Minor Courses (2022 Batch)

1.   Data Science
2.   Internet of Things (IoT)

S. No.	Course Code	Semesters	Course Structure	L	T	P	Credits
			Title				
1	DAS-01	3rd sem	Introduction to Data Science	3	0	2	4
2	DAS-02	4th sem	Introduction to AI and ML	3	0	0	3
3	DAS-03	5th sem	Computational Data analytics	3	0	2	4
4	DAS-04	6th sem	Web Data Mining	3	0	0	3
5	DAS-05	7th sem	Analysing, Visualizing and Applying Data science with python	3	0	2	4
			TOTAL	**15**	**0**	**6**	**18**

Course Code	:	DAS-01
Course Title	:	Introduction to Data Science
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	DAS

Course Objective:

- To Provide the knowledge and expertise to become a proficient data scientist;
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
- Produce Python code to statistically analyse a dataset;
- Critically evaluate data visualisations based on their design and use for communicating stories from data;

Course Contents:

Module 1: [7 Lectures]

Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science.

Module 2: [7 Lectures]

Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA- Quantitative technique, EDA- Graphical Technique, Data Analytics Conclusion and Predictions.

Module 3: [11 Lectures]

Feature Generation and Feature Selection (Extracting Meaning from Data)- Motivating application: user (customer) retention- Feature Generation (brainstorming, role of domain expertise, and place for imagination)- Feature Selection algorithms.

Module 4: [10 Lectures]

Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects- Exercise: create your own visualization of a complex dataset.

Module 5: [7 Lectures]

Applications of Data Science, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.

Lab Work:
1. Python Environment setup and Essentials.
2. Mathematical computing with Python (NumPy).
3. Scientific Computing with Python (SciPy).
4. Data Manipulation with Pandas.
5. Prediction using Scikit-Learn
6. Data Visualization in python using matplotlib

Text Books/References:

1. Data Sciences & Analytics, V.K. Jain, Khanna Publishing House, 2018.
2. Business Analytics: The Science of Data - Driven Decision Making, U Dinesh Kumar, John Wiley & Sons, 2017.
3. Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools, Davy Cielen, John Wiley & Sons, 2016
4. Joel Grus, Data Science from Scratch, Shroff Publisher/O'Reilly Publisher Media, 2019
5. Annalyn Ng, Kenneth Soo, Numsense! Data Science for the Layman, Shroff Publisher Publisher, 2017
6. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly Publisher. 2013
7. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press, 2016
8. Jake VanderPlas, Python Data Science Handbook, Shroff Publisher/O'Reilly Publisher Media, 2016
9. Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher/O'Reilly Publisher Media. 2010

Course Outcomes: After completion of course, students would be able:
1. To explain how data is collected, managed and stored for data science;
2. To understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
3. To implement data collection and management scripts using MongoDB.

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Course Code	:	DAS-02
Course Title	:	Introduction to AI and ML
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	DAS

Course Objective:

- To understand basics of machine learning in data science.
- To understand various basic machine learning algorithm that can be used with various type of data.

Course Contents:
Module 1: [6 Lectures]
Linear Regression: Basic facts of linear regression, implementation of linear regression, case studies of linear regression using data set

Module 2: [8 Lectures]
Logistic Regression: Basic facts and implementation of logistic regression, solve a case study to predict output using existing data set

Module 3: [11 Lectures]

Clustering and Principle Component Analysis: K means and hierarchical clustering, how to make market strategies using clustering, recommendation and PCA

Module 4: [9 Lectures]
Support Vector Machine: basics of SVM and use it to detect the spam emails and recognize alphabets

Module 5: [8 Lectures]
Model Selection and advanced regression: use of Lasso and Ridge

Lab Work:
1. Use python to predict employee attrition in a firm and help them plan their manpower. (take data set from kaggle).
2. Create customer clusters using different market strategies on a data set.
3. Make a movie recommendation system.
4. Develop a prediction mechanism to predict which employee can go on leave in a company in near future.
5. Recognizing alphabets using SVM.

