RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **IoT Architecture and Protocols**　　　　Subject Code: **BTechIOT-501T**

Load	Credits (TH+T)	College Assessment Marks	University Evaluation	Total Marks
3 T Hrs	3	30	70	100

Prerequisite(s):

Course Objectives

1	To study and understand Concept of Internet of Things architecture
2	To study IoT standards and protocols.
3	To study security issues and requirements in IoT system design.

Course Outcomes:

At the end of this course students are able to:

1	Demonstrate Concept of Internet of Things architecture
2	Demonstrate IoT protocol standards and ecosystem.
3	Explain Communication protocols for Basic designs in IoT
4	Select IoT Networking Protocols in different IoT System
5	Develop secure systems in IoT.

Course Contents:

Unit	Contents	Hours
I	**IoT Fundamental:** Basic Concept of IoT, Building block of IoT System, Top-Down Design Strategy for an IoT System, IoT Demands & Markets (Current status and future perspective of IoT), Technical Challenges, Fundamental characteristics, IoT cloud services. Need of IoT for Industry 4.0	8
II	**IoT Protocol Standard & ecosystem :** Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, Slot frame Structure, IEEE 802.11 AH, IoT Ecosystem	8

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III	**IoT Communication Protocols:** IoT Data Link Protocol, Wireless-HART, Z-Wave, Zigbee Smart Energy, DASH7, Network Layer Encapsulation Protocols	8
IV	**IoT Advance :** Lora WAN, RPL, CORPL, CARP, LoWPAN, TiSCH, IPv6 over G.9959, IPv6 over Bluetooth Low Energy, SMQTT, AMQP, XMPP, DDS	8
V	**IoT Security:** Security issues in IoT Systems and privacy preservation, IoT Security requirements, IoT System Security Control, Security model for IoT Securityframework, Light weight cryptography, IoT Data Encryption and Decryption. Case Study .	8

Text Books	1.	Internet of Things, Surya Durbha and Jyoti Joglekar, Oxford University Press, 2020
	2	Internet of Things and its Application BPB Publications (1 January 2020) ISBN-10 : 9389845769ISBN-13 : 978-9389845761
	3	IOT (Internet of things) and Its Application T Balaji Publication ISBN-10 : 81941363ISBN-13 : 978-8194136385
	4	Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education India, 2009, Second
Reference Books	1.	Learning Internet of Things by PeteWaher (ISBN-13: 978-1783553532 ISBN-10: 178355 3537
	2.	Getting Started with the Internet of Things by Cuno Pfister ISBN-13: 978-1449393571 ISBN-10: 1449393578
	3.	Building the Internet of Things by Maciej Kranz ISBN-13: 978-1119285663 ISBN-10: 1119285666
Online TL Material	1.	https://onlinecourses.nptel.ac.in/noc21_ee85/course Design for Internet of Things on NPTEL Swayam Platform

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **IoT Architecture and Protocols**   Subject Code: **BTechIOT-501P**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week **(Practical)**	1	25	25	50

Practical based on different IoT protocols

Sr. No.	Practical List
1	Study practical on IoT Protocol & Its Characteristics
2	Practical based on ISP Protocol
3	Practical based on IEEE802.11/a Protocol
4	Practical based on IEEE 802.15.1 Protocol
5	Practical based on RF HT12E & HT12D Protocol
6	Practical based on RS-232 Protocol
7	Practical based on I2C Protocol
8	Practical based on SPI Communication Protocol
9	Practical based on MQTT Protocol
10	Open Ended – Project to use IoT Protocol, Cloud interface for some application

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: Machine Learning **Subject Code: BTechIOT-502T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 T Hrs	3	30	70	100

Prerequisite(s): Artificial Intelligence

Course Objectives:

1.	To enable the Students with basic knowledge on Machine Learning Techniques.
2.	To develop skills of applying Machine Learning Techniques for solving real world problems.

Course Outcomes:

At the end of this course students are able to:

CO1	Explain basics of Machine Learning Techniques.
CO2	Explain different types of Regression Techniques.
CO3	Apply classification techniques.
CO4	Apply unsupervised machine learning techniques.
CO5	Apply & evaluate the machine learning techniques to real world problems.

Syllabus:

UNIT I: Introduction to Machine Learning Human learning & it's types, Machine learning and it's types (Supervised ,unsupervised reinforcement),well-posed learning problems, Applications of Machine learning, issues in machine learning. Types of data: Numerical and categorical data, data issues and remediation.	[08 Hours]
UNIT II: Supervised Learning: Regression Data pre-processing: Dimensionally reduction, feature subset selection, Types of regression: Multiple linear regression, Polynomial regression model.	[07Hours]
UNIT III: Supervised Learning: Classification Logistic regression, K-nearest neighbour (KNN),Naive Bayes Decision trees, Support vector machine, Recommendation Systems : Content based and collaborative techniques.	[07Hours]
UNIT IV: Unsupervised Learning: Introduction Clustering, K-means clustering, Apriori algorithm and association rule, anomaly detection algorithm, Hierarchial clustering , K-Medoids.	[07Hours]
UNIT V: Trends and applications in Machine learning Ensemble learning, Bagging, randomization, Boosting, Applications of Machine learning: Image recognition, speech recognition, Prediction recommendation: email spam and malware filtering, virtual personal assistant, online fraud detection.	[07Hours]

Textbooks:

1. Machine Learning by Subramanian Chandramouli, Saikat Dutt, Amit Kumar Das
2. Introduction to Machine Learning by Dr. Nilesh Shelke, Dr. Narendra. V. Choudhary, Dr. Gopal Sakarkar, Das Ganu Publications, ISBN-978-93-84336-63-9
3. Machine Learning by Tom Mitchell, Mc.Graw Publications

Reference books:

1. Python Machine Learning Dr Randal S. Olson

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Machine Learning**   Subject Code: **BTechIOT-502P**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

Sr. No.	Practical List
1	Introduction to Python Programming & Various libraries used in machine learning
2	For a given set of data write a program to implement linear regression algorithm & Create a model and evaluate the model
3	Write a Python program to Classify the given dataset using Logistic regression and evaluate the model.
4	Write a Program to demonstrate the working of a Decision tree based model classification
5	Write a Program to implement the Navie's Baysian classification for a sample training dataset .Compute the accuracy of the classifier ,considering a few test dataset
6	Write a Program to Implement the Principal Component analysis algorithm in a given datasets
7	Write a python Program to implement the K Means algorithm using the approximate dataset
8	Write a Python program to implement the K Nearnest Neibhour algorithm using the appropriate dataset
9	Write a Program to implement Support Vector machine in python
10	Machine Learning algorithm Implementation through Virtual Lab

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **CLOUD COMPUTING**   Subject Code: BTechIOT-503T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 T Hrs	3	30	70	100

Course Objectives:

1.	To understand Cloud Computing concepts, technologies, architecture and applications
2.	To understand the underlying principle of cloud virtualization, cloud storage, data management and data visualization
3	To understand different cloud programming platforms and tools to develop and deploy applications on cloud

