B.Tech(Hons) in Computer Science & Engineering
with specialization in Internet of Things & Intelligent System
Semester wise Breakup of Courses

SEMESTER V															
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods**			**CCA**				**ESE**	**Total**		**Credit**	
				L	**T**	**P**	**CT**	**AT**	**Total**	**PS**	**TE**	**PE**			
1	BIME-501	Introduction to Internet of Things	PECM-1	3	0	0	20	10	30	-	70	-	100		3
2	BIME-551	Application Oriented Programming using Python	PECM-2	0	0	4	-	-	-	15	-	35	50		2
TOTAL												**150**		**5**	

Introduction to Internet of Things

SL. NO	Engineering Minor Elective		L	T	P	C
1	BIME-501	Introduction to Internet of Things	3	0	0	3

OBJECTIVES

1. To Understand the Architectural Overview of IoT
2. To Understand the IoT Reference Architecture and RealWorld Design Constraints
3. To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)

COURSE OUTCOME

1. Able to comprehend the application regions of IOT.
2. Able to understand the insurgency of Internet in Mobile Devices, Cloud and Sensor Networks.
3. Able to comprehend building squares of Internet of Things and attributes.
4. Apply IOT to different applications.
5. Analysis and evaluate protocols used in IOT.
6. Design and develop smart city in IOT.

UNIT I –OVERVIEW

Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

UNIT II –REFERENCE ARCHITECTURE

IoT Architecture-State of the Art –Introduction, State of the art, Reference Model and architecture, IoT reference Model -IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints-Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

UNIT III –IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 -Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

UNIT IV –TRANSPORT & SESSION LAYER PROTOCOLS

Transport Layer(TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) –Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

UNITV –SERVICE LAYER PROTOCOLS & SECURITY

Service Layer -oneM2M, ETSI M2M, OMA, BBF –Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer.

REFERENCES

- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1st Edition, Academic Press, 2014.
- Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI
- Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer
- Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
- Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition,VPT,2014.6.http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Application Oriented Programming using Python

SL. NO	**Engineering Minor Elective**		**L**	**T**	**P**	**C**
1	BIME-551	Application Oriented Programming using Python	0	0	4	2

LAB

1. The Context of Software
2. Development-Software-Learning Programming with Python
3. Values and Variables
   -Integer and String Values
   -Identifiers
   -User Input-String Formatting
4. Expressions and Arithmetic
   -Expressions
   -Arithmetic Examples
5. Conditional Statements
   -Boolean expressions
   -If/Else statement
   -Other Conditional Expressions
6. Iteration
   -Loops
7. Using Functions
   -Introduction to Using Functions
   -Functions and Modules

SEMESTER VI														
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods**			**CCA**				**ESE**	**Total**		**Credit**
				L	**T**	**P**	**CT**	**AT**	**Total**	**PS**	**TE**	**PE**		
1	BIME-601	Data Science for Internet of Things	PECM-3	3	0	0	20	10	30	-	70	-	100	3
2	BIME-651	Modelling and Implementation to IOT	PECM-4	0	0	4	-	-	-	15	-	35	50	2
TOTAL												**150**		**5**

Data Science for Internet of Things

SL. NO	Engineering Minor Elective		L	T	P	C
1	BIME-601	Data Science for Internet of Things	3	0	0	3

COURSE OUTCOME

1. To understand Analysis and evaluate the data received through sensors in IOT.
2. To understand the primary goals of technology are has always been the enrichment of human lifestyle and with the IoT.
3. To understand Applying Data Science techniques and algorithms to IoT data and understand how this could allow devices – from sensors to end devices – to extract data and analyze the data to uncover information.
4. To understand that IoT is one of the forerunners in data generation and this is exactly why Data Science will be required in IoT more than ever

Unit-I

Introduction: Data Science- Big Data and Data Science hype – and getting past the hype- Why now? – Datafication- Current landscape of perspectives- Skill sets needed.
Statistical Inference- Populations and samples- Statistical modeling, probability distributions, fitting a model- Intro to R.

