Department of Electronics and Communication Engineering

Curriculum Structure & Syllabi

of

B.Tech.

In

ECE (IoT)

(w.e.f. 2023-2024)

Overall Credit Structure

Curriculum

Syllabus

Offered By

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

M. M. M. UNIVERSITY OF TECHNOLOGY

GORAKHPUR-273010, UP

July-2023

PROPOSED OVERALL CREDIT STRUCTURE FOR B.TECH ECE (IoT) PROGRAM

Credit Courses			
Core Courses (CC)**		**Electives Courses (EC)****	
Category	**Min.Credits**	**Category**	**Min.Credits**
Basic Sciences & Maths (BSM)	18	Program Electives (PE)	12
Engineering Fundamentals (EF)	18	Open Electives (OE) (Other Departments)	3
Professional Skill (PS)	4		
Program Core (PC)	64	Humanities & Social Science elective (HSSE)	2
Management (M)	4		
Humanities & Social Science (HSS)	6		
Project (P)	5		
Seminar (S)	2		
Industrial Practice (IP)/ Industrial Elective (IE)	12		
Program link basic science and engineering courses (PLBSE) (To be decided by the department)	15		
Sub-total	**148**	**Sub-total**	**17**
Grand Total	**165**		
**** subjects to be taught for more than one branch may be scheduled both in odd and even semesters.**			

1. Extracurricular Activities Courses (ECA) Two compulsory courses from the following S.No (ii) to (v) non-credit courses: (i) Induction Program (compulsory) (ii) Skill development (iii)Unity and Discipline (NCC or NSS) (iv)Sports, Cultural, and Games (v) Personality Development	**Non-Credit**
2. *Audit Courses (AC) Two of the Audit Courses are compulsory ***Audit Courses** 1. Constitution of India 2. Indian Culture and Heritage 3. Indian Architecture 4. Indian Festivals 5. Vaidic Mathematics 6. Astronomy 7. Arts of India 8. Intellectual Property Right 9. Logical Research 10. Professional Ethics 11. Environmental Law	**Non-Credit**

12. Health Law 13. Human Rights 14. Basics of Human health and preventive medicine	

Minor Degree Courses (Optional) from any department	**Credits**
Department Minor (DM) Courses	18-20

Credit Structure for B. Tech. ECE (IoT)

Category **Semesters**	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
Basic Sciences & Maths (BSM)	8	4	2	4	-	-	-	-	**18**
Engineering Fundamentals (EF)	5	8	5	-	-	-	-	-	**18**
Professional Skill (PS)	2	2	-	-	-	-	-	-	**4**
Program Core (PC)	-	-	10	18	13	14	9	-	**64**
Management (M)	-	-	-	-	2	2	-	-	**4**
Humanities & Social Science (HSS)	2	2	2	-	-	-	-	-	**6**
Humanities & Social Science Elective (HSSE)	-	2	-					-	**2**
Project (P)	-	-	-	-	-	2	3	0/4	**5/9**
Seminar (S)	-	-	-	-	-	2	-	-	**2**
Industrial Practice (IP)/ Industrial Elective (IE)#	-	-	-	-	-	-	-	12/8	**12/8**
Program link basic science and engineering courses (PLBSE) (To be decided by the department)	4	3	3	2	3		-	-	**15**
Program Electives (PE)	-	-	-	-	4	4	4	-	**12**
Open Electives (OE) (Other Departments)	-	-	-	-	-	-	3	-	**3**
Total	**21**	**21**	**22**	**24**	**22**	**24**	**19**	**12**	**165**

PROPOSED CURRICULUM FOR B.TECH. ECE (IoT)PROGRAM

First Year, Semester I

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-101	Calculus and Linear Algebra	3	1	0	4
2.	EF	BEE-101	Fundamentals of Electrical Engineering	3	1	2	5
3.	HSS	BHM-101	Professional Communication	2	0	0	2
4.	BSM	BSM-127	Engineering Physics	3	0	2	4
5.	PS	BEC-103	Electronic Component Testing and Measurement	0	0	4	2
6.	PLBSE	BIT-181	Computer Programming with C/C++	3	0	2	4
			Total	**14**	**2**	**10**	**21**
	ECA-I	ECA-100	Induction Program	**-**	**-**	**-**	**0**

First Year, Semester II

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-156	Applied Probability and Statistics	3	1	0	4
2.	EF	BEC-151	Fundamentals of Electronics Engineering	3	1	2	5
3.	HSS	BHM-155	Engineering Economics	2	0	0	2
4.	EF	BEC-155	Introduction to IOT Devices and Applications	2	0	2	3
5.	PS	BEC-153	Electronic Workshop	0	0	4	2
6.	PLBSE	BEC-156	Introduction to Arduino Uno Programming	0	0	6	3
7.	HSSE	BHM-154	Human Values&Professional Ethics	2	0	0	2
			Total	**14**	**2**	**10**	**21**
	ECA-II	ECA-200		**-**	**-**	**-**	**0**

Second Year,

Semester III

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-227	Physics of IOT Sensors and Actuators	2	0	0	2
2.	EF	BEC-201	Digital Electronics and Computer Organization	3	1	2	5
3.	HSS	BHM-201	Scientific and Technical Writing	2	0	0	2
4.	PC	BIT-281	Introduction to Java Programming	3	0	2	4
5.	PC	BEC-203	Electronic Measurement and Instrumentation	2	1	0	3
6.	PC	BEC-204	Electronic Devices and Circuits	2	1	0	3
7.	PLBSE	BCS-205	Data Structure & Algorithms	2	0	2	3
			Total	**16**	**4**	**4**	**22**
	ECA-III	ECA-320		-	-	-	0
	AC	AUC-11		1/2	-	-	0

Second Year, Semester IV

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-276	Principles of Electromagnetism and Antenna Systems	3	1	0	4
2.	PC	BEC-257	Computer Networks	3	1	0	4
3.	PC	BEC-252	Principles of Communication Systems	3	1	0	4
4.	PC	BEC-258	Introduction to Raspberry Pi Programming	3	0	4	5
5.	PC	BCS-258	Python for IOT	3	1	2	5
6.	PLBSE	BEC-255	Electronic Software Tools	1	0	2	2
			Total	**16**	**5**	**6**	**24**
	ECA-IV	ECA-401		-	-	-	0
	AC	AUC-09		1/2	-	-	0