Course Outcomes:

At the end of this course students are able to:

CO1	Develop and deploy cloud application using popular cloud platforms
CO2	Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud and building private cloud
CO3	Design and deploy a cloud application in a PaaS environment
CO4	Develop cloud computing solutions for an enterprise
CO5	Analyze various cloud programming models and apply them to solve problems on the cloud

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Course Contents:

Unit	Contents	Hours
I	**Introduction to Cloud Computing and Virtualization:** Virtualization Concepts, Cloud Computing Fundamental: Overview of Computing Paradigm, Evolution of cloud computing, Defining cloud computing, Components of a computing cloud, Essential Characteristics of Cloud Computing, Cloud Taxonomy. Infrastructure as a Service(IaaS), Platform as a Service(PaaS), Software as a Service (SaaS), Hardware-as-a-service: (HaaS), Oriented Architecture (SOA)	8
II	**Cloud Computing Architecture and Service Management in Cloud:** Computing Cloud architectural principles, Role of Web services, Benefits and challenges to Cloud architecture, Cloud Service Models, cloud computing vendors. Cloud Services, Management, Performance and scalability of services, tools and technologies used to manage cloud services deployment	7
III	Data Management in Cloud Computing and Resource Management in Cloud)	6
IV	**Cloud Security and Risk Management: Cloud Security:** Understanding cloud based security issues and threats, Data security and Storage, Identity& Access Management, Risk Management in cloud, Governance and Enterprise Risk Management.	7
V	**Open Source and Commercial Clouds:** Openstack, AWS, Google Cloud, Microsoft Azure, Cloud Simulator and IoT Cloud Framework, Research trend in Cloud Computing, Fog Computing,	8

Text Books	1.	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley,2011
	2.	Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010
E--Books	1.	CLOUD COMPUTING Principles and Paradigms Link: http://dhoto.lecturer.pens.ac.id/lecture_notes/internet_of_things/CLOUD%20COMPUTING%20Principles%20and%20Paradigms.pdf
Reference Books	1.	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
	2.	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010
Online TL Material	1.	https://nptel.ac.in/courses/106/105/106105167/

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: Signal Processing   Subject Code: **BTechIOT-504T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
3T Hrs/week + 1 tutorial	4	30	70	100

Prerequisite(s):

Course Objectives:

1.	To study the basic concepts of Analog and digital signal processing.
2.	To study analysis and processing of signals for different kind of applications and retrieval of information from signals.
3	To understand the physical significance of circular convolution and its relation with linear convolution

Course Outcomes:

At the end of this course students are able to:

CO1	Explain the basics of signal and system
CO2	Explain the concepts of Fourier Transform
CO3	Describe theoretical and practical aspects of DSP with regard to sampling and reconstruction.
CO4	Apply the properties of Z Transform
CO5	Represent discrete-time signals analytically and visualize them in the time domain.

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Unit	Contents	Hours
I	**UNIT I: Introduction & Classification of Signals** Classification of Signals and systems, Types of signals, Types of systems Basic signal operators, and their examples. Properties of System.	06
II	**UNIT II: Fourier Transform of continuous time signals** Analysis of Fourier methods, fourier series expansion of periodic signals, properties of fourier transform, Examples of fourier Transform, convolution properties.	08
III	**Unit III: Introduction to Digital Signal Processing** Basic elements of DSP and its requirement, Advantages of Digital over analog signal processing, sampling theorem, sampling process and reconstruction of sampling data. Discrete time signals & systems: Discrete time signals & systems, classification of discrete time signals and systems, LTI systems, linear convolution, Cross Correlation, Autocorrelation.	08
IV	**Unit IV: Z- Transforms** The Z-transform: Definition, properties of the region of convergence for the Z-transform, Z-transform properties, Inverse Z-transform, Parseval's theorem, unilateral Z-transform.	(08)
V	**Unit V: Discrete and Fast Fourier Transforms** Definition and properties of DFT, IDFT, Relation between DFT and Z–Transform, Frequency analysis of discrete time signals using DFT, circular convolution, Linear filtering methods based on DFT. Decimation in time FFT algorithm, decimation in frequency FFT radix-2 FFT.	(10)

Text Books:

1. J.G. Proakis, D.G. Manolakis "Digital Signal Processing: Principles, algorithms and applications, Pearson Education.

2. Oppenheim A.V., Willsky A.S. and Young I.T., "Signals and Systems", Second Edition, 1997, Prentice Hall.

3. Simon Haykin and Barry Van Veen, "Signals and Systems", Second Edition, Wiley International.

4. A.V. Oppenheim, R.W. Schafer, "Discrete Time Signal Processing", Pearson Education.

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5. Rabiner Gold " Theory and Application of DSP", PHI

6. Texas Instruments and Analog Devices DSP Chip Manuals.

Reference books:

1. Digital signal processing- A practical approach Second Edition, 2002.E. C. Ifeachar, B. W. Jarvis Pearson Education

2. Sanjit K. Mitra , 'Digital Signal Processing – A Computer based approach'

3. S. salivahanan, A Vallavaraj, C. Gnanapriya , 'Digital Signal Processing', 2nd Edition McGraw Hill.

4. A. Nagoor Kani, 'Digital Signal Processing', 2nd Edition McGraw Hill.

5. P. Ramesh Babu, 'Digital Signal Processing' Scitech

6. R.F. Ziemer, W.H Tranter and J.D.R.Fannin, "Signals and Systems - Continuous and Discrete", Forth Edition Prentice Hall.

7. M. J. Roberts, "Signals and Systems", 2003, Tata McGraw-Hill

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Signal Processing**   Subject Code: **BTechIOT-504P**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

Sr. No.	Practical List
1	Write a MATLAB program to generate the following elementary signals: i) Unit step sequence ii)Unit step signal iii)Unit ramp signal iv) Sine signal v) Cosine signal vi) Exponential signal
2	Write a MATLAB program to generate the some sequences:
3	Write a MATLAB program to illustrate: i)The effect of up-sampling in frequency domain. ii)The effect of Interpolation process.
4	Write a MATLAB program to find the linear convolution of two sequences. i)Without using MATLAB convolution function. ii) Using MATLAB function.
5	Write a MATLAB program to obtain i) Partial fraction expansion of rational Z-transform. ii)Z-transform from partial fraction expansion. iii)Power series expansion of Z-transform. iv)Stability test for Z-transform
6	Write a MATLAB program to obtain: i) N-point DFT of sequence. ii) ii)N-point IDFT of sequence. iii)Linear convolution by DFT
7	Compute the Discrete Fourier Transform and IDFT with and without fft and ifftin MATLAB
8	Implementation of Linear convolution using DFT
9	Implementation of Decimation-in-time radix-2 FFT algorithm
10	Implementation of Decimation-in-frequency radix-2 FFT algorithm

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Data Visualization** (Elective - I)   Subject Code: **BTechIOT-505T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 T Hrs	3	30	70	100

Course Objective:

1	To understand the basics of Data, Big data and Data visualization.
2	To understand of the key techniques and theory used in visualization, including data models, graphical perception and techniques for visual encoding and interaction.
3	To explore tools and practices for working with R.