Unit-II

Exploratory Data Analysis and the Data Science Process- Basic tools (plots, graphs and summary statistics) of EDA- Philosophy of EDA- The Data Science Process- Case Study: Real Direct (online real estate firm). Three Basic Machine Learning Algorithms- Linear Regression- k-Nearest Neighbors (k-NN)- k-means.

Unit-III

One More Machine Learning Algorithm and Usage in Applications- Motivating application: Filtering Spam- Why Linear Regression and k-NN are poor choices for Filtering Spam- Naive Bayes and why it works for Filtering Spam- Data Wrangling: APIs and other tools for scrapping the Web. 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– Filters; Wrappers; Decision Trees; Random Forests.

Unit-IV

Recommendation Systems: Building a User-Facing Data Product- Algorithmic ingredients of a Recommendation Engine- Dimensionality Reduction- Singular Value Decomposition- Principal Component Analysis- Exercise: build your own recommendation system. Mining Social-Network Graphs- Social networks as graphs- Clustering of graphs- Direct discovery of communities in graphs- Partitioning of graphs- Neighborhood properties in graphs.

Unit-V

Data Visualization- Basic principles, ideas and tools for data visualization - Examples of inspiring (industry) projects, Data Science and Ethical Issues- Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.

REFERENCES

- Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1,Cambridge University Press. 2014. (free online)
- Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0262018020. 2013.
- Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know aboutData Mining and Data-analytic Thinking. ISBN 1449361323. 2013.
- Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning,Second Edition. ISBN 0387952845. 2009. (free online)
- Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science.(Note: this is a book currently being written by the three authors. The authors have made the first draft of their notes for the book available online. The material is intended for a modern theoretical course in computer science.)
- Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Conceptsand Algorithms. Cambridge University Press. 2014.
- Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, ThirdEdition. ISBN 0123814790. 2011.

Modelling and Implementation to IOT

SL. NO	**Engineering Minor Elective**		**L**	**T**	**P**	**C**
1	BIME-651	Modelling and Implementation to IOT	0	0	4	2

List of Experiments:

1. Define and Explain Eclipse IoT Project.
2. List and summarize few Eclipse IoT Projects.
3. Sketch the architecture of IoT Toolkit and explain each entity in brief.
4. Demonstrate a smart object API gateway service reference implementation in IoT toolkit.
5. Write and explain working of an HTTP-to-CoAP semantic mapping proxyin IoT toolkit.
6. Describe gateway-as-a-service deployment in IoT toolkit.
7. Explain application framework and embedded software agents for IoT toolkit.
8. Explain working of Raspberry Pi.
9. Connect Raspberry Pi with your existing system components.
10. Give overview of Zetta.

SEMESTER VII															
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods**			**CCA**				**ESE**	**Total**		**Credit**	
				L	**T**	**P**	**CT**	**AT**	**Total**	**PS**	**TE**	**PE**			
1	BIME-701	Wireless & Sensor Network	PECM-5	3	0	0	20	10	30	-	70	-	100		3
TOTAL												**100**		**3**	

Wireless & Sensor Network

SL. NO	Engineering Minor Elective		L	T	P	C
1	BIME-701	Wireless & Sensor Network	3	0	0	3

COURSE OUTCOMES

1. Explain the design considerations for deploying the wireless network infrastructure.
2. Differentiate and support the security measures, standards. Services and layer wise security considerations.
3. To Understand the essential WSN innovation and supporting conventions, with accentuation put on institutionalization fundamental sensor frameworks and give a review of sensor innovation
4. Comprehend the medium access control conventions and address physical layer issues.
5. Learn key steering conventions for sensor systems and principle configuration issues.
6. Learn transport layer conventions for sensor systems, and structure prerequisites.
7. Comprehend the Sensor the executives, sensor organize middleware, working frameworks.

UNIT I – FUNDAMENTALS OF SENSOR NETWORKS

Introduction to computer and wireless sensor networks and Overview of the syllabus- Motivation for a network of Wireless Sensor nodes- Sensing and sensors-challenges and constraints - node architecture-sensing subsystem, processor subsystem-communication interfaces- prototypes, Application of Wireless sensors- Introduction of Tiny OS Programming and TOSSIM Simulator.

