Department of

Artificial Intelligence and Machine Learning

Curriculum Booklet - Theory Course

Class: T.E.

Name of the Course –

IoT with Artificial Intelligence

2020 Pattern

(With effect from 2022-23)

Prof. Aboli Deole — ***Course in charges***

Module Coordinator

Dr.Shraddha Pandit — ***HOD***

Teaching Plan

Sr. No.	Unit	Topics to be covered	Book Referred	Total Lecture Planned
1	I	Introduction to Internet of Things – Definition & Characteristics, Importance of IoT, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates, IoT and M2M, The role of Artificial Intelligence in IOT, Introduction to AIOT, Applications of Artificial Intelligence in Internet of Things: Collaborative Robots, Digital Twins, Drones, Smart Retailing, Smart Cities, Smart Health.	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities	06
2	II	Evolution of Internet of Things, Enabling Technologies, IoT Architectures: oneM2M, IoT World Forum(IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack ,Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities	07
3	III	IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ahand Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, 6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.	Internet of Things: Architecture, Design Principles And Applications, Rajkamal	07
4	IV	Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices	Internet of Things: Architecture, Design Principles And Applications, Rajkamal	07

5	V	Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus DataatRest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M.Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/ Services, Everything as a service and Cloud Service Models.	Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012	06
6	VI	Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT Software & Management Tools for IoT Cloud Storage Models & Communication APIs Cloud for IoT - Amazon Web Services for IoT.	Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols	06

Text Books:

1. 1. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities
Press, 2015.
2. 2. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education
3. 3. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012
4. 4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of
Things, Springer, 2011. 4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.

Reference Books:

1. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things – Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9 Hakima Chaouchi, “The Internet of Things Connecting Objects to the Web” ISBN: 978-1-84821-140-7, Willy Publications.
2. “From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence”, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014
3. 3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and
Florian (Eds), Springer, 2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media, 2011.

Reference Web Links/ Research Paper/ Referred Book other than Mention in Syllabus:

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Unit No.-I- INTRODUCTION TO INTERNET OF THINGS

Lecture No.	Details of the Topic to be covered	References
1	Introduction to Internet of Things – Definition & Characteristics, Importance of IoT,	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities
2	Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT functional Blocks,	
3	IOT Levels & Deployment Templates, IoT and M2M,Issues and challenges in IOT	
4	The role of Artificial Intelligence in IOT, Introduction to AIOT,Internet of Things: Collaborative Robots, Major AIOT segment	
5	Untapped potential of ai na IOT Applications of Artificial Intelligence in Digital Twins	
6	Applications of Artificial Intelligence in Drones, Smart Retailing, Smart Cities, Smart Health	

Question Bank: Theory & Numerical
Mapped to Course Outcome: CO1

Q. 1	What is role of things and Internet in IoT?
Q. 2	Why do IOT systems have to be self-adapting and self-configuring?
Q. 3	Describe an example of IoT service that uses Web Socket based communication.
Q. 4	Define IOT. What are the various characteristics of IOT?
Q. 5	What are architectural constraints of REST?

Unit No.-II- Fundamentals of IoT

Lecture No.	Details of the Topic to be covered	References
1	Data Analytics: Introduction, Structured Versus Unstructured Data, Evolution of IT,IOT Architecture ,One M2M,IOTWF	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti
2	Data in Motion versus Data at Rest, IoT Data Analytics Challenges,	
3	Data Acquiring, Organizing in IoT/M2M. IOT Devices- Sensors, IOT Devices-Actuators	
4	Supporting Services: Computing Using a Cloud Platform for IoT/M2M	
5	Fog computing, Edge computing, Cloud Computing	
6	Cloud Service Models, Functional Blocks of IOT,Connnecting Smart Objects in IOT	
7	Applications/Services, Everything as a service and Cloud Service Models, Functional Blocks of IOT,Connnecting Smart Objects in IOT	

Question Bank: Theory & Numerical
Mapped to Course Outcome: CO2

Q. 1	State difference between Sensors and Actuators? And Co relate with human brain?
Q. 2	What is ZIG Bee? Explain 802.15.4?
Q. 3	State goal of M2M architecture and Explain Application layer in it?
Q. 4	Explain architectural classification of smart objects?
Q. 5	List and explain the characteristics and attributes concerned when selecting and dealing with connecting smart objects?