Text Books/References:
1. Machine Learning using Python , U Dinesh Kumar and Manaranjan Pradhan, John Wiley & Sons, 2020
2. A Classical Approach to Artificial Intelligence, M.C. Trivedi, Khanna Publishing House, 2018
3. Machine Learning, V.K. Jain, Khanna Publishing House, 2019
4. Advanced Data Analytics Using Python: With Machine Learning, Deep Learning by By Sayan Mukhopadhyay, Apress, 2018
5. Practical Data Mining" by Monte F. Hancock, Auerbach Publication, 2011

6. "Machine Learning for Absolute Beginners: A Plain English Introduction (Second Edition)" by Oliver Theobald. 2017
7. Practical Data Science with R, Nina Zumel, John Wiley & Sons, 2014
8. Python for Data Science for Dummies, John Paul Mueller, Luca Massaron, John Wiley & Sons, 2019
9. Big Data and Analytics, Seema Acharya and Subhashini Chellappan, Wiley Publication, 2019
10. Introduction to Machine Learning, Jeeva Jose, Khanna Publishing House, 2020

Course Outcomes: After completion of course, students would be able:
1. To explain how data is collected, managed and stored for data science;
2. To use various type of Machine learning model
3. To implement various ML algorithms on data models

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Course Code	:	DAS-03
Course Title	:	Computational Data Analytics
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	DAS

Course Objective:

- To learn how to think about your study system and research question of interest in a systematic way in order to design an efficient sampling and experimental research program.
- To understand how to analyze collected data to derive the most information possible about your research questions.

Course Contents:

Module 1: [6 Lectures]
Introduction to R Computing language. Best practices in executing Reproducible Research in data science, Sampling and Simulation. Descriptive statistics, and the creation of good observational sampling designs.

Module 2: [8 Lectures]
Data visualization, Data import and visualization, Introduction to various plots

Module 3: [10 Lectures]
Frequentist Hypothesis Testing, Z-Tests, Power Analysis

Module 4: [10 Lectures]
Linear regression, diagnostics, visualization, Likelihoodist Inference, Fitting a line with Likelihood, Model Selection with one predictor

Module 5: [8 Lectures]
Bayesian Inference, Fitting a line with Bayesian techniques, Multiple Regression and Interaction Effects, Information Theoretic Approaches

Lab Work:
1. To give a basic insight of R and its various libraries.
2. Libraries in R. R as a Data Importing Tool, Dplyr. Forcats.
3. Simulation and Frequentist Hypothesis testing, Simulation and Power.
4. Bayesian computation in R, Fitting a line with Bayesian techniques.

Text Books/References:
1. Beginner's Guide for Data Analysis using R Programming, Khanna Publishing House, 2018
2. Practical Data Science with R, Nina Zumel, John Wiley & Sons. 2014
3. Big Data & Hadoop, V.K. Jain, Khanna Publishing House, 2017
4. N. C. Das, Experimental Designs in Data Science with Least Resources, Shroff Publisher Publisher, 2018
5. Hadley Wickham, Garret Grolemund, *R for Data Science*, Shroff Publisher/O'Reilly Publisher Publisher, 2017
6. Benjamin M. Bolker. *Ecological Models and Data in R*. Princeton University Press, 2008. ISBN 978-0-691-12522-0, 2008
7. John Fox and Sanford Weisberg. *An R Companion to Applied Regression*. Sage Publications, Thousand Oaks, CA, USA, second edition, 2011. ISBN 978-1-4129-7514- 8, 2018

Course Outcomes: After completion of course, students would be able to:
1. Explain how data is collected, managed and stored for data science;
2. When to use which type of Machine learning model.
3. Implement various ML algorithms on data models.

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Course Code	:	DAS-04
Course Title	:	Web Data Mining
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	DAS

Course Objective:
- To learn how to extract data from the Web.
- To understand how to analyze collected data to derive the most information

Course Contents:

Module 1: [6 Lectures]

Introduction to internet and WWW, Data Mining Foundations, Association Rules and Sequential Patterns, Basic Concepts of Association Rules, Apriori Algorithm, Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports, Extended Model, Mining Algorithm, Rule Generation

Module 2: [8 Lectures]

Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP, Mining Sequential Patterns on Prefix Span, Generating Rules from Sequential Patterns

Module 3: [10 Lectures]

Concepts of Information Retrieval, IR Methods, Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-processing, Stopword Removal, Stemming, Web Page Preprocessing, Duplicate Detection, Inverted Index and Its Compression, Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing, Singular Value Decomposition, Query and Retrieval, Web Search, Meta Search, Web Spamming

Module 4: [10 Lectures]

Link Analysis, Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, CommModuley Discovery, Problem Definition, Bipartite Core CommModuleies, Maximum Flow CommModuleies, Email CommModuleies, Web Crawling, A Basic Crawler Algorithm – Breadth First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics and Conflicts.