Third Year, Semester V

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	M	BHM-302	Industrial Management	2	0	0	2
2.	PC	BEC-302	Control System	3	1	0	4
3.	PC	BEC-306	Advanced IOT Applications	3	1	2	5
4.	PC	BEC-307	Information and Network Security	3	1	0	4
5.	PE1	-	Program Elective-I	3	1	0	4
6.	PLBSE	BEC-308	Python Based Machine learning and AI	2	0	2	3
			Total	**16**	**4**	**4**	**22**
	ECA-V	ECA-531		-	-	-	0

Third Year, Semester VI

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	M	BHM-354	Business Management	2	0	0	2
2.	PC	BEC-354	Wireless Sensor Network	3	0	2	4
3.	PC	BEC-355	Android Application Development	3	0	4	5
4.	PC	BEC-356	Digital and Wireless Communication	3	1	2	5
5.	PE2	-	Program Elective-2	3	1	0	4
6.	P	BEC-371	Project Part-I	0	0	4	2
7.	S	BEC-381	Seminar	0	0	4	2
			Total	**14**	**4**	**12**	**24**
	ECA-VI	ECA-651		-	-	-	0

Program Elective

S.N.	Paper Code	Subject	PrerequisiteSubject	L	T	P	Credits
		PE-1					
01.	BEC-333	Fundamental of AIOT		3	1	0	4
02.	BEC-334	Computer Vision for IoT		3	1	0	4
03.	BEC-335	Data Analytics for IOT		3	1	0	4

S.N.	Paper Code	Subject	PrerequisiteSubject	L	T	P	Credits
		PE-2					
01.	BEC-382	Industrial IoT		3	1	0	4
02.	BEC-383	Cloud Computing for IoT		3	1	0	4
03.	BEC-384	Privacy and Security in IoT		3	1	0	4

Course Code: BHM-302/ 305 INDUSTRIALMANAGEMENT

Course category : M
Pre-requisite Subject : NIL
Contact hours/week : Lecture:2, Tutorial:0, Practical: 0
Number of Credits : 2
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Studentswillbecomeefficientandacquireacumenformoreprofitablebusinesspractices.
2. Ableto understandconcept ofplant locationand layout
3. Studentswill understandtheimportanceofbettercustomerserviceandproduct quality.
4. Abletomakeworksafer, faster,easier,andmorerewarding.
5. Abletohelptheindustryintheproductionofmoreproductsthatpossessallutilityfactors.
6. Reducingcostsassociatedwithnewtechnologies.

Topics Covered

UNIT-I **9**

IntroductionofModernManagement: Definition,NatureandScopeofManagement,Process of Management, Elements of Management, Definition of Industrial Management,Scopeand Application ofIndustrial Management.

Plant Location and Layout: Factors affecting Plant Location, Objectives and

Principles ofPlantLayout,Types of Plant-Layouts

UNIT-II

9

Work Analysis and Measurement: Design of work Study, Steps involved in Work-studyprocess, Definition and Concept of Method study, Procedure involved in Method Study,ObjectivesandtechniquesofWorkMeasurement,Work - samplinganditsapplication,SelectionofPersonnel andwagepayment plans.

UNIT-III

9

Organizational Structures: Types of organizations, Functions, and objectives of industrialorganizations, Ownership of Industries; Proprietorship, Partnership, Joint-stock companies,Publicand Private undertakings, Co-operativeorganizations.Sourcesoffinance,TypesofBank accounts.

UNIT-IV

9

MaterialManagement:MeaningofInventorymanagement,EconomicOrderQuantity(EOQ) Model,ABCanalysis,Just-in-time(JIT),Minimum SafetyStock

IndustrialSafety: Occupationalsafety,safetyprograms;Safetyaspectsinworksystemdesign,

Textand ReferenceBooks

1. P.Crowson.EconomicsforManagers,Macmillan,London.
2. J.Russell(JosephRussell)Smith,"TheElementsofIndustrialManagement",HardPress
3. Rieske, David W., Asfahl and C. Ray, "Industrial Safety and Health Management", 6thEd.,PrenticeHall Professional Technical Ref.
4. Gavriel Salvendy, "Handbook of Industrial Engineering: Technology and OperationsManagement",JohnWiley & Sons, Inc.
5. Herman B. Henderson, Albert E. Haas, "Industrial Organization and ManagementFundamentals",Industrial Press,TheUniversity ofCalifornia.

CourseCode:BEC-302 **ControlSystems**

Course category		ProgramCore(PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial: 0, Practical: 0
Number of Credits	:	2
Course Assessment methods	:	Thiscourseisaimedat developingthe conceptsofcontrolsystemsskillswithintroducingthecomponents&theirrepresentationofcontrol systems, analyzing the time& frequency response, andstatevariableanalysis.
Course Objective		Thiscourseisaimedat developingthe

conceptsofcontrolsystemsskillswithintroducingthecomponents&theirrepresentationofcontrol systems, analyzing the time& frequency response, andstatevariableanalysis.

Course Outcomes : Thestudentsareexpectedtobeabletodemonstratethefollowing knowledge, skills, and attitudes after completingthiscourse

1. Describe the response characteristic and differentiate between the open loop and closed loopcontrol system.
2. Measureandevaluatethe performanceofbasiccontrolsystemsintimedomain.
3. Determinethe responseofacontrolsystemusingpolesand zerostodeterminetheresponseof acontrol system.
4. Determinethestabilityof acontrolsystem usingRouth-Hurwitzmethod.
5. Measureandevaluate the performanceof basiccontrolsystems infrequencydomain.
6. Able to derive mathematical models for simple electrical and mechanical systems usingtransfer function and statevariable method.

Topics Covered

UNIT-I **9**

BasicComponentsofacontrolsystem,Feedbackanditseffect,Typesoffeedbackcontrol**9**Systems, Blockdiagrams:representationandreduction,SignalFlowGraphs,ModelingofPhysical Systems: Electrical Networks and Mechanical Systems, Force-voltage analogy, Force-current analogy.