Unit No.-III- IoT PROTOCOLS

Lecture No.	Details of the Topic to be covered	References
1	IoT Access Technologies: Physical and MAC layers,	Internet of Things: Architecture, Design Principles And Applications, Rajkamal
2	Topology and Security of IEEE 802.15.4, 802.11ah IOT Network Layer Protocol.	
3	Lora WAN, Network Layer: IP versions, What is IP4, What is IP6, Difference between IPv4 and IPv6.	
4	6LoWPAN, 6LoWPAN and IETF, 6LoWPAN Application areas, 6LoWPANBasics, 6LoWPANSecurity, 6LoWPAN Inter-operability.	
5	Constrained Nodes and Constrained Networks, Application Transport Methods: SCADA.	
6	How does Scada software System works, features of Scada.	
7	Application Layer Protocols: CoAP and MQTT.Difference between COAP and MQTT.	

Question Bank: Theory & Numerical
Mapped to Course Outcome: CO3

Q. 1	Explain in brief Application layer protocols and compare MQTT and CoAP protocol.
Q. 2	State and describe various characteristics of LoRaWAN technology?
Q. 3	Explain 6LoWPAN protocol?
Q. 4	Compare IEEE 802.11ah and 802.15.4 protocol.
Q. 5	What is SCADA Software System? Describe features supported by SCADA.

Unit No.-IV- IoT Application Development

Lecture No.	Details of the Topic to be covered	References
1	Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration	Internet of Things: Architecture, Design Principles And Applications, Rajkamal
2	- Implementation of Device integration, Data acquisition and integration, Device data storage.	
3	Unstructed data storage Challenges, Storage Requirement for Unstructed data	
4	Scale out NAS, object Storage, Unstructed data storage with data lakes, data warehouse	
5	Cloud Application and Constraints, Not as unstructed as you might think.	
6	Unstructured data storage on cloud/local server, Authentication, authorization of devices.	
7	Authentication, authorization of devices. What is A Authentication,Authorization,Three types of Authentication ,authorization	

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	State and explain IOT frameworks
Q. 2	Differentiate between Data Warehouse and Data Lake?
Q. 3	Explain four basic components of IOT frameworks.
Q. 4	What is Authentication and Authorization? Describe three types of Authentication and Authorization
Q. 5	Explain KAA and ZETTA IOT frameworks.

Unit No.-V- Data Analytics and Supporting Services

Lecture No.	Details of the Topic to be covered	References
1	Data Analytics: What are the Tools used in data analytics, Introduction, difference between data analytics and Data Science.	Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols
2	Structured Versus Unstructured Data, Data in Motion versus Data at Rest, Difference between data in Motion and Data at Rest	
3	IoT Data Analytics Challenges, Data Acquiring, Data acquiring and Storage	
4	Computing Using a Cloud Platform for IoT/M2M ,Integration of clouds big data considering The IOt	
5	Data categorization for storage, Organizing in IoT/M2M.Supporting Services:	
6	Applications/Services, Everything as a Service Model Example, Everything as a service and Cloud Service Models	

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	List and explain challenges in data analytics.
Q. 2	Describe Device Integration
Q. 3	Distinguish between Structured and unstructured data
Q. 4	Describe security concerns for Data in Motion and Data at Rest
Q. 5	List advantages and disadvantages of structured data.

Unit No.-VI- AI and the Internet of Thing: Real World

Lecture No.	Details of the Topic to be covered	References
1	Real world design constraints - Applications - Asset management,	Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols
2	Industrial automation, smart grid,	
3	Commercial building automation, Smart cities -	
4	participatory sensing - Data Analytics for IoT –	
5	Software & Management Tools for IoT,	
6	Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.	