Course Outcome:

At the end of this course students are able to:

CO1	Apply the concepts of big data analytics for a domain.
CO2	Apply the data analytics technique for visualization.
CO3	Locate the data from different sources (small dataset and large datasets),clean and manipulate data.
CO4	Evaluate and design data analytics Framework.
CO5	Use rich visualization libraries to deliver your findings as reports.

Contents:

Unit	Contents	Hours
I	**Unit 1: The Value of Visualization and data model** What is visualization?, Why create visualizations?, Record Information ,Make a decision: Challenger, Goals of Visualization Research ,Data and Image Models, Visualization Software, Graphical Perception, Visualization Reference Model, Data and Image Models, Properties of data, Properties of images Mapping data to images, Data models vs. Conceptual models, Types of variables, From data model to N,O,Q data type, Relational data model, Relational data model, Dimensions and Measures, Roll-Up and Drill-Down	8
II	**Unit 2: Visualization Design and Exploratory Data Analysis** Visual Encodings, Expresses facts not in the data, Mackinlay Ranking Design Algorithim, Limitation, What is Exploratory Data Analysis ?,The Golden Age of Data Visualization, The Rise of Statistics, Data Diagnostics, Graphical Methods for Data Transformation, Statistical Models, Hypothesis Testing, Data "Wrangling", gauge the quality of a visualization, Data Quality & Usability Hurdles.	8
III	**Unit 3: Multidimensional Visualization** Multi-Dimensional Data , Multidimensional Visualization ,Transforming data, Plot the Residuals, Multiple Plotting Options, Visual Encoding Variables, Trellis Plots, Visualizing Multiple Dimensions , Separation: Small Multiples, Scatterplot Matrix (SPLOM), Multiple Coordinated Views, Principal Component Analysis, Parallel Coordinates, Overview of Tableau / Polaris, Hypotheses	8
IV	**Unit 4: Graphical Perception** Graphical Perception, best encodes quantities, Detection, Detecting Brightness, Mapping & Cartography, Visual pop-out: Color, Visual pop-out: Shape, Feature Conjunctions, Pre-Attentive features, Feature-integration theory, Multiple Attributes, One-dimensional: Lightness, Correlated dims: Shape or lightness, Speeded Classification, Types of Dimensions, Layering, Visual Pathway , Integral vs. separable, Feature-integration theory.	8
V	**Unit 5: Visualization Tools** Table Algebra: Operands, Table Algebra: Operands, Visualization Tools, Table Algebra, Querying the Database, Protovis: A Language for Visualization, Case study and it's application.	8

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Text Books	1.	The Visual Display of Quantitative Information, 2nd Ed. 2nd Edition by Edward R. Tufte,2nd Edition). E. Tufte. Graphics Press, 2001.
	2.	SeemaAcharya," Data analytics using R", McGraw Hill Education (India) Private Limited CHENNAI.
	3.	Information Visualization, In Readings in Information Visualization. Stuart Card, Jock Mackinlay, and Ben Shneiderman
E-Books	1.	https://www.analyticsvidhya.com/blog/2016/03/pca-practical-guide-principal-component-analysis-python/
	2.	https://www.listendata.com/2016/05/free-ebooks-on-r-python-and-data-science.html
Reference Books	1.	The Eyes Have It: A Task by Data Type Taxonomy for Information Visualizations, Shneiderman, Proc. IEEE Conference on Visual Languages, Boulder 1996.
	2.	The Value of Visualization. Jarke van Wijk. Visualization 2005
Online TL Material	1.	https://www.tableau.com/learn/articles/books-about-data-visualization
	2.	https://www.r-project.org/

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Wireless Communication Technologies (Elective - I)** Subject Code: **BTechIOT-505T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 T Hrs	3	30	70	100

Course Objective:

1	To understand the basic concepts in cellular communication
2	To understand the characteristics of wireless channels.
3	To know the Impact of digital modulation techniques in fading
4	To get exposed to diversity techniques in wireless communication.
5	To acquire knowledge in multicarrier systems

Course Outcome:

At the end of this course students will be able to

CO1	Design solutions for cellular communication
CO2	Compute the capacity of wireless channels
CO3	Analyze the performance of the digital modulation techniques in fadingchannels.
CO4	Apply various diversity techniques in wireless communication.
CO5	Design multicarrier systems in wireless communication

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Syllabus:

UNIT I CELLULAR CONCEPTS Frequency Reuse – Channel Assignment Strategies – Hand off Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring-Repeaters for Range Extension-Microcell Zone Concept.	[08 Hours]
UNIT II THE WIRELESS CHANNEL Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.	[07 Hours]
UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS Performance of flat fading and frequency selective fading – Impact on digital modulation techniques –- Outage Probability- Average Probability ofError — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference	[07 Hours]
UNIT IV DIVERSITY TECHNIQUES Realization of Independent Fading Paths – Receiver Diversity – Selection Combing – Threshold Combing – Maximal-Ratio Combing – Equal - Gain Combing – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.	[07 Hours]
UNIT V MULTICARRIER MODULATION Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio-Frequency and Timing offset.	[07 Hours]

Text Books:

1. Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2ndEdition, Pearson Education, India, 2009.

2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.

3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication",Wiley Series in Telecommunications, Cambridge University Press, 2005.

References:

1. Keith Q. T. Zhang, " Wireless Communications: Principles, Theory andMethodology" John Wiley & Sons, 1st Edition, 2016.

2. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House,2004.

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FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: Web and Social Media Analytics (Elective - I)   Subject Code: BTechIOT-505T

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs (Theory)	3	30	70	100

Prerequisite(s):

Course Objectives:

1	Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics.
2	Identify and select key performance indicators to accurately measure the success of social media efforts.
3	Analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools.
4	Develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively.

Course Outcomes:

At the end of the course students will be able to :

CO1	analyze social media, web and social media analytics, and their potential Impact.
CO2	Explain usability, user experience, and customer experience.
CO3	Explain usability metrics, web and social media metrics.
CO4	Design and conduct usability studies.
CO5	Use various data sources and collect data relating to the metrics and key Performance indicators.