UNIT-II

9

Timeresponseofcontinuousdatasystems,DifferenttestSignalsforthetimeresponse,Unit**9**step response and Time-Domain Specifications, Time response of a first order and second ordersystemsfordifferenttestsignals,SteadyStateErrorandErrorconstants,Sensitivity,ControlActions:Proportional,Derivative,IntegralandPID control.IntroductiontoProcessControlSystems,Pneumatic hydraulics, Actuators.

UNIT-III

9

Stability:MethodsofdeterminingstabilityRouthHurwitzCriterion,RootLocus,Frequency**9**DomainAnalysis:ResonantPeak,ResonantfrequencyandBandwidthofthesecondordersystem, Effect ofaddingazeroanda pole to the forwardpath,NyquistStability Criterion,RelativeStability: GainMargin and PhaseMargin, BodePlot

UNIT-IV

9

State-SpaceAnalysisofControlSystem:Vectormatrixrepresentationofstateequation,State**9**transition matrix,Relationshipbetweenstateequationsandhigh-orderdifferentialequations,Relationshipbetweenstateequationsandtransferfunctions,Blockdiagramrepresentationofstateequations,DecompositionTransferFunction,Kalman'sTestforcontr

ollabilityandobservability

Textand ReferenceBooks

1. B.C.Kuo&FaridGolnaraghi,"AutomaticControlSystems",8e,JohnWileyIndia,2008 .
2. I.J. Nagrath &M.Gopal, "Control System Engineering", New Age InternationalPublishers.
3. WilliamA.Wolovich,"AutomaticControlSystems",OxfordUniversityPress,2010.
4. KatsuhikoOgata,"ModernControlEngineering",3e,PHIPublication,2000

Course Code: BEC-306		**Advanced IoT Applications**
Course category	:	PC
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Studentswillbecomeefficientfor IoT Architecture and Frameworks: Layers of IoT, communication protocols (MQTT, CoAP, AMQP), cloud integration. Ableto understandconcept ofplant locationand layout.
2. Studentswill understandtheimportanceofIoT Sensors, Actuators, and Communication: Advanced IoT Devices: Abletomakeworksafer, faster,easier,andmorerewarding.
3. AbletohelptheData Analytics in IoT:Big Data in IoT: Storage and processing (Hadoop, Spark).
4. Reducingcostsassociatedwithnewtechnologies.

Topics Covered

UNIT-I **9**

IoT Architecture and Frameworks: Layers of IoT, communication protocols (MQTT, CoAP, AMQP), cloud integration. Emerging Trends: Edge computing, fog computing, and AI at the edge. IoT Standards and Interoperability: IEEE standards, IoT open standards, and interoperability challenges. Use Cases: Overview of IoT applications in smart cities, industrial automation, healthcare, and agriculture.

UNIT-II

9

IoT Sensors, Actuators, and Communication: Advanced IoT Devices: Intelligent sensors, low-power design, energy harvesting. Communication Technologies: Short-range: Zigbee, Bluetooth Low Energy (BLE), RFID, NFC. Long-range: LoRaWAN, NB-IoT, Sigfox, and 5G for IoT. Data Acquisition and Preprocessing: Sensor interfacing, filtering, and fusion techniques. IoT Gateways: Role, architecture, and design considerations.

UNIT-III

9

IoT Data Analytics and Security: Data Analytics in IoT:Big Data in IoT: Storage and processing (Hadoop, Spark).Real-time analytics and visualization.AI/ML in IoT for predictive maintenance, anomaly detection, etc.IoT Security Challenges:Secure communication protocols and encryption techniques.Device authentication and access control.Security standards (ISO/IEC 27001, NIST).Privacy Concerns: Data anonymization and GDPR compliance

UNIT-IV

9

IoT Applications and Future Directions: Advanced IoT Applications:Smart Healthcare: Remote monitoring, wearable devices, and telemedicine.Industry 4.0: Industrial IoT (IIoT), digital twins, and predictive maintenance.Autonomous Systems: Connected vehicles, drones, and robotics.Smart Grids: Energy management and renewable energy integration.IoT Ecosystem Tools: Platforms like AWS IoT, Google Cloud IoT, Azure IoT Hub.Research Trends and Challenges:IoT scalability and deployment in resource-constrained environments.Ethical and societal impacts of IoT.Quantum IoT and next-gen technologies.

List of Experiments

1. To study and draw the architecture of IoT, showing the four layers: sensing, network, data processing, and application.
2. To interface a DHT11 sensor and display temperature and humidity values on serial monitor.
3. To send temperature data to the ThingSpeak cloud using HTTP protocol and view it on a real-time graph.
4. To send real-time sensor data from NodeMCU to ThingSpeak cloud using HTTP protocol.
5. To build an RFID-based identification system and display card UID on serial monitor
6. To visualize sensor data on a local web dashboard using charts (Temperature chart using Node-RED).
7. To demonstrate data transmission between two NodeMCU boards using ESP-NOW (short-range, peer-to-peer protocol).
8. To create a dashboard using Node-RED to visualize live sensor values (temperature, humidity, etc.).

To develop an IoT-based authentication system using a keypad and password verification with cloud-based logging.

Textand ReferenceBooks

1. Designing the Internet of Things, Authors: Adrian McEwen and Hakim Cassimally, Publisher: Wiley, Edition/Year: 2013
2. The Elements of Industrial Management, Author: J. Russell (Joseph Russell) Smith ,Publisher: Hard Press, Edition/Year: 1915 (Reprint available)

References

1. Building the Internet of Things: Implement New Business Models, Disrupt Competitors, and Transform Your Industry, Author: Maciej Kranz. Publisher: Wiley, Edition/Year: 2016
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet

of Things, Authors: David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Publisher: Cisco Press, Edition/Year: 2017
3. Fog Computing and Its Role in the Internet of Things, Authors: Flavio Bonomi et al., Published In: Proceedings of the MCC Workshop on Mobile Cloud Computing, Year: 2012

Course Code: BEC-307	**Information and Network Security**
Course category	PC
Pre-requisite Subject	NIL
Contact hours/week	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	4
Course Assessment methods	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Studentswillbecomeefficient for Media- Based-Vulnerabilities, Network Device Vulnerabilities.
2. Studentswill understandtheimportanceofAuthentication Service, Scanning: Port Scanning, Port Knocking- Advantages
3. AbletohelptheApplication level gateways, Encrypted tunnels, Cookies.
4. Assignments on latest network security techniques

Topics Covered

UNIT-I **9**

Introduction to Network security, Model for Network security, Model for Network access security, Real-time Communication Security: Introduction to TCP/IP protocol stack, Implementation layers for security protocols and implications, IPsec: AH and ESP, IPsec: IKE.