Module 5: [8 Lectures]

Opinion Mining, Sentiment Classification, Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization, Problem Definition, Object feature extraction, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam. Web Usage Mining, Data Collection and Preprocessing, Sources and Types of Data, Key Elements of Web Usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web

Usage Patterns, Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigation Patterns.

Text Books/References:

1. Mining the Web: Discovering Knowledge from Hypertext Data, Soumen Chakrabarti, Morgan Kaufmann Publishers, 2002
2. Bing Liu, Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Springer Publications, 2011.

3. Jiawei Han, Micheline Kamber, Data Mining: Concepts and Techniques, Second Edition, Elsevier Publications 2010.
4. Anthony Scime, Web Mining: Applications and Techniques, 2005.

5. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.
6. Mathew Russell, Mining the Social Web 2nd Edition, Shroff Publisher/O'Reilly Publisher Publication, 2013
7. Data Mining and Data Warehousing Principles and Practical Techniques, Parteek Bhatia, Cambridge University Press, 2019
8. Data Mining & Business Intelligence, Balram Krishan, Khanna Publishing House, 2014

Course Outcomes: After completion of course, students would be able:

1. To explain how data is can be collected from the Web.
2. To extract data and information from the webpages.
3. To make decision based on the data collected.

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Course Code	:	DAS-05
Course Title	:	Analysing, Visualizing and Applying data science with python
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	DAS

Course Objective:

- To learn how to use python for data science.
- To understand and use all the tools and libraries of python for data science.

Course Contents:

Module 1: [6 Lectures]
Data Analysis libraries: will learn to use Pandas DataFrames, Numpy multi-dimentional arrays, and SciPy libraries to work with a various dataset.

Module 2: [8 Lectures]

Pandas, an open-source library, and we will use it to load, manipulate, analyze, and visualize various datasets.

Module 3: [10 Lectures]

Scikit-learn, and we will use some of its machine learning algorithms to build smart models and make predictions, various parameters that can be used to compare various parameters.

Module 4: [10 Lectures]

Descriptive Statistics, Basic of Grouping, ANOVA, Correlation, Polynomial Regression and Pipelines, R-squared and MSE for In-Sample Evaluation, Prediction and Decision Making

Module 5: [10 Lectures]

Grid Search, Model Refinement, Binning, Indicator variables

Lab Work:

1. Demonstrate knowledge of Data Science and Machine Learning.
2. Apply Data Science process to a real life scenario.
3. Explore New York City - 311 Complaints and Housing datasets.
4. Analyze and Visualize data using Python.
5. Perform feature engineering exercise using Python.
6. Build and validate predictive machine learning model using Python.
7. Create and share Actionable Insights to real life data problems.

Text Books/References:

1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House, 2017
2. Data Visualization with Python and JavaScript, Kyran Dale, Shroff Publisher/O'Reilly Publisher Publication. 2016
3. Data Science Using Python and R by Chantal D. Larose and Daniel T. Larose, Wiley Publication, 2019
4. Data Science & Analytics (with Python, R, SPSS Programming), V.K. Jain, Khanna Publishing House, 2018
5. Python for Data Science and Visualization -Beginners to Pro, Udemy, 2021

Course Outcomes: After completion of course, students would:

1. To explain how data is can be collected from the Web.
2. To extract data and information from the webpages.
3. To make decision based on the data collected.

Detailed Syllabus (Internet of Things (IoT)

S. No.	Course Code	Semester	Course Structure Title	L	T	P	Credits
1	IoT-01	3rd sem	Introduction to Internet of Things	3	0	2	4
2	IoT-02	4th sem	Introduction to Security of Cyber-Physical Systems	3	0	0	3
3	IoT-03	5th sem	Ubiquitous Sensing, Computing and Communication	3	0	2	4
4	IoT-04	6th sem	Embedded Systems for IoT	3	0	0	3
5	IoT-05	7th sem	IoT with Arduino, ESP, and Raspberry Pi	3	0	2	4
			TOTAL	**15**	**0**	**6**	**18**

Detailed Syllabus

Course Code	:	IoT-01
Course Title	:	Introduction to Internet of Things
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	IoT

Course Objective:

- To make students know the IoT ecosystem.
- To provide an understanding of the technologies and the standards relating to the Internet of Things.
- To develop skills on IoT technical planning.

Course Contents:

Module 1 [8 Lectures]
IoT & Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Module 2 [9 Lectures]
M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module 3 [9 Lectures]
IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference

Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Module 4 [8 Lectures]

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Module 5 [8 Lectures]

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.

