	16.991	17.046	17.102	17.157	17.212	17.268	17.323	17.378	17.434	
320	17.434	17.489	17.544	17.599	17.655	17.710	17.765	17.820	17.876	17.931	17.986	
330	17.986	18.041	18.097	18.152	18.207	18.262	18.318	18.373	18.428	18.483	18.538	
340	18.538	18.594	18.649	18.704	18.759	18.814	18.870	18.925	18.980	19.035	19.090	



Electrical Engineering > Sensors Modeling & Simulation Lab > Experiments

**Characterise the Temperature Sensor(Thermocouple)**

**Aim**

**Theory**

**Pretest**

**Procedure**

**Simulation**

**Posttest**

**References**

**Feedback**

**CJC stands for**

- ☐ a. Central Junction Compensation
- ☐ b. Cold Joint Compensation
- ☐ c. Central Joint Compensation
- ☒ d. Cold Junction compensation

**Lead wire compensation is necessary for**

- ☐ a. RTDs
- ☐ b. T/Cs
- ☒ c. Both RTDs and T/Cs
- ☐ d. None of them

**For j type thermocouple materials used are**

- ☒ a. Iron Constantan
- ☐ b. Chromel Constantan
- ☐ c. Chromel Alumel
- ☐ d. All of these

**Thermowell is used for protection of**

- ☐ a. Process fluid
- ☒ b. sensing element
- ☐ c. None of these
- ☐ d. Both a and b

**---- Type thermocouple is used for cryogenic applications**

- ☐ a. S
- ☐ b. T
- ☒ c. E
- ☐ d. P

Submit Quiz

Score: 5 out of 5

Start

Virtual Labs

Characterise the Temperature Sensor(Thermocouple) ★★★★★

Rate Me Report a Bug

### Thermocouple

Sensor Analysis Laboratory

**Level-2 Dynamic Characteristics**

Bare: ☒ <<Level-1

Thermocouple Type:

Withsheath: ☒

Material:

Thickness:

Thermowell: ☒

Material:

Thickness:

Filling Material:

Plot Refresh

Output:  $t_{bare} = t_{sheath} + t_{well} + t_{junction}$

Time constant is: 16.76 sec. for SS 304

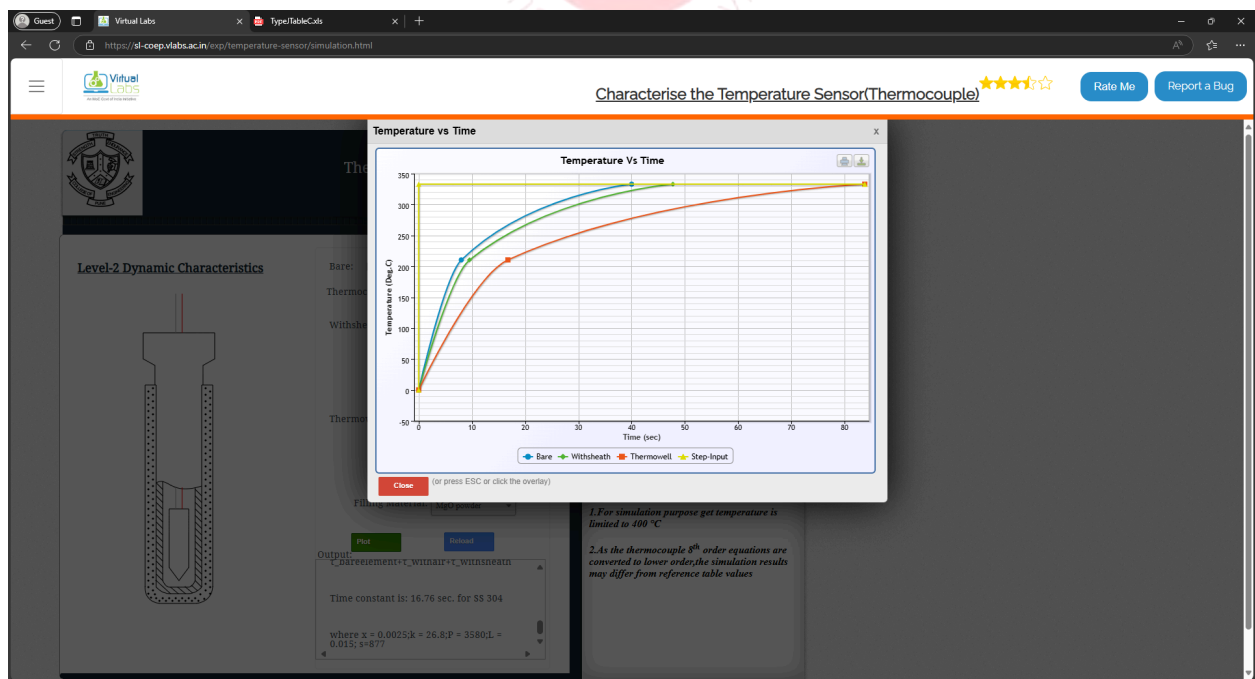
where  $x = 0.0025$ ;  $k = 26.8$ ;  $P = 3580$ ;  $L = 0.015$ ;  $s = 877$

**Thermocouple Reference Table link**

- Type B Thermocouple
- Type E Thermocouple
- Type J Thermocouple
- Type K Thermocouple
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**NOTE**

1. For simulation purpose get temperature is limited to 400 °C
2. As the thermocouple 8<sup>th</sup> order equations are converted to lower order, the simulation results may differ from reference table values



**Questions:**

**1. Explain AWS IoT Greengrass concept.**

AWS IoT Greengrass is a service that extends AWS cloud capabilities to local devices, allowing them to process data, execute machine learning models, and communicate securely even when offline. It enables edge devices to act intelligently by running AWS Lambda functions, synchronizing data with the cloud, and securely interacting with other devices in the network.

**Key features of AWS IoT Greengrass:**

- i. Local Computing:** Allows devices to process data locally without always depending on the cloud.
- ii. Machine Learning (ML) Inference:** Enables edge devices to run pre-trained ML models for faster decision-making.
- iii. Secure Device Communication:** Provides authentication and encryption for secure device-to-device and device-to-cloud communication.
- iv. Connectivity Management:** Supports intermittent connectivity by caching messages and synchronizing them with the cloud when the connection is restored.
- v. Lambda Function Execution:** Allows running AWS Lambda functions on local devices to automate tasks and respond to local events.

AWS IoT Greengrass is widely used in industries like smart homes, industrial automation, and healthcare to improve efficiency and reduce latency in IoT applications.

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**Outcomes: CO2 — Comprehend IoT architecture, enabling technologies and protocols**

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**Conclusion:**

In this experiment, we explored the concept of Virtual Labs and how they enable remote experimentation in IoT. The selected experiment demonstrated the functionality of a temperature sensor using a virtual simulation. The use of Virtual Labs enhances learning by providing hands-on experience without requiring physical hardware. Additionally, we learned about AWS IoT Greengrass and its role in enabling edge computing for IoT devices, allowing them to process data locally while maintaining secure communication with the cloud. This knowledge is essential for developing efficient and scalable IoT applications.

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**Grade: AA / AB / BB / BC / CC / CD / DD**

**Signature of faculty in-charge with date**

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**References:**

**Links:**

<https://www.vlab.co.in/>

**Books:**

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
  2. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
  3. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things - From Research and Innovation to Market Deployment”, River Publisher, 2014
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