UNIT-II

9

Media- Based-Vulnerabilities, Network Device Vulnerabilities, Back Doors, Denial of Service (DoS), Spoofing, Man-in-the-Middle, and replay, Protocol -Based Attacks, DNS Attack, DNS Spoofing, DNS Poisoning, ARP Poisoning, TCP/IP Hijacking, Virtual LAN (VLAN), Demilitarization Zone (DMZ) , Network Access Control (NAC), Proxy Server , Honey Pot , Network Intrusion Detection Systems (NIDS) and Host Network Intrusion Prevention Systems Protocol Analyzers, Internet Content Filters, Integrated Network Security Hardware .

UNIT-III

9

Authentication: Kerberos, X.509 Authentication Service, Scanning: Port Scanning, Port Knocking- Advantages, Disadvantages. Peer to Peer security. Electronic Mail Security: Distribution lists, Establishing keys, Privacy, source authentication, message integrity, non-repudiation, proof of submission, proof of delivery, message flow confidentiality, anonymity, Pretty Good Privacy (PGP)

UNIT-IV

9

Firewalls and Web Security: Packet filters, Application-level gateways, Encrypted tunnels,

Cookies. Assignments on latest network security techniques, Security applications in wireless sensor network and wireless Communication networks

Textand ReferenceBooks

1. William Stallings, "Cryptography and Network Security – Principles and Practices", Prentice Hall of India, Third Edition, 2003.

References:

1. Cisco: Fundamentals of Network Security Companion Guide (Cisco Networking Academy Program).
2. Saadat Malik, Saadat Malik. "Network Security Principles and Practices (CCIE Professional Development)". Pearson Education. 2002. (ISBN: 1587050250) .
3. Mark Ciampa "Security + Guide to Network Security Fundamentals/Edition 3" Cengage Learning publisher, ISBN-10: 1428340661, ISBN-13: 978-1428340664

Course Code: BEC-308 Python-Based Machine Learning and Artificial Intelligence

Course category	:	PLBSE
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:2, Tutorial:0, Practical: 2
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamentals of AI and ML and the role of Python in their development.
2. Apply Python libraries for data analysis and visualization.
3. Develop and train neural networks for AI tasks using TensorFlow/Keras.
4. Analyze the performance of deep learning models in real-world applications.
5. Utilize advanced ML techniques for better model accuracy.
6. Understand ethical implications in AI and ML applications.

Topics Covered

UNIT-I 9

Overview of AI and Machine Learning (ML): Definitions, types, and applications.Introduction to Python for ML/AI: Libraries such as NumPy, Pandas, Matplotlib, and Scikit-learn.Supervised Learning Basics: Linear regression, logistic regression, and evaluation metrics.Unsupervised Learning Basics: K-means clustering and dimensionality reduction (PCA).

UNIT-II

9

Neural Networks and Deep Learning with Python, Introduction to Neural Networks:

Perceptron, activation functions, and loss functions.Deep Learning Basics: Feedforward and backpropagation algorithms.Frameworks for Deep Learning: TensorFlow and Keras.Case Studies: Image classification, text sentiment analysis.

UNIT-III

9

Advanced Machine Learning Techniques and Model Optimization Ensemble Learning: Random Forest, Gradient Boosting, and XGBoost.Model Optimization Techniques: Hyperparameter tuning (Grid Search, Random Search).Natural Language Processing (NLP): Tokenization, TF-IDF, Word2Vec.Ethical AI: Bias, fairness, and interpretability in ML models.

UNIT-IV

9

AI Applications and Future Trends: Reinforcement Learning: Introduction, Q-Learning, and policy gradients.AI in Real-World Scenarios: Robotics, recommendation systems, and predictive analytics.AI for Edge and Cloud: Concepts of AI deployment.Emerging Trends: Generative AI (e.g., GPT), Explainable AI, and Auto ML.

List of Experiments

1. To study and implement basic Python programming constructs such as variables, data types, conditional statements, loops, functions, and file handling.
2. To perform data manipulation using NumPy arrays and pandas DataFrames on a sample dataset.
3. To visualize data using matplotlib and seaborn by creating line graphs, bar charts, histograms, and scatter plots.
4. To apply data preprocessing techniques including handling missing values, label encoding, one-hot encoding, and feature scaling.
5. To implement Linear Regression using scikit-learn on a real-world dataset and evaluate it using Mean Squared Error (MSE) and R^2 score.
6. To build a Logistic Regression model for binary classification (e.g., diabetes prediction) and evaluate it using accuracy and confusion matrix.
7. To implement k-Nearest Neighbors (k-NN) for classification and test it on a small dataset (e.g., Iris dataset).
8. To perform unsupervised learning using k-Means Clustering and visualize the resulting clusters.
9. To implement a simple Artificial Neural Network (ANN) using TensorFlow/Keras for classification on the MNIST or similar small dataset.

Textand ReferenceBooks

1. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", Authors: Aurélien Géron, Publisher: O'Reilly Media, Edition/Year: 2nd Edition, 2019
2. "Python Machine Learning", Authors: Sebastian Raschka and Vahid Mirjalili, Publisher: Packt Publishing, Edition/Year: 3rd Edition, 2019

References

1. Machine Learning Yearning", Author: Andrew Ng, Publisher: Self-published, Edition/Year: 2018
2. "Artificial Intelligence: A Guide to Intelligent Systems", Authors: Michael

Negnevitsky, Publisher: Pearson, Edition/Year: 3rd Edition, 2011
3. "Reinforcement Learning: An Introduction", Authors: Richard S. Sutton and Andrew G. Barto, Publisher: MIT Press, Edition/Year: 2nd Edition, 2018"

PE1 (BEC-333) Fundamental of AIOT

Course category	:	Program Elective (PE-1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the concepts of AIoT and their significance in modern industries.
2. Apply techniques to connect mobile devices to IoT gateways, bridging the gap between different networks.
3. Analyze sensor technologies in IoT and their academic foundations to showcase practical understanding.
4. Develop and Evaluate AIoT applications to address real-world challenges.
5. Gain Understanding of AIOT applications.
6. Develop and collect real time data from sensors.