UNIT II- COMMUNICATION CHARACTERISTICS AND DEPLOYMENT MECHANISMS

Wireless Transmission Technology and systems-Radio Technology Primer-Available Wireless Technologies - Hardware- Telosb, Micaz motes- Time Synchronization- Clock and the Synchronization Problem - Basics of time synchronization-Time synchronization protocols -

Localization- Ranging Techniques- Range based Localization-Range Free Localization- Event driven Localization

UNIT III- MAC LAYER

Overview-Wireless Mac Protocols-Characteristics of MAC protocols in Sensor networks – Contention free MAC Protocols- characteristics- Traffic Adaptive Medium Access-Y-MAC, Low energy Adaptive Clustering - Contention based MAC Protocols- Power Aware Multi-Access with signaling, Sensor MAC-Timeout MAC-Data gathering MAC- Case study – Implementation and Analysis of MAC player protocol in TinyOS.

UNIT IV- ROUTING IN WIRELESS SENSOR NETWORKS

Issues in WSN routing- Data Dissemination and Gathering-Routing Challenges in WSN - Flooding-Flat Based Routing – SAR, Directed Diffusion, Hierarchical Routing- LEACH, PEGASIS - Query Based Routing- Negotiation Based Routing- Geographical Based Routing-Transport layer- Transport protocol Design issues- Performance of Transport Control Protocols.Case study- Implementation and analysis of Routing protocol or transport layer protocol in Tiny OS

UNIT V - MIDDLEWARE AND SECURITY ISSUES

WSN middleware principles-Middleware architecture-Existing middleware - operating systems for wireless sensor networks-performance and traffic management - Fundamentals of network security-challenges and attacks - Protocols and mechanisms for security. Case study- Handling attacks in Tiny OS.

REFERENCES

- Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011
- Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2010.
- Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005
- C.S Raghavendra, Krishna M.Sivalingam, Taiebznati , "Wireless Sensor Networks", Springer Science

SEMESTER VIII															
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods**			**CCA**				**ESE**	**Total**		**Credit**	
				L	**T**	**P**	**CT**	**AT**	**Total**	**PS**	**TE**	**PE**			
1	BIME-801	Introduction to Machine Learning	PECM-6	3	0	0	20	10	30	-	70	-	100		3
2	BIME-802	Embedded Software Design	PECM-7	3	0	0	20	10	30	-	70	-	100		3
3	BIME-851	Internet of Things: Sensing and Actuator Devices	PECM-8	0	0	4	-	-	-	15	-	35	50		2
TOTAL												**250**		**8**	

Introduction to Machine Learning

SL. NO	Engineering Minor Elective		L	T	P	C
1	BIME-801	Introduction to Machine Learning	3	0	0	3

COURSE OUTCOME

1. Addition information about fundamental ideas of Machine Learning
2. Identify AI strategies appropriate for guaranteed issue
3. Solve the issues utilizing different AI strategies
4. Apply Dimensionality decrease strategies.
5. Design application utilizing AI strategies

Unit-I

Foundations of Probability: Bayes rule. Independence, Moments, MLE estimation, MAP estimation. Gaussian distribution, Learning Linear Models, Learning linear regression models, General issues for predictors: evaluating predictors, model selection: bias-variance, regularization.

Unit-II

Linear classifiers: perceptron, logistic regression, linear discriminant analysis, (Linear) support vector machines: duality, Lagrange method, quadratic programming, Learning: Non-Linear Models Kernel foundations. Learning kernel classifiers. Support vector machines.

Unit-III

Artificial neural nets: back propagation, line search, conjugate gradient, Decision trees: entropy, pruning. Gaussian processes. Ensemble Methods Bagging. Boosting, Computational Learning Theory PAC learning. VC-dimension.

Unit-IV

Graphical Models Directed models: belief nets, parameter estimation. Dynamic Bayesian net: hidden Markov models, linear dynamical systems. Learning Bayesian net structure. Undirected models: Markov random fields.

Unit-V

Unsupervised Learning Principle components analysis. Independent component analysis. Independent subspace analysis. Independent process analysis. Nonnegative matrix factorization. K-means clustering. Hierarchical clustering.

