EKLAVYA UNIVERSITY
ज्ञान प्राप्तये लक्ष्य संधानम्
Estd. by Madhya Pradesh Niji Vishwavidyalaya (Sthapna Avam Sanchalanal Adhyadesh, 2020

SCHOOL OF ENGINEERING

SYLLABUS

INTERNET OF THINGS

Class	**M.TECH. - IOT**	**L**	**T**	**P**	**C**
Semester/Year	**III/II**	**3**	**-**	**-**	**3**
Subject Name	**Microcontrollers for IOT Prototyping**				
Subject Code	**MCSIOT20S301**				
Paper **English**					
Hindi					
Max. Marks	**100**				

Course Objective:

1. Introduce low power microcontrollers and to develop the skill set of programming low power sensing applications.
2. Impart the knowledge of various peripheral related to sensing and communication using wired or wireless means.
3. Upgrade the students by introducing Advanced ARM Cortex microcontrollers.
4. Develop the skill set of students to build IoT systems and sensor interfacing.

Course Outcomes:

After completion of course, students would be:

CO1. Design and develop embedded programs for low power microcontrollers for sensor applications.
CO2. Develop ARM basic and advanced programs.
CO3. Interface and deploy analog and digital sensors.
CO4. Develop communication system with sensor units.
CO5. Design and develop IoT systems using Wi-Fi CC3200.

Unit	Syllabus	Periods
UNIT - I	**Microcontrollers:** Architecture of the MSP430, Memory, Addressing modes, Reflections on the CPU instruction set. Clock system, Exceptions: Interrupts and resets. Functions and subroutines, Mixing C and assembly language, Interrupts, Interrupt service routines, Issues associated with interrupts Low power modes of operation.	**12**
UNIT - II	**ARM Cortex MX microcontroller:** ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations, Advanced Cortex MX Microcontroller, core, architecture, on-chip wi-fi.	**10**
UNIT - III	**Display and Communication modules:** GPIO, LCD display, graphical display, relays, Peripheral programming SPI, I2C, UART, Zigbee controller.	**10**
UNIT - IV	**Sensors interfacing:** Sensors interfacing techniques- Port Programming, ADC, SPI thermometer, I2C thermometer, PWM generation and demodulation, DTH11, single wire thermometer, Frequency counters.	**12**
UNIT - V	**Microcontrollers for IoT:** ESP8266, NodeMCU,TI-CC3200,Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards. **Single board computers:** Raspberry pi board, porting Raspbian, sensor interface examples, Python programming for cloud access, sensor systems using Arduino boards. **Cloud interfacing:** Interfacing and data logging with cloud: Thing speak, Things board, Blync platform.	**12**

TEXT BOOKS:

1. John H. Davies, "MSP430 Microcontroller Basics", 2011, 2nd ed., Newnes publishing, New York.
2. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 2014, 4th ed., Springer, New York

REFERENCE BOOKS:

1. Sergey Y. Yurish,"Digital Sensors and Sensor Systems: Practical Design", 2011, 1st ed., IFSA publishing, New York.
2. Jonathan W Valvano, "Introduction to ARM Cortex –M3 Microcontrollers", 2012, 5th ed., Create Space publishing, New York.
3. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi, Sepehr Naimi, "TI ARM Peripherals Programming and Interfacing: Using C Language", 2015, 2nd ed., Mazidi and Naimi publishing, New York.

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Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Wireless Sensor Networks and IOT**				
Subject Code		**MCSIOT20S302**				
Paper	**English**	**English**				
	Hindi					
Max. Marks		**100**				

Course Objectives:

1. To identify and expose the students to the central elements in the design of communication protocols for the WSNs.
2. To disseminate the design knowledge in analysing the specific requirements for applications in WSNs regarding energy supply, memory, processing, and transmission capacity.
3. To get the perception of mobile ad hoc networks, design, implementation issues, and solutions based on different algorithms and protocols for power management, sensor data routing and query processing.
4. To associate, hardware platforms and software frameworks used to realize dynamic Wireless sensor network.

Course Outcomes:

After completion of course, students would be able to:

CO1. Assess the applicability and limitations of communication protocols for a real time WSN application.

CO2. Confirms the behaviour of mobile ad hoc networks (MANETs) and correlates the infrastructure based networks.

CO3. Proactive in understating the routing protocols function and their implications on data transmission delay and bandwidth.