Topics Covered

UNIT-I

Introduction to AIoT: Overview of Artificial Intelligence (AI) and its applications across various industries. Introduction to the Internet of Things (IoT) and its significance in the modern interconnected world. Understanding the concept of Artificial Intelligence of Things (AIoT) and its potential to revolutionize technology integration. Connecting Mobile Devices to IoT Gateways: networks. Techniques for establishing seamless connections between mobile devices and IoT gateways. Hands-on exercises demonstrating the setup and configuration of mobile-to-IoT connections. 9

UNIT-II

Sensor Technologies and Academic Concepts: Comprehensive overview of sensor technologies commonly employed in IoT applications. In-depth exploration of various types of sensors and their academic underpinnings. 9

Practical demonstrations and experiments showcasing the functionality and applications of sensors in IoT systems.

UNIT-III

AIoT Application Development: Introduction to tools and platforms essential for building AIoT applications. Practical Aspects of AIoT applications, including: Smart Traffic Signal System for Color Blind Individuals Plant Health Analysis Smart Door Access Control System. Weather Forecasting with AIoT: Design and implementation of a weather forecasting system leveraging AIoT technologies. Integration of real-time weather data from sensors with AI algorithms for accurate predictions. Hands-on exercises for building, testing, and refining weather forecasting systems. 9

UNIT-IV

Smart Solutions Development: Development and deployment of smart solutions utilizing 9

AIoT principles. Case studies and real-world examples of successful smart solutions in various domains. Project-based learning allowing students to conceptualize, design, and implement their own AIoT solutions.

Books & References

1. "Michael Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", Pearson Education, 2021.
2. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things: Principles and Paradigms", Morgan Kaufmann, 2016.
3. Kashif Naseer Qureshi, Thomas Newe Artificial Intelligence of Things (AIoT): New Standards, Technologies and Communication Systems, CRC Press 2024

PE1 (BEC-334) Computer Vision for IoT

Course category : Program Elective (PE-1)
Pre-requisite Subject : NIL
Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 0

Number of Credits : 4

Course Assessment Methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamental concepts of computer vision and its integration with IoT systems.
2. Identify and apply key image processing techniques for feature extraction and object detection.
3. Gain understanding of computer vision and its applications in IoT.
4. Comprehend the role of machine learning and deep learning models in vision-based IoT applications.
5. Implement vision solutions on embedded IoT platforms using sensors, cameras, and lightweight AI models.
6. Analyze real-world use cases and develop practical vision-enabled IoT systems for smart applications.

Topics Covered

UNIT-I

Introduction to computer vision and its applications in IoT, image formation and representation including pixels and color spaces such as RGB, HSV, and grayscale, image processing operations like filtering, edge detection using Sobel and Canny operators, histogram equalization, feature extraction techniques including Harris corners, SIFT, SURF, and ORB, basic object detection using contours and bounding boxes, and implementation using OpenCV with Python. 9

UNIT-II

Introduction to machine learning techniques used in computer vision, comparison between supervised and unsupervised learning with examples, fundamentals of deep learning including convolutional neural networks (CNNs), operations like convolution and pooling, exploration of pre-trained models such as VGG, ResNet, and MobileNet suitable for embedded devices, and transfer learning techniques for vision tasks on edge devices using frameworks like TensorFlow. 9

UNIT-III

Overview of IoT architecture and communication protocols including MQTT, HTTP, and CoAP, introduction to embedded platforms for vision applications such as Raspberry Pi, Jetson Nano, and ESP32-CAM, methods to interface cameras and auxiliary sensors like PIR, DHT, and ultrasonic sensors, techniques for capturing and streaming images or video on IoT devices, and deployment of lightweight AI models using TinyML and TensorFlow Lite. 9

UNIT-IV

Development of smart surveillance and security systems using vision, vision-based traffic monitoring and vehicle counting, industrial IoT use cases such as visual inspection and defect detection, agricultural applications including crop monitoring and disease detection with UAV or IoT devices, healthcare solutions such as fall detection and patient monitoring through vision, real-time project discussions on design, deployment, and optimization challenges for IoT-based vision systems. 9

Books & References

1. Computer Vision: Algorithms and Applications by Richard Szeliski, Neural Networks and Learning Machines by Simon Haykin,
2. Practical Python and OpenCV by Adrian Rosebrock,

3. Signals and Systems by Alan V. Oppenheim (for signal and image basics),
4. OpenCV documentation, TensorFlow Lite guides, and Nvidia Jetson developer tutorials.

PE1 (BEC-335) Data Analytics for IOT

Course category	:	Program Elective (PE-1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamentals of IoT Analytics and Challenges
2. Understand and analyze IoT Devices and Networking Protocols
3. To Analyze the IoT data to infer the protocol and device characteristics
4. Apply IoT Analytics for the Cloud
5. Understand exploring and visualizing data
6. Gain use cases for deep learning with IoT data.

Topics Covered

UNIT-I

Defining IoT Analytics and Challenges: Introduction to IoT, applications, IoT architectures, introduction to analytics, IoT analytics challenges. 9

UNIT-II

IoT Devices and Networking Protocols: IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics. 9

UNIT-III

IoT Analytics for the Cloud: Introduction to elastic analytics, Decouple key components, Cloud security and analytics, Designing data processing for analytics, Applying big data technology to storage. Exploring IoT Data: Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis. 9

UNIT-IV

Data Science for IoT Analytics: Introduction to Machine Learning, Feature engineering with IoT data, Validation methods, Understanding the bias–variance tradeoff, Use cases for deep learning with IoT data. 9

Books & References

1. Minteer, Andrew, Analytics for the Internet of Things (IoT), Packt Publishing Ltd. July 2017, ISBN 9781787120730.
2. Huaiyu Geng, Internet of Things and Data Analytics Handbook, Wiley.
3. Practical Python and OpenCV by Adrian Rosebrock.