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Syllabus:

UNIT – I: Introduction Web and social media (Web sites, web apps, mobile apps and social media) Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages Web analytics and a Web analytics 2.0 framework (click stream, multiple outcomes analysis, experimentation and testing, voice of customer, competitive intelligence,Insights).	[8 Hours]
UNIT – II: Background Data (Structured data, unstructured data, metadata, Big Data and Linked Data)Lab testing and experiment design (selecting participants, within-subjects or between subjects study, counterbalancing, independent and dependent variable; A/B testing,multivariate testing, controlled experiments) Data analysis basics (types of data, metrics and data, descriptive statistics, comparing means, correlations, nonparametric tests, presenting data graphically)	[7 Hours]
UNIT – III Measuring user experience Usability metrics (performance metrics, issues-based metrics, self-reported metrics), Planning and performing a usability study (study goals, user goals, metrics and evaluation methods, participants, data collection, data analysis) Typical types of usability studies and their corresponding metrics (comparing alternative designs, comparing with competition, completing a task or transaction, evaluating the impact of subtle changes)	[7 Hours]
UNIT – IV: Web metrics and web analytics PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical issues; HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; On-site web analytics, off-site web analytics, the goal-signal-metric process.	[7 Hours]
UNIT – V : Social media analytics Social media analytics (what and why) Social media KPIs (reach and engagement) Performing social media analytics (business goal, KPIs, data gathering, analysis, measure and feedback) Data analysis language and tools Ready-made tools for Web and social media analytics (Key Google Analytics metrics,dashboard, social reports) Statistical programming language (R).	[7 Hours]

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TEXT BOOKS:

1. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons; Pap/Cdr edition (27 Oct 2009)

2. Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann; 1 edition (28 April 2008)

3. Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons (16 April 2010)

4. Brian Clifton, Advanced Web Metrics with Google Analytics, John Wiley & Sons; 3rd Edition edition (30 Mar 2012)

REFERENCE BOOKS:

1. Social Media & Web Analytics by Aditya Kumar by R. Narain & Co.

2. Social Media and Web Analytics by Vishnuprasad Nagadevara

3. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics By: Marshall Sponder

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **ARM Processor & its Essentials (Elective - I)**   Subject Code: **BTechIOT-505T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs (Theory)	3	30	70	100

Course Objective:

1	Know the architecture of ARM 7 processor, LPC2148 andassembly programming of ARM.
2	Learn to design, construct, program, verify, analyze and troubleshoot ARM, assembly and C language programs and supporting hardware.

Course Outcome:

At the end of this course students are able to:

CO1	Explain the features of embedded systems, architecture of ARM7 and applications.
CO2	Explain the instruction set and development tools of ARM
CO3	Analyse the THUMB state and achieving competency in assemblyprogramming of ARM.
CO4	Explain the exception, interrupts and interrupt handling schemes
CO5	Analyse the architectural features of LPC2148 microcontrollers.

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Syllabus:

UNTI I ARM Embedded Systems and ARM Processor Fundamentals The RISC design philosophy, ARM design philosophy, embedded system hardware-AMBA bus protocol, embedded system software- applications. ARM core data flow model ,Registers, CPSR-Processor modes, Banked registers. Pipeline-Characteristics.	**[07 HOURS]**
UNIT II ARM Instruction Set Fundamentals of ARM instructions, Barrel shifter, Classification and explanationo instructions with examples-Data processing, Branch, Load-store, SWI and Program StatusRegister instruction.	**[07 HOURS]**
UNIT III Introduction to THUMB and ARM Programming Introduction to THUMB, Differences between ARM and THUMB, Register usage ir Thumb, ARM Thumb Interworking. General Structure of ARM assembly modul Assembler directives- AREA, ENTRY, END, SPACE, DCD, DCB, DCW, DCI, DCC EQU, EXPORT, ALIGN, CODE16, CODE32, DATA. Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan.	**[08 HOURS]**
UNIT IV Exception and Interrupt handling schemes Exception handling- ARM processor exceptions and modes, vector table, exceptior priorities,link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design.	**[07 HOURS]**
UNIT VLPC2148 ARM CPU LPC 2148 - Salient features, applications, block diagram, memory mapping. Functional features of Interrupt controller, RTC, USB, UART, I2C, SPI, SSP controllers, watch dogtimers and other system control units.	**[07 HOURS]**

TEXTBOOKS

1. ARM System Developer's guide –Andrew N. SLOSS, ELSEVIER Publications,ISBN978-81-8147-646-3, 2016

2. ARM Assembly Language – William Hohl, CRC Press, ISBN:978-81-89643-04-1

3. ARM System-on-chip Architecture by Steve Furber, Pearson Education,ISBN978-81-317-0840-8, 2E,2012

REFERENCES:

1. Dananjay V. Gadre 'Programming and Customizing the AVR microcontroller', McGraw Hill 2001 5. William Hohl, ' ARM Assebly Language' Fundamentals and Techniques.

2. ARM Architecture Reference Manual 6. LPC213x User Manual

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEARBACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: V (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Effective Technical Communication**   Subject Code: **BTechIOT-506T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
2 Hrs (Theory)	2	15	35	50

Course Objective:

1.	At the end of the semester, students will have enough confidence to face competitive examinations (IELTES/ TOEFL/CAT/ MAT/ XAT/SNAP/GMAT/GATE etc.) to pursue masters degree. They will also acquire language skills required to write their Reviews/Projects/Reports. They will be able to organize their thoughts in English and hence face job interviews more confidently.

Course Outcome: By the end of the course, students will be able to

CO1	Describe of structure of language.
CO2	Face competitive exams and the interview process and can become employable
CO3	Develop business writing skills.
CO4	Become familiar with technology enabled communication and can develop technical and scientific writing skills.

Syllabus:

Unit 1: Functional Grammar:
Common errors, Transformation of Sentences- Change the Voice, Change the Narration, Simple, Compound Complex sentences, Use of Phrases, Idioms & Proverbs.

Unit II. English for Competitive Exams & Interview Techniques:
Word building, English words /phrases derived from other languages, Prefixes and Suffixes, Synonyms/Antonyms, Technical Jargons, Verbal Analogies, Give one word for,

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Types & Techniques of Interview.
Unit III. Formal Correspondence Business Letters, (Enquiry, Quotation, Order, Complaint), Job applications and Resume Writing, e-mail etiquette,* Writing Memorandum, Circulars, notices, Analytical comprehension
Unit IV. Technical & Scientific Writing: Features of Technical Writing, Technical Report writing (Accident, Feasibility, Trouble, Progress), Writing Scientific Projects, Writing Manuals, Writing Project Proposals, Writing Research papers.

Text and Reference Books:

1. Effective technical Communication by Barun K. Mitra, Oxford UniversityPress.

2. Technical Communication-Principles and Practice by Meenakshi Raman &Sharma, Oxford University Press, 2011

3. Functional English for Technical Students by Dr. Pratibha Mahato and Dr. DoraThompson, Himalaya Publishing House.

4. How to Prepare a Research Proposal: Guidelines for Funding and Dissertationsin the Social and Behavioral Sciences by Krathwohl & R David.