CO4. Able to establish networks with an attempt to reduce issue of broadcast and flooding techniques.

CO5. Contribute appropriate algorithms to improve existing or to develop new wireless sensor network applications.

Unit	Syllabus	Periods
UNIT – I	**Network for embedded systems:** RS232, RS485, SPI, I2C, CAN, LIN, FLEXRAY. **Embedded wireless communication and Protocols:** Bluetooth, Zigbee, Wifi, MiWi, Nrf24, Wireless LAN &PAN, UWB.	**8**
UNIT – II	**Wireless sensor network (WSN):** Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.	**12**
UNIT – III	**WSN (Medium access control):** Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC – BMAC, Traffic-adaptive medium access protocol (TRAMA), The IEEE 802.15.4 MAC protocol.	**12**
UNIT – IV	**Sensor Network Architecture:** Data Dissemination, Flooding and Gossiping-Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs- Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling.	**12**
UNIT – V	**IP based WSN:** Circuit switching, packet switching, concept of IPV4, IPV6, 6LOWPAN and IP, IP based WSN, 6LOWPAN based WSN. **Tiny OS:** Tiny OS for WSN and IoT, M2M communication, All joyn network.	**10**

TEXT BOOKS:

1. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks” 2011, 1 st ed., John Wiley & Sons, New Jersey.
2. Jun Zheng, Abbas Jamalipour, “Wireless Sensor Networks: A Networking Perspective”, 2014, 1 st ed., Wiley-IEEE Press, USA.

REFERENCE BOOKS:

1. Waltenegus W. Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 2014, 1 st ed., John Wiley & Sons, New Jersey.
2. Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", 2011, 1 st ed., John Wiley & Sons, New Jersey.
3. Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", 2009, 1 st ed., John Wiley & Sons, New Jersey.

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Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Signal Processing and Data Analytics Decision Support System**				
Subject Code		**MCSIOT20S303**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:

1. To introduce the concepts of discrete time signal processing and the characterization of random signals.
2. To present the basic theory of modeling the signals and the methods of estimating the unknowns using prediction filters.
3. To provide a comprehensive understanding on applying FFT, DCT, and wavelet techniques for extracting the signal features.
4. To provide an overview of analysing big data using intelligent techniques and an in-depth introduction to two main areas of Machine Learning: supervised and unsupervised.

Course Outcomes:

After completion of course, students would be:

CO1. Apply FFT, DCT wavelet techniques for extracting the features from the big data.

CO2. Develop algorithms that can be used to analyse the real-world univariate and multivariate time series data.

CO3. Design an approach to leverage data using the steps in the machine learning process.

CO4. Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.

CO5. Estimate the signal parameters and identify the model using ARMA models and prediction filters.

Unit	Syllabus	Periods
UNIT - I	**Discrete Random Signal Processing:** Random Processes, Ensemble Average, Gaussian Process, Multi variate Gausssian Process, Stationary process, Autocorrelation, Auto Covariance, Ergodicity, White noise, Power Spectrum, Filtering of Random Process.	**12**
UNIT - II	**Signal Modeling:** ARMA, AR, MA Models. Wiener filter, Linear prediction, Kalman Filter. **Feature extraction:** FFT, Power spectrum, DCT, filter banks, Wavelet, Wavelet Packets, Cepstrum.	**10**
UNIT - III	**Time series analysis:** Basic analysis, Univariate time series analysis, Multivariate time series analysis, non stationary time series. **Reduction of dimensionality:** Bayesian decision, Linear discrimination, Principal Component analysis, SVD, Independent Component Analysis.	**12**
UNIT - IV	**Machine learning:** Supervised learning, generative algorithms, Support Vector machines, Unsupervised learning, K means clustering, Neural network (SOM, ART), and Expectation maximization.	**10**
UNIT - V	**Big Data Analytics** Introduction Big data analytics, visualization and data exploration, basic and intermediate analysis, linear and logistic regression, decision tree.	**12**

TEXT BOOKS:

1. J. G. Proakis, DG. Manolakis and D. Sharma, "Digital signal processing principles, algorithms and applications", 2012, 4th ed., Person education, USA.
2. Sophocles J. Orfanidis, "Inroduction to signal Processing" 2010, 2nd ed., Prentice Hall, New Delhi India.