REFERENCES

1. E. Alpaydin: "Introduction to Algorithms", 3rd ed. MIT Press, 2014. ISBN978-0-26202-818-9.

Internet of Things: Sensing and Actuator Devices

SL. NO	**Engineering Minor Elective**		**L**	**T**	**P**	**C**
1	BIME-851	Internet of Things: Sensing and Actuator Devices	0	0	4	2

LAB

- Become familiar with Raspberry Pi (Rpi) hardware
- Set up and Install Raspbian OS on Rpi
- Understand how Rpi can be leveraged as an IoT gateway
- Become familiar with Linux OS
- Set up Rpi as an IoT gateway
- Using Python Interface with Arduino using Serial Port Interface
- Build Socket applications to communicate to Arduino device using Ethernet, Wifi and Bluetooth interfaces
- Build IoT applications using HTTP and MQTT protocols
- Learn to use Node Red programming tool

Embedded Software Design

SL. NO	Engineering Minor Elective		L	T	P	C
1	BIME-802	Embedded Software Design	3	0	0	3

COURSE OUTCOME

1. Comprehend the idea of implanted framework, microcontroller, diverse segments of microcontroller and their communications.
2. Get acquainted with programming condition to create installed arrangements.
3. Program ARM microcontroller to perform different assignments.
4. Comprehend what an installed framework is.
5. Fundamental comprehension of PCB how this applies to implanted framework designers, and how this contrasts from the customary robotic hypothesis.

Unit-I

Core of the embedded system, Memory, Sensors (resistive, optical, position, thermal) and Actuators (solenoid valves, relay/switch, opto-couplers), Communication Interface, Embedded firmware (RTOS, Drivers, Application programs), Power-supply (Battery technology, Solar), PCB and Passive components, Safety and reliability, environmental issues. Ethical practice, Characteristics and quality attributes (Design Metric) of embedded system. Real time system's requirements, real time issues, interrupt latency.

Unit-II

Embedded Product development life cycle, Program modeling concepts: DFG, FSM, Petri-net, UML, Introduction to ARM-v7-M (Cortex-M3), ARM-v7-R(CortexR4) and comparison in between them.

Unit-III

Study of basic communication protocols like SPI, SCI (RS232, RS485), I2C, CAN, Field-bus (Profibus), USB (v2.0), Bluetooth, Zig-Bee, Wireless sensor network, Embedded C-programming concepts (from embedded system point of view): Optimizing for Speed/Memory needs, Interrupt service routines, macros, functions, modifiers, data types, device drivers, Multithreading programming. (Laboratory work on J2ME Java mobile application).

Unit-IV

Basic embedded C programs/applications for ARM-v7, using ARM-GCC-tool-chain, Emulation of ARM-v7 (e.g. using QEMU), and Linux porting on ARM-v7 (emulation) board CASE STUDY:1) Medical monitoring systems, 2)Process control system (temp, pressure) 3)Soft real time: Automated vending machines, 4)Communication: Wireless (sensor) networks, Real time operating system: POSIX Compliance , Need of RTOS in Embedded system software, Foreground/Background systems, multitasking, context switching, IPC, Scheduler policies, Architecture of kernel, task scheduler, ISR, Semaphores, mailbox, message queues, pipes, events, timers, memory management, RTOS services in contrast with traditional OS.

Unit-V

Introduction to µCOS-II RTOS, study of kernel structure of µCOS-II, Synchronization in µCOS-II, Inter-task communication in µCOS-II, Memory management in µCOS-II, porting of RTOS on ARM-v7 (emulation) board, Application developments using µCOS-II, Introduction Linux OS, Linux IPC usage, basic device (drivers) usage.

REFERENCES

- Introduction to Embedded Systems : Shibu K. V. (TMH)
- Embedded System Design –A unified hardware and software introduction: F. Vahid (John Wiley)
- Embedded Systems : Rajkamal (TMH)
- Embedded Systems : L. B. Das (Pearson)
- Embedded System design : S. Heath (Elsevier)
- Embedded microcontroller and processor design: G. Osborn (Pearson)
- Embedded Systems:Frank Vahid , Wiley India, 2002
- Embedded Microcomputer Systems –Real Time Interfacing –Jonathan W. Valvano; Cengage Learning; Third or later edition.