5. Technical Writing- Process and Product by Sharon J. Gerson & Steven M.Gerson, 3rd edition, Pearson Education Asia, 2000

6. Developing communication skills by Krishna Mohan and Meera Banerjee.

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE
SEMESTER: VI (C.B.C.S.)
BRANCH: Industrial IOT

Subject: **Mobile & Web Application Development** Subject Code: **BTechIOT-601T**

Load [Th+Tu]	Credits [Th]	College Assessment Marks	University Evaluation	Total Marks
3T Hrs/week	3	30	70	100

Course Objectives	1. Students will learn mobile application development for Internet of Things (IoT) devices
	2. Students will learn various components of mobile devices and essential sensors for various application
	3. Students will learn analytics and security aspects of mobile applications in IoT platforms
Course Outcomes	Up on successful completion of this course, student will be able to:
	CO1 Explain basic of IoT Ecosystem
	CO2 Describe various sensor in each IoT devices
	CO3 Execute Sensor Data Processing using tools
	CO4 Create programming framework for IoT technologies
	CO5 Execute and demonstrate low power communication technologies for IoT

Course Contents:

Unit	Contents	Hours
I	**Introduction to IoT Ecosystem** IoT ecosystem; Industry 4.0; Application development platforms for IoT; IoT Data sources	8
II	**Sensor for Mobile and Handheld Devices** Temperature sensors, Proximity sensor, IR sensors, Image sensors, Motion detection sensors, Accelerometer sensors, Gyroscope sensors, Optical sensors	8
III	**Sensor Data Processing** Sensor Data-Gathering and Data-Dissemination Mechanisms; Sensor Database system architecture; Sensor data-fusion mechanisms; Data-fusion Architectures and models	8

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IV	**Programming frameworks for Internet of Things** IoT Programming Approaches: Node-Centric Programming - Database approach - Model-Driven,Development - IoT Programming Frameworks: Android Things - ThingSpeak - IoTivity- Node-RED - DeviceHive - Contiki and Cooja – Zetta.	8
V	**Communication Technologies for Low Power Wireless** **Interactions** Wireless communications in product development – Bluetooth LE - Near Field Communications (NFC) – WiFi; Prototyping Bluetooth LE with Arduino Nano; Power management strategies and practices.	8

Text Books	1.	Kale, Vivek. Parallel Computing Architectures and APIs: IoT Big Data Stream Processing1st edition, CRC Press, 2019.
	2	Lea, Perry. Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, 1st edition, Packt Publishing Ltd, 2018.
Reference Books	1.	Fadi Al-Turjman, Intelligence in IoT-enabled Smart Cities, 1st edition, CRC Press,2019
	2.	Giacomo Veneri, and Antonio Capasso, Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0, 1st edition, Packt Publishing,2018
	3.	DiMarzio J. F., Beginning Android Programming with Android Studio, 4th edition., Wiley,2016

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Mobile & WebApplication Development**   Subject Code: **BTechIOT-601 P**

Load [Th+Tu]	Credits [Th+Tu]	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

Sr.no	Name of Experiments
1	Create and implement the Web User Interface for various activities related to handlers.
2	Create and implement fragment in activity's UI and show activity communicates with fragments
3	Create and implement widgets to your project, handle update requests, and make widgets interactive using various sensors.
4	Create and implement the Android sensor framework to get data from device sensors in IoT environment.
5	Create and implement Android framework to control actuator in IoT environment.
6	Create and implement tools to identify performance issues in web/android apps with report using SQL database.
7	Create and implement the localization of your apps to other languages and how to make your apps accessible to users with disabilities.
8	Create and implement advanced graphics and extended custom views.

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Digital Modelling and System Design   **Subject Code: BTECH_IIOT-602T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
3T Hrs/week + 1 tutorial	4	30	70	100

Course Objectives:

1	Interpret different modeling styles.
2	Analyse working of various digital circuits.
3	Synthesize various digital circuits using FPGA.
4	Implement Combinational system.

Course Outcomes:

At the end of this course students will be able to:

CO1	Explain digital system designs skills using Verilog HDL.
CO2	Explain Gate level modeling.
CO3	Design Behavioral modeling and loop constructs.
CO4	Compare synthesis of digital and sequential sub systems.
CO5	Design and implement complete digital systems using Verilog HDL and demonstrate the innovation skills.

Syllabus:

UNIT I:	[06 Hours]
Introduction to Digital Systme Design: Verilog as HDL, Levels of design Description, Concurrency, Simulation and Synthesis, Functional Verification , System Tasks, Programming Language Interface(PLI), Module, Simulation and Synthesis Tools, Test Benches. Language Constructs and Conventions: Introduction, Keywords, Identifiers, Data Types, Scalars and Vectors, Parameters, Operators.	

Unit II:	**[08 Hours]**
Gate Level Modeling and Gate Primitive, Module structure, other GATE primitives, Illustrative Examples, Tri-State Gates,Arrays of Instances of Primitives , Design of Flip-flops with Gate Primitives, Modeling at Data Flow Level Introduction.	
Unit III:	**[08 Hours]**
Behavioral Modeling Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Behavioral modeling of Flip Flops and latches, Assignments with Delays, Wait construct, Multiple Always Blocks, Blocking and Non blocking Assignments, The case statement, if and if-else constructs, Assign-de-assign construct, repeat construct, for loop, The disable construct, while loop, forever loop, Parallel blocks, Force-release, construct, Event.	
UNIT IV	**[06 Hours]**
Synthesis of Digital Sub-systems: Synthesis of Combinational Sub-systems: Introduction to Synthesis, Synthesis of Combinational Logic, Synthesis of Three-state Devices and Bus Interfaces. Synthesis of Sequential Sub-systems: Synthesis of Sequential Logic latches, flip-flops, registers, countersSynthesis of State Machines,	
UNIT V	**[08 Hours]**
System Implementation and User-Defined Primitives: Introduction of Programmable Logic Array (PLA), Programmable Array Logic(PAL), Programmability of PLDs, Complex PLDs (CPLDs), Field Programmable Gate Arrays, The role of FPGAs in the ASIC Market, FPGA Technologies, Verilog-Based Design Flows for FPGAs and ASICs. Comparison of design implementation using CPLDs, FPGA and ASIC.	

Text books:

1. Verilog HDL- A guide to design Digital design and synthesis by Samir Palnitkar (Pearson).
2. Design Through Verilog HDL by T.R. Padmanabhan, WILEY INDIA.
3. Verilog HDL Primer 3rd Edition by Bhasker. J., Bsp.
4. Digital Design: with an Introduction to the Verilog HDL by Moris Meno.

Reference books:

1. Advanced Digital Design with the Verilog HDL by Michael D. Ciletti.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: **Digital Modelling and System Design**   Subject Code: **BTECH_IIOT-602P**

Load P	Credits P	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

1.	Design and simulate the Verilog code to realize three and fourvariable Boolean functions
2.	Design of decoder and encoder
3.	Design of multiplexer and de multiplexer
4.	Design of code converters
5.	Full adder and full subtractor design modeling
6.	Design of 8-bit Arithmetic logic unit
7.	Verilog model for flip flops
8.	Design of counters
9.	Verilog code for universal shift register
10.	Design of Sequence detector

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IOT

Subject: Big data Analytics   Subject Code: **BTechIOT-603 T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
3T Hrs/week	**3**	30	70	100

Course Objective:

1	Understand basic concepts and techniques of Big data
2	To Learn Hadoop Distributed File System (HDFS) & its applications
3	Understand MapReduce and its qualities and retain advanced MapReduce thoughts.
4	Understand Different Big Data tools and Framework.
5	Make aware of Pig, HIVE and Spark tools.