REFERENCE BOOKS:

1. Oppenhiem V. A.V and Schaffer R. W, "Discrete- time signal Processing", 2014, 3 rd ed., Prentice Hall,. New Delhi, India.
2. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", 2016, 2 nd ed., Springer Verlag, UK.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" 2012, 1 st ed., MIT Press, USA.

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Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Fiber Optic Sensors and Phototonics**				
Subject Code		**MCSIOT20S304**				
Paper	**English**	**English**				
	Hindi					
Max. Marks		**100**				

Course objective:

1. To introduce the theory and technology of fiber optics sensing to improve their understanding in rapidly growing field.
2. To predict the optical parameters in optical devices to understand the phenomena induced due to intensity based effects.
3. To estimate the phase, charge distribution due to polarization effects and its application in optical sensing.
4. To analyses and decide the process flow conditions and steps involved for different polymers with appropriate optical characteristic for polymer waveguides based sensing.

Course Outcomes:

After completion of course, students would be:

CO1. Attainment of basic knowledge of optical waveguides and optical devices employed in optical sensors.

CO2. Conversance in optical parameters involved in active and passive components.

CO3. Entrust the characteristics of a suitable optical materials for the sensing device in a given application.

CO4. Identify and apply the knowledge in designing interferometric devices which is more effectively used in sensing.

CO5. Aware of different polymers and their chemical, optical characteristics to formulate miniaturized optical devices.

Unit	Syllabus	Periods
UNIT - I	**Theory of Optical Waveguides**: Wave theory of optical waveguides, formation of guided modes, Slab waveguide, Rectangular waveguide, Radiation fields from waveguide, Effective index method, Marcatili's method, Beam propagation method. Basic characteristic of Optical Fiber Waveguides, Acceptance angle, Numerical aperture, skewrays-Electromagnetic Modes in Cylindrical Waveguides.	**12**
UNIT - II	**Active and Passive Optical Components:** Electro-optic and acousto optic wave guide devices, directional couplers, optical switch, phase and amplitude modulators,filtersetc,Yjunction,powersplitters,arrayedwaveguidedevices,fiberpigtailing, endfiber prism coupling, FBG and fabrication of FBG, Tapered couplers.	**10**
UNIT - III	**Intensity and Polarization Sensors:** Intensity sensor: Transmissive concept –Reflective concept-Micro bending concept–Transmission and Reflection with other optic effect-Interferometers –Mach Zehnder-Michelson-Fabry-Perot and Sagnac– Phase sensor: Phase detection-Polarization maintaining fibers. Displacement and temperature sensors: reflective and Micro bending Technology- Applications of displacement and temperature sensors.	**10**
UNIT - IV	**Interferometric Sensors:** Pressure sensors: Transmissive concepts, Micro bending –Intrinsic concepts–Interferometric concepts, Applications. Flow sensors: Turbine flow meters- Differential pressure flow sensors –Laser Doppler velocity sensors-Applications- Sagnac Interferometer for rotation sensing. Magnetic and electric field sensors: Intensity and phase modulation types– applications.	**12**
UNIT - V	**Polymer based waveguide in sensing:** Polymer based waveguide, materials, properties, fabrication process of polymer based waveguide, Polymer based optical components - Passive, Active polymer devices, Ring Resonator, structure, theory, Filter using Ring Resonator-application in sensing. **Fiber based Chemical Senors:** Fiber based Chemical Sensing: Absorption, Fluorescence, Chemi-luminescence, Vibrational Spectroscopic, SPR. **Fiber based Bio-Senors:** Fiber based Bio-molecules sensing: High Index, SPR, Hollow core fiber probes, Label Free biomolecules.	**10**

TEXT BOOKS:

1. David A. Krohn, Trevor W. MacDougall, Alexis Mendez, "Fiber Optic Sensors: Fundamentals and Applications" SPIE Press, 4th ed. 2015. ISBN: 1628411805.
2. Eric Udd , William B. Spillman Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists", Wiley, 2nd Ed., 2011. ISBN: 0470126841.

REFERENCE BOOKS:

1. Zujie Fang & et. al., "Fundamentals of Optical Fiber Sensors" Wiley, 1st Ed., 2012.
2. Shizhuo Yin, Paul B. Ruffin, and Francis T.S. Yu, "Fiber Optic Sensors", CRC Press, 2 Ed, 2017.
3. F.Baldini & etal, “Optical Chemical Sensors”, NATO Science Series II: Mathematics, Physics and Chemistry, Springer, 2008.