Text Books/References:

1. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018
2. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher, 2015
3. Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons, 2019
4. Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons, 2019
5. Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media, 2011
6. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2014
7. Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers, 2015

Corresponding Online Resources:

1. https://www.coursera.org/specializations/internet-of-things

Course Outcomes: After completion of course, students would be able:

1. To understand the technology and standards relating to IoTs.
2. To understand the critical ecosystem required to mainstream IoTs.
3. To Acquire skills on developing their own national and enterprise level technical strategies.

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Course Code	:	IoT-02
Course Title	:	Introduction to Security of Cyber-Physical Systems
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	IoT

Course Objective:

- To learn the basics of security and various types of security issues.
- To study different cryptography techniques available and various security attacks.
- Explore network security and how they are implemented in real world.
- To get an insight of various issues of Web security and biometric authentication.

Course Contents:

Module 1 [6 Lectures]
Overview of Security and Privacy in Information System.

Module 2 [10 Lectures]
Applied Cryptography & Intrusion Detection, Architecture of Applied Cryptography, One Way Hash Function and Integrity, Encryption Algorithms and Confidentiality, Digital Signature and Authentication (DH, RSA, 2 class), Intrusion Detection and Information Theory.

Module 3 [10 Lectures]
Internet of Things Security, Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare.

Module 4 [8 Lectures]
Software-Defined Networks, Introduction of Software-Defined Networks, Security for Software-Defined Networks, Privacy Leakages for Software-Defined Networks, Case Studies: How to Attack Software-Defined Networks.

Module 5 [8 Lectures]
Cyber-Physical Systems (CPS), CPS - Platform components, CPS implementation issues, Intelligent CPS, Secure Deployment of CPS.

Text Books/References:

1. Cyber Security, Nina Godbole, John Wiley & Sons, 2011
2. Li Da Xu, Shancang Li, "Securing the Internet of Things", Syngress, 2017
3. Alasdair Gilchrist, "IoT Security Issues", De Gruyter, 2017
4. Sean Smith, "The Internet of Risky Things", Sean Smith, Shroff Publisher/O'Reilly Publisher, 2017
5. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018

Course Outcomes: After completion of course, students would be able:
1. To Apply basics of security and issues related to it.
2. To use biometric techniques available and how they are used in today's world.
3. To investigate Security issues in web and how to tackle them.
4. To Learn mechanisms for transport and network security

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Course Code	:	IoT-03
Course Title	:	Ubiquitous Sensing, Computing and Communication
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	IoT

Course Objective:

- Basic introduction of all the elements of IoT-Mechanical, Electronics/sensor platform, Wireless and wireline protocols, Mobile to Electronics integration, Mobile to enterprise integration.
- To have an understanding of basics of open source/commercial electronics platform for IoT.
- To have an understanding of basics of open source /commercial enterprise cloud platform for IoT.

Course Contents:

Module 1
Introduction, Overview, Challenges in IoT, Networking Basics of IoT, NFC, Wireless LAN.

Module 2
Location in ubiquitous computing: Personal assistants, Location aware computing, Location tracking, Architecture, Location based service and applications, Location based social networks (LBSN), LBSN Recommendation.
Context-aware computing: Context and Context-aware Computing, Issues and Challenges, Developing Context-aware Applications, System Architecture.

Module 3
Privacy and security in ubiquitous computing, Energy constraints in ubiquitous computing.
Wearable computing, Glass and Augmented Reality, Eye-Tracking, Digital Pen and Paper, Mobile social networking & crowd sensing, Event based social network.

Module 4
Mobile affective computing: Human Activity and Emotion Sensing, Health Apps, Mobile p2p computing, Smart Homes and Intelligent Buildings, Mobile HCI, Cloud centric IoT, Open challenges, Architecture, Energy Efficiency, Participatory sensing, Protocols, QoS, QoE.

Module 5
IoT and data analytics IoT and Data Management, Data cleaning and processing, Data storage models.
Search techniques, Deep Web, Semantic sensor web, Semantic Web Data Management, Searching in IoT.
Real-time and Big Data Analytics for The Internet of Things, Heterogeneous Data Processing, High-dimensional Data Processing, Parallel and Distributed Data Processing.