Course Outcome:

At the end of this course students will be able to:

CO1	Explain basic concepts and techniques of Hadoop and Big data computing.
CO2	Develop skills for implementation of various Hadoop ecosystem component
CO3	Apply ecosystem knowledge to real time problems of moderate complexity
CO4	Implement and Design different Big Data framework.
CO5	Implement data science and big data analysis in various applications.

UNIT	DETAILS	HRS
I	**Unit I: Big data and Hadoop** Introduction to Hadoop and Big Data, Big data, challenges for processing big data, technologies support big data, History of Hadoop, Use cases of Hadoop, RDBMS vsHadoop When to use and when not to use Hadoop.	10
II	**Unit II: HDFS** Hadoop Distributed File System, Significance of HDFS in Hadoop, Features of HDFS,Data Storage in HDFS: Introduction about Blocks, Data replication. Accessing HDFS:CLI (Command Line Interface) and admin commands, Java Based Approach, Fault tolerance. Download Hadoop, Installation and set-up of Hadoop., Start-up & Shut down process	10
III	**Unit III: Map Reduce** Map Reduce: Map Reduce Story, Map Reduce Architecture, How Map Reduce works, Developing Map Reduce, Map Reduce Programming Model, Different phases of Map Reduce Algorithm, Different Data types in Map Reduce	9
IV	**Unit IV: Pig And HIVE** Introduction to Apache Pig, Map Reduce Vs. Apache Pig, Modes of Execution in Pig, Loading data, Exploring Pig Latin commands, HIVE: Hive introduction, Hive architecture, Data types and schemas, Partitions and buckets, Concept of HBASE.	8
V	**Unit V: Spark** Spark Shell, Spark Application, Flume, SQOOP introduction and application.	9

Text Books	1.	Tom White, "Hadoop: The Definitive Guide", 3rd edition, O'Reilly Media.
	2.	Big Data (Black Book), Wiley
E--Books	1.	BigData Now current perspective from O'Reilly Media
	2.	Data-Intensive Text Processing with MapReduce, Jimmy Lin and Chris Dyer
Reference Books	1.	V. Ankam, Big Data Analytics, Packt Pub Ltd.
	2.	N. Dasgupta, Practical Big Data Analytics, Packt Pub Ltd.
online TL Material	1.	https://www.udemy.com/big-data-hadoop-the-complete-course/
	2.	https://www.cloudera.com/more/training/certification.html
	3.	https://www.edureka.co/big-data-and-hadoop https://www.simplilearn.com/big-data-and-analytics/big-data-and-hadoop-training

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.Tech.) DEGREE COURSE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IOT

Subject: **Big data Analytics**   Subject Code: **BTechIOT-603 T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/Week (Practical)	1	25	25	50

Sr.No.	List of Experiments
1	To install Hadoop framework, configure it and setup a single node cluster. Use web based tools to monitor your Hadoop setup
2	To implement file management tasks in Hadoop HDFS like adding,retrieving and deleting files
3	To implement a word count application using the MapReduce API.
4	Creating the HDFS tables and loading them in Hive
5	To create HDFS tables and load them in Hive and implement joining of tables in Hive.
6	To install, deploy & configure Apache Spark Cluster. To Select the fields from the dataset using Spark SQL. To explore Spark shell and read from HDFS
7	To install and run Pig and then write Pig Latin scripts to sort, group, join, project, and filter your data
8	To perform Graph analytics and visualization using Tableau.
9	To implement basic functions and commands in R Programming. better visualization than a data table
10	To use following platforms for solving any big data analytic problem of your choice. (1) Amazon web services,(2) Microsoft Azure, (3)Google App engine

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: MEMS & SOC (Elective-II)   Subject Code: **BTECH_IIOT-604T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs (Theory)	3	30	70	100

Prerequisite(s):

Course Objectives:

1	To understand Standard microfabrication techniques and the issues surrounding them.
2	To understand Major classes, components, and applications of MEMS devices/systems and
3	to demonstrate an understanding of the fundamental principles behind the operation of these

Course Outcomes:

At the end of the course students will able to:

CO1	Apply working principles of currently available microsensors, actuators used in Microsystems.
CO2	Apply scaling laws that are used extensively in the conceptual design of micro devices and systems.
CO3	Apply the basic principles and applications of micro-fabrication processes, such as photolithography, ion implantation, diffusion, oxidation, CVD, PVD, and etching.
CO4	Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process
CO5	Explain recent advancements in the field of MEMS and devices.

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Syllabus:

UNIT 1: Introduction to MEMS	[06 Hours]
Benefits of Miniaturization, Types of MEMS (Sensors & Actuators): Optica MEMS, Bio-MEMS, molecule-based biosensors , cell-based biosensors, RF MEMS, ,Microfludics, Pressure sensor, Accelerometer, Micro-mirror TV Projector,chemical sensors & actuators and electrophoresis: thermal sensors, magnetic sensors.	
UNIT 2 : Microfabrication and Micromachining	[0 8 Hours]
Integrated Circuit Processes, Bulk Micromachining, Surface LIGA process , wet & dry etching processes , Device fabrication using Surface Micromachining example, Microcantilever fabrication.	
UNIT 3: RF MEMS Devices	[08 Hours]
Capacitor, Inductor, Switches, and antennas, RF MEMS components in communications, space and defense applications.	
UNIT 4: Micro System Packaging	[06 Hours]
Overview of mechanical packaging of microelectronics micro-system packaging.	
UNIT 5: Introduction to system-on-chip	[07 Hours]
Design of system on chip , Microsystems technology and applications, core architecture for digital media and the associated compilation techniques.	

TEXT BOOKS:

1." Micro and Smart Systems", Ananthasuresh, G. K., Vinoy, K. J., Gopalakrishnan, S., Bhat, K. N., and Aatre V.K., Wiley-India, NewDelhi, 2010.

2."Micromachined Transducers Sourcebook" , Kovacs, Gregory T. A, McGraw-Hill Publications

REFERENCE BOOKS:

1. VLSI Technology, Sze S.M. (ed), McGraw Hill Publications.

2. RFMEMS and Their Applications: Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, 2002.

3. "MEMS Practical Guide to Design, analysis and Applications", Jan G Korvinik and Oliver Paul William Andrew, Inc Springer.

4. "MEMs & Microsystem Design and Manufacture", Tai-Ran Hsu, McGraw Hill Publication.