Course Code: BHM-354 BUSINESSMANAGEMENT

Course category	:	M
Pre-requisite Subject	:	NIL

Contact hours/week	:	Lecture:2, Tutorial :0, Practical: 0
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will comprehend and correlate all the fundamental Management functions and the concepts and principles of Management.
2. Demonstrate Engineering students, demonstrate the roles, skills, and functions of Management.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life- long changing environment in various fields of business.
4. One can analyze the effective application of management knowledge principles and practices to diagnose and solve organizational problems and develop optimal managerial decisions.
5. Demonstrate the acumen in organizing and understanding the staffing process.
6. Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities

Topics Covered

UNIT-I **6**

Meaning and Definition, Need for business, Nature of Business, Scope, Objectives, Qualitiesof a Successful Businessman. Forms of Business Ownership, Public, Private, and Joint SectorUndertaking,Public-Private Partnership, NGO – onlymeaning.

UNIT-II

6

Meaning, Emergence of Management Thought, Characteristics of Management, Bureaucracy,Scientific Management, Administrative Theories of Management, Principles of Management,SocialResponsibility ofManagement, and Business Ethics.

UNIT-III

6

Meaning&Definition,CharacteristicsofaGoodPlan,PlanningProcess,TypesofPlans,MBO&MBE, Decisionmaking:TypesofDecisions,StepsinvolvedinDecisionMaking,Communication,Importan ceofCommunication and Typesof Communication.

UNIT-IV

6

Meaning, characteristics, the importance of organization, steps in organization, organizationstructure, departmentation–meaning and basis for departmentation. The span of management-Meaning Only, Centralization vs. Decentralization, Definition, Staffing-Meaning, Functions,SelectionProcedureandInstruments usedin theselection.

Textand ReferenceBooks

1. BusinessManagement,Dr.P.SubbaRao,RoopaTraisa,HimalayaPublishing.
2. Management, Michael A Hitt, J Stewart Black, Lyman W - Prentice-Hall publishing –2ndRevised edition.
3. Essentials of management, Harold Koontz Heinz Weihrich - Tata Mc Graw hillpublishing.
4. Businessmanagement, R.K Sharma,Shashi K.Gupta–Kalyani publishers – 2009.
5. Businessmanagement,AppanniahReddy-Himalayapublishers.2008.

Course Code: BEC-354 Wireless Sensor Networks (WSN)

Course category	:	PC
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamental concepts of Wireless Sensor Networks (WSNs) and their applications.
2. Analyse protocols and algorithms for communication, data aggregation, and energy efficiency in WSNs.
3. Develop skills to design and evaluate WSN systems for real-world applications.
4. Explore recent advancements and research challenges in WSNs.
5. Advanced Topics and Applications
6. Quality of Service (QoS): Parameters and trade-offs in WSNs.
7. Mobile WSNs: Mobility models and dynamic network adaptation.
8. IoT and WSN Integration: Role of WSN in IoT applications.
9. Emerging Research Areas: Machine learning in WSNs, blockchain for secure WSNs.
10. Case Studies: Real-world implementations and emerging trends.

Topics Covered

UNIT-I **6**

Introduction to Wireless Sensor NetworksIntroduction: Overview of WSNs, Characteristics, and Applications, Architecture: WSN architecture, sensor nodes, and network topologies.Technologies: Enabling technologies for WSNs (e.g., IEEE 802.15.4, ZigBee).Challenges: Deployment, Scalability, Fault tolerance, and Energy efficiency.Case Studies: WSN applications in agriculture, health, and smart cities.

UNIT-II

6

Communication Protocols in WSN Physical Layer: Modulation and energy-

efficient communication.MAC Layer Protocols: TDMA, FDMA, and CSMA; energy-efficient MAC protocols like SMAC.Routing Protocols: Flat-based, Hierarchical, and Location-based protocols (e.g., LEACH, PEGASIS, SPIN).Transport Layer: Protocols ensuring reliability and congestion control.

UNIT-III

6

Data Management and Energy Efficiency Data Aggregation: Techniques for data collection and aggregation. Energy Conservation: Energy-efficient design techniques; Duty cycling and Node sleep schedules. Localization: Node localization and positioning techniques. Security: Challenges and protocols for secure communication in WSNs.

UNIT-IV

6

Advanced Topics and Applications Quality of Service (QoS): Parameters and trade-offs in WSNs. Mobile WSNs: Mobility models and dynamic network adaptation. IoT and WSN Integration: Role of WSN in IoT applications. Emerging Research Areas: Machine learning in WSNs, blockchain for secure WSNs. Case Studies: Real-world implementations and emerging trends.

LIST OF EXPERIMENTS:

1. Familiarization of various sensors used in wireless sensor networks
2. Familiarization with NS2 software.
3. Basic WSN Node Deployment: Simulate random deployment of sensor nodes in a 2D field
4. Energy Consumption Model: Simulate energy consumption for nodes transmitting data.
5. Connectivity Analysis: Check node connectivity based on communication range
6. LEACH ClusteringL Simulate LEACH protocol for cluster head selection.
7. Shortest path routing: Find shortest path from a node to sink using Dijkstra Algorithm
8. Energy-Aware Routing: Route data through nodes with highest remaining energy
9. Localization using Trilateration: Estimate node position using anchor nodes
10. Packet Loss Simulation: Simulate packet loss based in distance
11. Data Aggregation: Simulate data aggregation at cluster heads

Network Lifetime Simulation: Simulate network lifetime based on energy depletion

Textand ReferenceBooks

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley, 2005.
2. Feng Zhao and Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, Elsevier, 2004.
3. Kazem Sohraby, Daniel Minoli, and Taieb Znati, *Wireless Sensor Networks: Technology, Protocols, and Applications*, Wiley, 2007.
4. Anna Hac, *Wireless Sensor Network Designs*, Wiley, 2003.

Course Code: BEC-355 Android Application and Development

Course category	:	PC
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial: 0, Practical: 4
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Minor test and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamentals of Android platform and application development.
2. Gain practical knowledge of designing and implementing Android user interfaces.
3. Learn to work with Android APIs for building interactive and efficient mobile applications.
4. Explore advanced features like data storage, networking, and services in Android.
5. Develop basic Android applications with functional user interfaces.
6. Implement advanced UI designs and interactive features in Android apps.
7. Utilize Android APIs for data storage, networking, and multimedia functionalities.
8. Design and deploy efficient, feature-rich Android applications using modern practices.