Question Bank: Theory & Numerical
Mapped to Course Outcome:

Q. 1	Explain Industrial Automation in IOT and state its advantages and disadvantages.
Q. 2	Explain Amazon web services for IOT.
Q. 3	State and explain IOT data analytics application.
Q. 4	Discuss Asset management in IOT.
Q. 5	What is the Smart grids? Discuss how Smart cities are adopting Smart grid technology.

Execution Record

Class: TE **Course: IOT with AI** **AY: 2022-23**
Term: I

**Mode of delivery: PPT, Video, Demonstration, Chalk and Board, Flipped Classroom, Think-Pair Share, etc.*

Lect. No.	Unit No.	Date	Main Topic to be covered	Sub Topic to be covered	Mode of Delivery
1	I	18/07/22	Introduction to Internet of Things	Introduction to Internet of Things – Definition & Characteristics, Importance of IoT	PPT & Board
2	I	20/07/22	Physical Design of IOT, Logical Design of IOT,	Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT functional Blocks,	PPT & Board
3	I	21/07/22	Data Acquiring, Organizing in IoT/M2M.	Data Acquiring, Organizing in IoT/M2M. IOT Devices- Sensors, IOT Devices-Actuators	PPT & Board
4	I	25/07/22	The role of Artificial Intelligence in IOT,	The role of Artificial Intelligence in IOT, Introduction to AIOT,Internet of Things: Collaborative Robots, Major AIOT segment	PPT & Board
5	I	27/07/22	Applications of Artificial Intelligence in Digital Twins	Untapped potential of ai na IOT Applications of Artificial Intelligence in Digital Twins	PPT & Board
6	I	28/07/22	Applications of Artificial Intelligence in Drones, Smart Retailing	Applications of Artificial Intelligence in Drones, Smart Retailing, Smart Cities, Smart Health	PPT & Board
7	II	1/08/22	Data	Data Analytics: Introduction,	PPT &

			Analytics: Introduction, Structured Versus Unstructured Data	Structured Versus Unstructured Data, Evolution of IT,IOT Architecture ,One M2M,IOTWF	Board
8	II	3/08/22	Data in Motion versus Data at Rest,	Data in Motion versus Data at Rest, IoT Data Analytics Challenges	PPT & Board
9	II	4/08/22	Data Acquiring, Organizing in IoT/M2M.	Data Acquiring, Organizing in IoT/M2M. IOT Devices- Sensors, IOT Devices-Actuators	PPT & Board
10	II	8/08/22	Computing Using a Cloud Platform for IoT/M2M	Supporting Services: Computing Using a Cloud Platform for IoT/M2M	PPT & Board
11	II	10/08/22	Fog, Edge and Cloud computing	Fog computing, Edge computing, Cloud Computing	PPT & Board
12	II	11/08/22	Functional Blocks of IOT,	Cloud Service Models, Functional Blocks of IOT, Connecting Smart Objects in IOT	PPT & Board
13	II	17/08/22	Applications/Services, Everything as a service	Applications/Services, Everything as a service and Cloud Service Models, Functional Blocks of IOT,Connnecting Smart Objects in IOT	PPT & Board
14	III	18/08/22	IoT Access Technologies	IoT Access Technologies: Physical and MAC layers,	PPT & Board
15	III	22/08/22	Topology and Security of IEEE	Topology and Security of IEEE 802.15.4, 802.11ah IOT Network Layer Protocol.	PPT & Board