5. "MEMs", Nitaigour Premchand Mahalik, McGraw Hill Publications

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: **Intelligent sensor and Instrumentation (Elective II)**   Subject Code: **BTECH_IIOT-604T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite: Digital Electronics

Course Objective

1	Study the concepts of intelligent sensor and instrumentation
2	Learn the various technics to measure the physical quantity using smart sensor
3	Introduce the concepts of data acquisition and applications of smart sensor

Couse Outcome

At the end of the course students will be able to :

CO1	Analyse Classification & selection of sensors
CO2	Compute and measure various physical quantity using transducers
CO3	Analyze the performance of the virtual instrumentation
CO4	Apply various diversity techniques in data acquisition methods
CO5	Design various application using smart sensor

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Syllabus:

Unit- I: Sensors & Transducer: Definition, Classification &selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm& piezoelectric sensor.	[07 Hours]
Unit-II: Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging. Measurement of position using Hall effect sensors, Proximity sensors: Inductive &Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic& Capacitive.	[08 Hours]
Unit -III: Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters &graphs, Structures: Case, Sequence & Formula nodes, Need Of software based instruments for industrial automation.	[07 Hours]
Unit-IV: Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types ofADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor andR-2R Ladder type, Use of Data Sockets for Networked Communication.	[07 Hours]
Unit V: Intelligent Sensors: General Structure of smart sensors &its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.	[07 Hours]
Text Books: 1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition2013 2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013. 3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994. 4. Gary Johnson / Lab VIEW Graphical Programing II Edition /McGraw Hill 1997.	
Reference Books: 1. Arun K. Ghosh, Introduction to measurements andInstrumentation, PHI, 4th Edition 2012. 2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation& Measurement Techniques, PHI – 2001 3. Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition2012, Oxford University Press.	

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Subject: Robotics and Intelligent System (Elective II)   **Subject Code: BTECH_IIOT-604T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite: Artificial Intelligence

Course Objective:

1	Study the concepts of Artificial Intelligence.
2	Learn the methods of solving problems using Artificial Intelligence.
3	Introduce the concepts of Expert Systems and Machine learning.

Course Outcome:
At the end the course the Student will be able to:

CO1	Identify problems that are amenable to solution by AI methods.
CO2	Identify appropriate AI methods to solve a given problem.
CO3	Formalize a given problem in the language/framework of different AI methods.
CO4	Summarize the learning methods adopted in AI
CO5	Design and perform an empirical evaluation of different algorithms on a problem formalization. 6. Illustrate the applications of AI in Robotic Applications.

Syllabus:

Unit 1: Introduction	[07 Hours]
History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.	
Unit 2: Problem Solving	[07 Hours]
Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning– knowledge representation – first order logic	
Unit3: Planning	[07 Hours]
Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.	
Unit 4: Reasoning	[08 Hours]
Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions. Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.	
Unit 5: AI In Robotics:	[07 Hours]
Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.	

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2016.

2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems".. Harlow: AddisonWesley, 2002.

Reference Books:

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.

2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2000. 3. Francis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.

4. Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.

5. Michael Brady, Gerhardt, Davidson, "Robotics and Artificial Intelligence", Springer, 2012.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE

SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Block chain and cyber security (Elective II)   **Subject Code: BTECH_IIOT-604T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Prerequisite(s): Network Security

Course Objectives:

1	To learn fundamentals of Cyber Security.
2	Obtain knowledge about technologies of Blockchain.
3	To learn different models and their application.

Course Outcomes:

At the end of this course students are able to:

CO1	Explain fundamentals of Cyber Security and Blockchain Technology
CO2	Learn models of Blockchain.
CO3	Analyze and demonstrate ethereum.
CO4	Analyze and demostrate Hyperledger fabric.

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Syllabus:

UNIT I: Introduction to Cyber Security: Private and Public Key Cryptography, RSA algorithm, Hash Functions SHA-256, SHA-512 algorithms, and Digital signatures, Message Authentication HMAC, MD5	**[07 Hours]**
Unit II: Digital Cash, Bitcoin Blockchain -Wallet -Why Nakamoto came up with Block chain cryptocurrency-Merkley Tree, transaction variability, Double spending, Bitcoin challenges and solutions.	[07Hours]
Unit III: Models f-GARAY, RLA model, proof of work, proof of state, Consensus Algorithm in Blockchain Byzantine General Problems.	[08Hours]
UNIT IV: Smart Contract Tools and Hands-on -Ethereum Virtual Machine(EVM), wallets, introduction to solidity, attacks on smart contracts.	[07Hours]
UNIT V Introduction to Hyper Ledger fabric, mechanism in permissioned Blockchain, application of Blockchain in Cyber Security, limitation of Blockchain as a technology.	[07Hours]

Textbooks:

1. S.Shukla, M.Dhawan, S.Sharma, S.Venkateshan Blockchain technology: cryptocurrency and applications, Oxford University Press 2019.

2. Arvind Narayanan, Joseph Bonneau, Edverd Felten, Andrew Miller and Steaven GoldFeder, Bitcoin and Cryptocurrency technologies: A comprehensive introduction, Priceton University Press 2016.

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Open Elective-I- Current Trends and Technologies   **Subject Code: BTECH_IIOT-605T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objective

1	Gain fundamental knowledge of electronic communication.
2	Understand the technologies in Internet, eTechnologies & e-Learning
3	Learn the basics of Green Computing and its implementation in industries
4	Develop the understanding of concepts in Social Media

Course Outcome:
Upon successful completion of this course, the student will be able to:

CO1	Use the basics of internet for deployment of various servers and recourses
CO2	Design and implement technologies for e-Commerce and e-Learning.
CO3	Choose appropriate implementation of Green Computing.
CO4	Make use of Social Networking properly and securely.

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Syllabus:

UNIT I:	[07 Hours]
Fundamentals of Communications: Types of communication-Wired, wireless, mobile, Modes of transmission: Simplex, Half Duplex, Full Duplex Multiplexing techniques, History and evolution of wireless and mobile systems Transition and characteristics of 1G, 2G, 3G, 4G. Spectrum, regulations, and frequency allocation	
UNIT II:	[07 Hours]
Fundamental of INTERNET: History, Internet working, Connections, Internet services, The World Wide Web, Tools for the WWW, Web servers, Web browsers, Web page makers and editors, Plug-ins and delivery vehicles	
UNIT III:	[07 Hours]
e-Technologies: Electronic Commerce: Framework, Media Convergence of Applications, Consumer, Applications, Organization Applications, Electronic Payment Systems: Digital Token, Smart Cards, Credit Cards, Risks in Electronic, Payment System, Designing Electronic Payment Systems, Electronic Data Interchange (EDI): Concepts, Applications, (Legal, Security and Privacy) issues, EDI and Electronic Commerce, Standardization and EDI, EDI Software, Implementation, EDI Envelope for Message Transport, Internet-Based EDI.	
UNIT IV:	[08 Hours]
Green Computing: Introduction, Why Green Computing? Approaches to Green ComputingVirtualization, Power Management, Power supply, Storage Video Card, Display, IT Equipment, Recycling, Remote Conferencing & Telecommuting Strategies, Product longevity, Resource allocation, Termina servers, Operating system support, How to Implement? Industria implementations of Green Computing- Blackle, Fit-PC, Zonbu computer, Sunray thin client.	
UNIT V:	[07 Hours]
Social Networking: Definition, Overview of Social Networking Sites, Types of Social Networking Sites: General purpose, Niche. Advantages of Social Networking Sites, Drawbacks of Social Networking Sites, Features and Need of Social Networking, Security Issues with Social Networking Sites, Case Studies	

Text Books

1. Impact of E-Business Technologies on Public and Private Organizations, OzlemBak, Nola Stair

2. Mobile Computing, Tomasz Imielinski Henry F. Korth

3. Broadband telecommunications technology, Byeong Gi Lee, Minho Kang, Jonghee Lee

References

1, Introduction to broadband communication systems, Cajetan M. Akujuobi, Matthew, N. O. Sadiku

2. E-Learning Tools and Technologies, William Hortan, Katherine Hortan Wiley

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RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Open Elective-I-Embedded & Real Time System　　**Subject Code: BTECH_IIOT-605T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objective:

1	To give sufficient background for understanding of embedded systems design.
2	To give knowledge of RISC processor.
3	To understand connections of various peripherals with microcontroller based system
4	To study of embedded system design aspects.