Topics Covered

UNIT-I **9**

Introduction to Android Development Introduction: Overview of mobile app development, Android platform features, Android architecture. Development Environment: Setting up Android Studio, SDK installation, and AVD configuration. Project Structure: Understanding Android project structure, AndroidManifest.xml, and Gradle. Basic Components: Activities, intents, and lifecycle of an Android application. UI Basics: XML-based layouts, Views, ViewGroups, and designing basic interfaces.

UNIT-II

9

Advanced UI and User Interaction UI Widgets: Buttons, TextView, EditText, ListView, RecyclerView, and ScrollView. Event Handling: Handling user inputs and gestures. Fragments: Fragment lifecycle, communication between fragments, and designing dynamic UIs. Styles and Themes: Customizing UI with themes, styles, and animations. Material Design: Using Material Design components for advanced UI development.

UNIT-III

9

Data Storage and Networking Data Persistence: SharedPreferences, SQLite, and Room database. Files and Content Providers: Reading/writing files and using content providers. Networking: HTTP requests, REST APIs, and JSON parsing. Firebase Integration: Real-time database and authentication. Multimedia: Audio, video playback, and working with Camera APIs.

UNIT-IV

9

Advanced Android Development Background Services: Services, foreground services, and background tasks. Broadcast Receivers: Using broadcast receivers for notifications. Sensors and Location: Accessing device sensors, GPS, and location services. Publishing Applications: Preparing apps for deployment and publishing on Google Play Store. Emerging Topics:

Introduction to Jetpack Compose, MVVM architecture, and Kotlin Coroutines.

List of Experiments

1. To study and draw the architecture of the Android operating system and understand its key components such as Activities, Services, Broadcast Receivers, and Content Providers.
2. To install and set up Android Studio and create a basic "Hello World" application to understand the project structure and emulator setup.
3. To develop an Android application demonstrating the activity lifecycle using log messages (Logcat).
4. To create a simple login screen using EditText, Button, and Toast for basic user input validation.
5. To design and implement a basic calculator app to perform arithmetic operations using buttons and text views.
6. To implement navigation between two screens using explicit intents in an Android application.
7. To use implicit intents to open system applications like the phone dialer, web browser, and camera.
8. To design a form using basic UI widgets such as CheckBox, RadioButton, and Spinner, and handle user selections.

To store and retrieve simple user data (e.g., username) using SharedPreferences in Android.

Textand ReferenceBooks

1. 1. Ian F. Darwin, *Android Cookbook: Problems and Solutions for Android Developers*, O'Reilly Media, 2017.
2. Dawn Griffiths and David Griffiths, *Head First Android Development*, O'Reilly Media, 2017.
3. Wei-Meng Lee, *Beginning Android Programming with Kotlin*, Wiley, 2020.
4. Reto Meier, *Professional Android*, Wrox, 2018.

CourseCode:BEC-356 **Digital and Wireless Communication**

Course category	ProgramCore(PC)
Pre-requisite Subject	: **Principles of Communication**
Contact hours/week	: Lecture:3, Tutorial:1, Practical:2
Number of Credits	: 5
Course Assessment methods	: Continuous assessments through teaching assessment, attendance, home assignments, quizzes, two minor tests and one major theory examination.
Course Objective	The aim of this course is to give basic concepts and advance issues relating to digital and wireless mobile communications and the development of cellular communication infrastructure.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1: Understand the system level aspects of cellular network design and planning with a special focus on GSM, WCDMA, UMTS, 4G and 5G standards.

2: Understand the basic aspects of wireless propagation models and analyse their

performance like link budget, coverage, BER etc

3: Understanding of 5G on systems level along with core technologies and signal waveform

4: Understanding of advanced PHY layer technologies for 5G Radio access network (RAN) like OFDM, MIMO etc.

5: Apply the concepts of digital modulation to wireless communication

6: contribute to the research in the various protocol stack of wireless communication.

Topics Covered

UNIT-I **9**

Wireless Communication Systems & Standards

Evolution of Mobile Radio Communications, Cellular telephone systems, Different generations (1G to 6G) of Cellular Networks, Recent advances in mobile communication, Overview of Channel Impairments.

UNIT-II

9

Cellular Communications

Introduction to Cellular Communications, Cell structure, Frequency Reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity in cellular systems, power control, Wireless Standards:

Overview of 2G, 3G and 4G cellular standards.

UNIT-III

9

5G Network:

New Radio (NR), Standalone and non-standalone mode, non-orthogonal multiple access(NOMA), massive MIMO, beam formation, PHY API Specification, flexible frame structure, Service Data Adaptation Protocol (SDAP), centralized RAN, open RAN, multi-access edge computing (MEC);Introduction to software defined networking (SDN), network function virtualization (NFV), network slicing; restful API for service-based interface, private networks.

UNIT-IV

9

Grand Challenges:

5G penetration in developed countries; deployment challenges in low-middle income countries, stronger backhaul requirements, dynamic spectrum access and usage of unlicensed spectrum, contrasting radio resource requirements, large cell usage, LMLC, possible solutions for connectivity in rural areas (BharatNet, TVWS, Long-range WiFi, FSO); non-terrestrial fronthaul / backhaul solutions: LEOs, HAP/UAV.

LIST OF EXPERIMENTS:

1. Hardware based experiment on assessment of path loss coefficient in indoor environment.
2. Hardware experiment on hands-off of cellular communication system
3. SDR/MATLAB based implementation of a digital wireless communication system with different modulation formats (QPSK, QAM, 64-QAM).
4. Experiment and Simulation of various fading channels and Analyze their SNR vs. BER

performance in MATLAB/SDR platform.

1. Experiment on various diversity techniques like selection combining, equal gain combining and MRC in MATLAB and their BER analysis in a fading environment. Show the capacity improvement as well.
2. Implement linear adaptive equalization for a digital wireless communication system and analyze the BER performance.
3. Performance analysis of space-time coding (Alamouti Coding for 2X1 and 2X2 MIMO) overfading channel in MATLAB.
4. Experiment on MIMO-OFDM systems over fading channel in MATLAB and analyze its capacity.
5. Experiment with wide band real time signals related to different communication standards like WLAN and LTE in MATLAB/LabVIEW.
6. Signal Processing for MIMO Systems.
7. Digital Beamforming.
8. Massive MIMO Channel Model– Large/ Small Scale Fading
9. Transmitter and Receiver Schemes with Imperfect CSI
10. Multi-Cell Massive MIMO Model.