			802.15.4, 802.11ah		
16	III	24/08/22	Lora WAN, Network Layer	Lora WAN, Network Layer: IP versions, What is IP4, What is IP6, Difference between IPv4 and IPv6.	PPT & Board
17	III	25/08/22	6LoWPAN Protocol	6LoWPAN, 6LoWPAN and IETF, 6LoWPAN Application areas, 6LoWPANBasics, 6LoWPANSecurity, 6LoWPANInter operability.	PPT & Board
18	III	1/09/22	Constrained Nodes and Constrained Networks,	Constrained Nodes and Constrained Networks, Application Transport Methods: SCADA	PPT & Board
19	III	5/09/22	SCADA	How does Scada software System works, features of Scada.	PPT & Board
20	III	7/09/22	Application Layer Protocols: CoAP and MQTT	Application Layer Protocols: CoAP and MQTT.Difference between COAP and MQTT.	PPT & Board
21	IV	8/09/22	Solution framework for IoT	Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration	PPT & Board
22	IV	12/09/22	Implementation of Device integration, Data acquisition	Implementation of Device integration, Data acquisition and integration, Device data storage.	PPT & Board
23	IV	14/09/22	Unstructed data storage	Unstructed data storage Challenges, Storage Requirement for Unstructed	PPT & Board

				data	
24	IV	15/09/22	Data lakes, Data warehouse	Scale out NAS, object Storage, Unstructed data storage with data lakes, data warehouse	PPT & Board
25	IV	19/09/22	Cloud Application and Constraints	Cloud Application and Constraints, Not as unstructed as you might think.	PPT & Board
26	IV	21/09/22	Authentication, authorization of devices.	Authentication, authorization of devices. What is A Authentication,Authorization, Three types of Authentication ,authorization	PPT & Board
27	IV	22/09/22	Unstructured data storage on cloud/local server	Unstructured data storage on cloud/local server, Authentication, authorization of devices.	PPT & Board
28	V	26/09/22	Data Analytics	Data Analytics: What are the Tools used in data analytics, Introduction, difference between data analytics and Data Science.	PPT & Board
29	V	28/09/22	Structured Versus Unstructured Data	Structured Versus Unstructured Data, Data in Motion versus Data at Rest, Difference between data in Motion and Data at Rest	PPT & Board
30	V	29/09/22	IoT Data Analytics Challenges,	IoT Data Analytics Challenges, Data Acquiring, Data acquiring and Storage	PPT & Board
31	V	3/10/22	Computing Using a Cloud Platform for IoT/M2M	Computing Using a Cloud Platform for IoT/M2M ,Integration of clouds big data considering The IOt	PPT & Board
32	V	6/10/22	Data categorization	Data categorization for storage, Organizing in	PPT &

			for storage,	IoT/M2M.Supporting Services:	Board
33	V	10/10/22	Everything as a service and Cloud Service Models	Applications/Services, Everything as a Service Model Example, Everything as a service and Cloud Service Models	PPT & Board
34	VI	13/10/22	Asset management,	Real world design constraints - Applications - Asset management,	PPT & Board
35	VI	20/10/22	Industrial automation	Industrial automation, smart grid,	PPT & Board
36	VI	27/10/22	Smart cities	Commercial building automation, Smart cities	PPT & Board
37	VI	3/11/22	Data Analytics for IoT –	participatory sensing - Data Analytics for IoT –	PPT & Board
38	VI	10/11/22	Software & Management Tools for IoT,	Software & Management Tools for IoT,	PPT & Board
39	VI	11/11/22	Cloud Storage Models & Communication APIs	Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.	PPT & Board

Schedule of CO-wise Assessment Tools

Academic Year: _____ (TERM –___)

CO No.	Unit	Date	Assessment Tool	Marks

**Batch is year of admission and graduating year*

Course Assessment Tool Quality and Alignment Matrix

AY:_____ Term:_____

Class: _____ Course: _____

Sr. No.	Assessment Tool used	Bloom's Taxonomy Level (BTL) wise distribution of marks				CO wise Distribution of Marks					
		BTL1	BTL 2	BTL 3	BTL4	CO1	CO2	CO3	CO4	CO5	CO6
1.	Unit Test										
2.	Quiz										
3.	Assignment										
4.	Open Book Test										
Total Marks											
% of Marks for BTL											
		BTL wise expected % of marks distribution		**BTL wise expected % of marks distribution**		**Expected % of marks distribution for 6 COs**					
		40%		**60%**		16.66 %	16.66 %	16.66 %	16.66 %	16.66 %	16.66 %
						Expected % of marks distribution for 5 COs					
						20%	20%	20%	20%	20%	–
						Expected % of marks distribution for 4 COs					
						25%	25%	25%	25%	–	–

Name and Signature of Course in-charge Coordinator

Name and Signature of Module

Name and Signature of Head of Dept.