Course Outcome:
Upon successful completion of this course, the student will be able to:

CO1	Outline the concepts of embedded systems
CO2	Describe the architecture of embedded systems
CO3	Describe the architecture and programming of ARM processor
CO4	Design embedded system based on RTOS and communication protocols. Model real-time applications using embedded-system concepts
CO5	Explain the basic concepts of real time operating system design

Syllabus:

UNIT I: EMBEDDED SYSTEM INTRODUCTION	[07 Hours]
History, Design challenges, Optimizing design metrics, Time to market, NRE and UNIT cost design metrics, Application of embedded systems and recent trends in embedded systems.	
UNIT II: EMBEDDED SYSTEM ARCHITECTURE	[08 Hours]
Hardware and software architecture, Processor selection for Embedded System, Memory Architecture and IO devices , Interrupt Service Mechanism ,Context switching, Device Drivers.	
UNIT III: ARM PROCESSOR	[07 Hours]
Architecture and Programming: RISC and CISC, ARM organization, ARM Programmers model,operating modes, Exception Handling, Nomenclature, Core Extensions, ARM Assembly Language Programming, Introduction to ARM instruction set	
UNIT IV: PROTOCOLS	[07 Hours]
Bluetooth, IEEE 802.11 and IEEE 802.16, GPRS, MODBUS CAN, I2C and USB	
UNIT V: REAL TIME OPERATING SYSTEM CONCEPTS	[07Hours]
Architecture of the kernel, Task scheduler, ISR, Semaphore, Mailbox, Message queues, Pipes, Events, Timers, Memory Management.	

TEXTBOOKS:

1) Raj Kamal, "Embedded Systems ", TMH Publications.

2) Frank Vahid, "Embedded System Design", Wiley Publications, New edition 2001.

3) Sloss endrew & Dominic Symes, "ARM system Developers Guide", Morgan Kaufmann , 2004 .

Reference Books:

1) Dr. K.V.K.K. Prasad , "Embedded / Real Time Systems", Dreamtech Publications

2) Iyer, Gupta , "Embedded Real systems programming", TMH Publications.

3) Steve Heath, "Embedded System Design", Neuwans Publications

4) Jonathan,W. Valvano, " Embedded Microcomputer System Realtime Interfacing", Cenage Publications, 3 rd Edition.

Subject: Open Elective-I- INDUSTRY 4.0 & IoT   **Subject Code: BTECH_IIOT-605T**

Load Th	Credits Th	College Assessment Marks	University Evaluation	Total Marks
3 Hrs(Theory)	3	30	70	100

Course Objective:

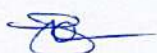|	
1	Able to learn an introduction to Industry 4.0 (or the Industrial Internet)
2	Will able to understand its applications in the business world.
3	Will able to understand Business Model and Reference Architecture in Industry
4	Will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

Course Outcome:

Upon successful completion of this course, the student will be able to:

CO1	Explain the basics of IoT and basics of Industry 4.0.
CO2	Apply Business Model and Reference Architecture
CO3	Explain the different Business issues in Industry 4.0 and how to solve them.
CO4	Explain the need of Security and Fog Computing and applications of IIoT.

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Syllabus:

UNIT I : Introduction to Industry 4.0: History, Concept, The Journey so far: Developments in USA, Europe, China and other countries, The Fourth Revolution, Compelling Forces and Challenges for Industry 4.0, Comparison of Industry 4.0 Factory and Today's Factory, Globalization and Emerging Issues.	[07 Hours]
UNIT II: Basics of Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Life-cycle Management, Augmented Reality and Virtual Reality, Introduction to Artificial Intelligence, Big Data and Advanced Analysis, Cyber-Security in Industry 4.0, Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems.	[07 Hours]
UNIT III: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking.	[07 Hours]
UNIT IV: Security and Fog Computing: Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT. Application Domains: Factories and Assembly Line, Food Industry, Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications)	[08 Hours]
UNIT V: Industrial IOT- Application domain: Milk Processing and Packaging Industries, Manufacturing Industries, Virtual Reality Lab, Steel Technology Lab. Facility Management, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries. Facility Management.	[07 Hours]

TEXTBOOKS:

1. Industry 4.0: The Industrial Internet of Things , Alasdair Gilchrist, Apress

2. Industrial Internet of Things: Cyber manufacturing Systems, Sabina Jeschke, ChristianBrecher, Houbing Song, Danda B. Rawat, Springer

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Organization Behaviour　　　　　　　　**Subject Code: BTechIOT-606T**

Load	Credits	College Assessment Marks	University Evaluation	Total Marks
2 Hrs/week	Audit Course	Grades to be awarded based on internal assessment		

Course Objective:

1.	The objective of the course is to create awareness among learners about the various essential aspects of organizational processes and structure and motivation in organization.

Course Outcome:
By the end of the course, students will be able to

CO1	Explain the concept and importance of organizational behaviour.
CO2	Acquire the knowledge of interpersonal behaviour and transaction analysis
CO3	Know different traits and theories of personality
CO4	Analyze the importance of motivation in organization and types of leadership

Syllabus:

Unit 1. Introduction to organizational behaviour. Concept of organization behaviour, Importance of organization behaviour, Key elements of organization behaviour, scope of organizational behaviour.
Unit 2: Introduction to interpersonal behaviour. Nature and meaning of interpersonal behaviour, concept of transaction analysis, benefits and uses of transaction analysis, Johari window model.
Unit 3: Introduction to personality Definition and meaning of personality, importance of personality, theories of personality, personality traits.
Unit 4: Introduction to Motivation and leadership. Concept and importance of motivation, Maslow's theory of motivation. Significance of motivation in organization. Types of leadership styles.
List of books 1. Organizational behaviour by MN Mishra, published by S.Chand.

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2. The human side of organization by Michale Drafke, published by Pearson education.

3. Management and Organizational behaviour by Laurie.J. Mullins, published by Pearson education.

4. Organizational behaviour by K. Aaswathappa, Published by Himalaya publications.

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FOUR YEAR BACHELOR OF TECHNOLOGY (B.TECH) DEGREE
SEMESTER: VI (C.B.C.S.)

BRANCH: Industrial IoT

Subject: Mini Project/ Internship　　　　　　**Subject Code: BTechIOT-607P**

Load Pr	Credits	College Assessment Marks	University Evaluation	Total Marks
6 Hrs.	3	25	25	50

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