Text Books/References:

1. N. Jeyanthi, Ajith Abraham, Hamid Mcheick, "Ubiquitous Computing and Computing Security of IoT", 2018
2. John Krumm, Ubiquitous Computing Fundamentals, CRC Press, 2009
3. Dirk Slama, "Enterprise IoT", Shroff Publisher/O'Reilly Publisher, 2015
4. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018

Course Outcomes: After completion of course, students would be able:
1. To understand merging technological options, platforms and case studies of IoT implementation in home & city automation.
2. To determine the Market perspective of IoT.

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Course Code	:	IoT-04
Course Title	:	Embedded Systems for IoT
Number of Credits	:	3 (L: 3; T: 0; P: 0)
Course Category	:	IoT

Course Objective:

- To make students know the basic concept and architecture of embedded systems.
- Different design platforms used for an embedded system for IoT applications.
- To have knowledge about the IoT enabled technology.

Course Contents:

Module 1 [7 Lectures]
Purpose and requirement specification, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Pillars of Embedded IoT and Physical Devices: The internet of devices.

Module 2 [8 Lectures]
Design of Embedded Systems: Common Sensors, Actuators, Embedded Processors, Memory Architectures, Software architecture.

Module 3 [7 Lectures]
Inputs and Outputs: Digital Inputs and Outputs, Digital Inputs, Digital Outputs, BusIn, BusOut, and BusInOut, Analog Inputs and Outputs, Analog Inputs, Analog Outputs, Pulse Width Modulation (PWM), Accelerometer and Magnetometer, SD Card, Local File System (LPC1768).

Module 4 [10 Lectures]
IoT Enabling Technologies: Communications, RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE), LiFi, 6LowPAN, ZigBee, Z-Wave, LoRa, Protocols, HTTP, WebSocket, MQTT, CoAP, XMPP, Node-RED, Platforms, IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT, ThingWorx, GE

Predix, Xively, macchina.io, Carriots.

Module 5 [10 Lectures]

Web of Things and Cloud of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Cloud of Things. IoT Physical Servers,

Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API.

Text Books/References:

1. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018
2. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons, 2019
3. Klaus Elk, "Embedded Software for the IoT", 2018
4. Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed", 2018
5. Elizabeth Gootman et. al, "Designing Connected Products", Shroff Publisher/O'Reilly Publisher, 2015

Corresponding Online Resources:

1. Introduction to the Internet of Things and Embedded Systems, https://www.coursera.org/learn/iot

Course Outcomes: After completion of course, students would be able to:
1. Understand the embedded system concepts and architecture of embedded systems.
2. Understand the different hardware/software co-design techniques for microcontroller-based embedded systems, apply techniques in IoT applications.
3. To be able to design web/cloud based IoT applications.

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Course Code	:	IoT-05
Course Title	:	IoT with Arduino, ESP, and Raspberry Pi
Number of Credits	:	4 (L: 3; T: 0; P: 2)
Course Category	:	IoT

Course Objective:

- To give students hands-on experience using different IoT architectures.
- To provide skills for interfacing sensors and actuators with different IoT architectures.
- To develop skills on data collection and logging in the cloud.

Course Contents:

Module 1 [5 Lectures]

IoT- introduction and its components, IoT building blocks, Sensors and Actuators, IoT Devices, IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).

Module 2 [10 Lectures]

Arduino Uno – getting started with the Uno boards, blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts. Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module.

Module 3 [10 Lectures]

ESP 8266-12E Node MCU – getting started with the ESP board, Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API- GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board. Case Study: Switching light on /off remotely. Case Study: Voice-based Home

Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).

Module 4 [8 Lectures]

Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS, Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet, Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP address, Rpi 3 - Testing the GPIO pins through Scripts.

Module 5 [9 Lectures]

Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED), Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.

Text Books/References:

1. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House, 2018
2. Rao, M. Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd, 2018
3. Baichtal, J., *Arduino for beginners: essential skills every maker needs*. Pearson Education, 2013
4. Schwartz, M., *Internet of Things with ESP8266*. Packt Publishing Ltd., 2016
5. Richardson, M., & Wallace, S. *Getting started with raspberry PI.* " O'Reilly Publisher Media, Inc.", 2012

Software/Hardware Requirements:

Python, IOT boards - Arduino UNO, NODEMCU ESP 8266, Raspberry PI 3, Few resistors, potentiometer (5K~10K OHM), breadboard, LEDs, DHT 11 sensor.

Course Outcomes: After completion of course, students would:

1. To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud.
2. To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration.
3. To solve analog sensor and digital sensor Interfacing with IOT devices.

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