Peer Feedback on ICT in Teaching Learning

Academic Year:_____ **Term: I/II**

Name of the Faculty: _____ Date of submission to ICT In-charge: _____ Course: _____Topic covered: _____ Web-link:_____

Date of Assessment: _____

Please follow the below Rubric to evaluate the contents given on web-link.

Sr. No	Criteria	1 point	2 point	3 point	Points given
1	Pedagogy used in ICT	1. Video prepared, but no reflection spots missing. 2. Quiz not prepared on the topic 3.Think pair share activity not prepared relevant to the topic 4. No Feedback form on the session	1.Video prepared but only one reflection spot in it. 2.Quiz prepared on the topic but not on all contents covered in video 3.Think pair share activity prepared but not relevant to the topic 4.Feedback not adherent to the contents in the video	1. Video prepared with more than one reflection spots in it 2. Quiz is prepared on the contents covered in video 3. Think pair share activity prepared relevant to the topic. 4. Feedback adherent to the contents in the video.	
2	Creative commons License	No License has been provided in the document	Only the license image or name has been provided. There are no further details	The license image or name has been provided with further details.	
3	Technical Contents	Contents in the video are not relevant to the course.	Contents in the video are relevant to the course but need more finishing.	Contents in the video are relevant to the course and self explanatory.	
4	Audibility	The video recorded is not clearly audible.	The recorded video is audible but needs improvement in content delivery.	The recorded video is clearly audible without disturbance and has good contents.	
5	Fluency in delivery	Satisfactory	Need improvement	Excellent	

6	Content in video	The contents in video are from other websites and references not specified	The contents in video are from books or other PPT's available on website but references are mentioned partially	Most of the contents in video are prepared by faculty and appropriate references are included.	
7	Duration and effectiveness of video	Video is more than 15 min and not effective	Video is between 10 to 15 min and moderately effective	Video is between 10 to 15 min and very effective	

Reassessment required: Yes / No

Remarks / Suggestions:

_____

_____

_____

_____

Name and signature of the assessing team:

1. _____

2._____

I accept the remarks provided by the peer team and will submit the changes for reassessment within 5 days. Thank you for your valuable feedback.

Name and signature of the Faculty: _____

Note:

1. **The assessing faculty should provide feedback which will be helpful and should suggest methods for improvement and do reassessment if necessary.**
2. **Reassessment should be done after one week.**

Sign of Head of Department: _____

Course Outcome Attainment Details

Course Outcome Attainment of Previous Years

AY	Set Attainment Level (SAL)	Difficulty Level	CO1	CO2	CO3	C O4	CO5	CO6	Average of COs /Target Attainment Level (TAL)

CO attainment of course for all the academic years should be included since when the course is added in the curriculum

Course Outcome Attainment of Current Academic Year

Course Name:

Course Code:

Class:

Term:

Course Instructor:

AY	Set Attainment Level (SAL)	Difficulty Level	CO1	CO2	CO3	C O4	CO5	CO6	Average of COs /Target Attainment Level (TAL)

Inference Drawn (if any):

Planned Action (if any):

Signature of Course Instructor

Result Analysis of Previous Years

AY	No. of Students	Grade							No. of Failed Students	No. of Absent students	Total Appeared Students	Total pass Students	% Passing	% Failure
		O	A+	A	B+	B	C	P						

Results of course for all the academic years should be included since when the course is added in the curriculum

Result Analysis of Current Academic Year

Course Name:

Course Code:

Class:

Term:

Course Instructor:

AY	No. of Students	Grade							No. of Failed Students	No. of Absent students	Total Appeared Students	Total pass Students	% Passing	% Failure
		O	A+	A	B+	B	C	P						

Inference Drawn (if any):

Planned Action (if any):

Signature of Course Instructor