Fixed NOMA Protocol for UL/ DL – Performance Analysis

Text and Reference Book

1. Mobile Communications by Jochen Schiller Pub: Financial Times / Imprint of Pearson.
2. Mobile Cellular Telecommunications: Analog and Digital Systems by William Lee, Pub: McGraw Hill Education
3. Mobile Communications Design Fundamentals by William Lee, Pub: Wiley India Pvt. Ltd.
4. Wireless Communications: Principles and Practice by Theodore S. Rappaport, Pub: Pearson.

Course Code: BEC-382 Industrial IoT

Course category	:	Program Elective (PE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand basic IoT Concept, sensing, actuation and IoT Architecture.
2. Understand Industry 4.0 Principles and Cyber Physical System
3. Identify major IIOT applications and interpret simple industrial case studies
4. To understand the structure of Industrial IoT architectures, the role of IIOT layers, reference architectures, and industrial communication technologies such as MQTT, CoAP, OPC-UA, and industrial networking concepts.
5. Analyze IIOT data acquisition and processing methods, compare cloud, edge, and fog computing models,

and apply essential IIOT security principles including authentication, encryption, and secure communication.

6. Evaluate cloud-enabled IoT applications and case studies and identify future trends such as digital twins and edge AI for real-world IoT solutions.

Topics Covered

UNIT-I

Introduction to IoT, sensing and actuation in industrial environments, communication fundamentals, IoT architecture layers, overview of Industry 4.0, cyber-physical systems, smart factories and connected manufacturing, role of industrial sensors and next generation sensing technologies. 9

UNIT-II

IIOT introduction and requirements, IIOT layered architecture (sensing, edge, processing, communication, networking), IIOT reference architectures, industrial communication protocols such as MQTT, CoAP and OPC-UA, industrial networking basics including TSN and industrial Ethernet, device connectivity and interoperability in IIOT systems. 9

UNIT-III

IIOT data acquisition and processing, batch and stream data handling, introduction to big data analytics in industries, cloud computing for IIOT systems, edge and fog computing concepts, software-defined networking for IIOT, cybersecurity fundamentals in IIOT including authentication, encryption, secure communication and basic threat models. 9

UNIT-IV

Applications of IIOT in manufacturing and assembly lines, food and process industries, power plants and energy systems, logistics and inventory management, industrial safety and healthcare applications, predictive maintenance and remote monitoring, AR/VR use in industrial environments, simple case studies from industrial automation, process monitoring and smart production systems. 9

Books & References

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2016.
2. Arshdeep Bahga& Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.
3. Sabina Jeschke, Christian Brecher, Tobias Meisen, Dennis Özdemir, Industrial Internet of Things: Cybermanufacturing Systems, Springer, 2017.
4. Lingfeng Wang & Mohamed A. El-Sharkawi, Cyber-Physical Systems for Next-Generation Networks, Springer, 2020.
5. Ovidiu Vermesan & Peter Friess (Eds.), Internet of Things – From Research and Innovation to Market Deployment, River Publishers, 2014.

Course Code: BEC-383 Cloud Computing for IoT

Course category	:	Program Elective (PE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the core concepts of cloud computing and IoT, including service models, deployment models, virtualization, and the basic architecture of IoT systems.
2. Explain the working of major IoT cloud platforms (AWS IoT Core, Azure IoT Hub).

3. To demonstrate knowledge of cloud storage, device management, and IoT connectivity methods.
4. Analyse cloud-based IoT data processing techniques using serverless computing and apply essential cloud–IoT security principles such as IAM, encryption, and secure communication.
5. Evaluate cloud-enabled IoT applications and case studies.
6. To identify future trends such as digital twins and edge AI for real-world IoT solutions.

Topics Covered

UNIT-I

Introduction to Cloud Computing: Definition, characteristics, benefits, Cloud Service Models: IaaS, PaaS, SaaS, Deployment Models: Public, Private, Hybrid, Basics of Virtualization, Introduction to IoT: components, architecture, Role of Cloud in IoT. 9

UNIT-II

Overview of Major IoT Cloud Platforms: AWS IoT Core, Azure IoT Hub, IoT Device Management: Device registry, authentication, IoT gateway, Cloud Storage for IoT, Edge vs Cloud vs Fog. 9

UNIT-III

Serverless Computing Concepts: AWS Lambda / Azure Functions, IoT Data Processing: Batch vs stream, Real-time dashboard idea, Security Basics in IoT and Cloud: IAM, Encryption in brief, Secure communication (TLS/MQTT). 9

UNIT-IV

Cloud-based IoT Applications: Smart Home, Smart Agriculture, Smart Healthcare, Simple Case Studies: Cloud-based environmental monitoring, Vehicle tracking using IoT and Cloud, Future Trends: Digital Twin, Edge AI/TinyML. 9

Books & References

1. Thomas Erl, Zaigham Mahmood & Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 2013.
2. Arshdeep Bahga& Vijay Madisetti, "Internet of Things: A Hands-On Approach", Universities Press, 2014.
3. Dieter Uckelmann, Mark Harrison & Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
4. Rajkumar Buyya, James Broberg & Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.

Course Code: BEC-384 Privacy and Security in IoT

Course category	:	Program Elective (PE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, record, viva voce, and Minor test and one Major Theory.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To know the state-of-the-art methodologies in Cyber Physical system.
2. To impart knowledge on Model threats and countermeasures.
3. To explore the Privacy Preservation and Trust Models in Internet of Things (IoT).
4. To apply the concept of Internet of Things Security in the real-world scenarios.

5. To analyse the integration of communication networks, embedded systems, and cloud computing in cyber-physical systems for secure operation.
6. To develop the ability to design and evaluate secure IoT architectures.

Topics Covered

UNIT-I

IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle. Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems. 9

UNIT-II

Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto (PKI), signature algorithms. 9

UNIT-III

Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing 9

UNIT-IV

Authentication in IoT- Computational Security for the IoT- Privacy-Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things. 9

Books & References

1. Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1st edition,CRC Press, 2016.
2. Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1st edition, Packt Publishing Ltd, 2016.
3. Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1st edition, NCC Group, 2014
4. DaCosta, Francis, and Byron Henderson. Rethinking the Internet of Things: a scalable approach to connecting everything, 1st edition, Springer Nature, 2013.