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INTERNET OF THINGS

Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Big Data and Cloud Computing**				
Subject Code		**MCSIOT20S305**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:

1. To study the basic technologies that forms the foundations of Big Data.
2. To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications.
3. To understand the specialized aspects of big data including big data application, and big data analytics.
4. To study different types Case studies on the current research and applications of the Hadoop and big data in industry.

Course Outcomes:

Upon completion of the course The students will be able to.

CO1. Describe the concepts and technologies of big data analytics.
CO2. Apply the techniques in handing and analysis of big data.
CO3. Discuss the concepts and terminologies of cloud computing.
CO4. Demonstrate cloud frameworks and technologies.
CO5. Describe and apply fine data intensive computing.

Unit	Syllabus	Periods
UNIT - I	Introduction To Big Data: Characteristics of Data, Evolution of Big Data, Definition of Big Data, Challenges with Big Data, Other Characteristics of Data, Traditional Business Intelligence (BI) versus Big Data, A Typical Data Warehouse Environment, A Typical Hadoop Environment, Big Data Analytics: Classification of Analytics, Top Challenges Facing Big Data, Data Science, Few Top Analytics Tools.	**12**

UNIT - II	**Frameworks, Tools & Visualization**: Installing and Running Pig & Hive, Applications on Big Data Using Pig and Hive, Pig Latin, User Define Functions, Data processing operators in Pig , Hive services , HiveQL , Querying Data in Hive, User Define Functions, fundamentals of HBase and Zookeeper , Oracle Big Data. Visualizations: Visual data analysis techniques, interaction techniques; Systems and applications.	**12**
UNIT - III	Introduction: Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Computing Platforms and Technologies.	**10**
UNIT - IV	Virtualization: Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples.	**10**
UNIT - V	Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Types of Clouds, Economics of the Cloud, Open Challenges, Aneka: Cloud Application Platform: Framework Overview, Anatomy of the Aneka Container, Building Aneka Clouds, Cloud Programming and Management.	**10**

TEXT BOOKS:

1. Big Data and Analytics – Seema Acharya, Subhashini Chellappan Willey India ISBN 13 9788126554782.
2. Mastering Cloud Computing – Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi McGraw Hill Education.

REFERENCE BOOKS:

1. Big Data Analytics with R and Hadoop – Vignesh Prajapati, 2013 Packt Publishing.
2. Cloud Computing Bible – Barrie Sosinsky, Wiley-India, 2010.
3. Cloud Computing: A Practical Approach – Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill Professional Publications, 2009. [ISBN: 0071626956].

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Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**3**	**-**	**-**	**3**
Subject Name		**Real Time Operating System Embedded System OS**				
Subject Code		**MCSIOT20S306**				
Paper	**English**					
	Hindi					
Max. Marks		**100**				

Course Objectives:

1. The objective of the subject is to provide understanding of the techniques essential to the design and implementation of device drivers and kernel internals of embedded operating systems.
2. This syllabus provides the students with an understanding of the aspects of the Realtime systems and Real-time Operating Systems and to provide an understanding of the techniques essential to the design and implementation of real-time embedded systems.

Course Outcomes:

At the end of the course, the student should be able to

CO1. Understand the Embedded Real Time software that is needed to run embedded systems.
CO2. Understand the open source RTOS and their usage.
CO3. Understand the VxWorks RTOS and real-time application programming with it.
CO4. Build device driver and kernel internal for Embedded OS & RTOS.
CO5. Testing a real time application on the board.

Unit	Syllabus	Periods
UNIT - I	Embedded OS (Linux) Internals Linux internals: Process Management, File Management, Memory Management, I/O Management. Overview of POSIX APIs, Threads – Creation, Cancellation, POSIX Threads Inter Process Communication – Semaphore, Pipes, FIFO, Shared Memory Kernel: Structure, Kernel Module Programming Schedulers and types of scheduling. Interfacing: Serial, Parallel Interrupt Handling Linux Device Drivers: Character, USB, Block & Network.	**12**

UNIT - II	Open source RTOS Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS, Basic architecture of an RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models.	**10**
UNIT - III	Interrupt management in RTOS environment, Memory management, File systems, I/O Systems, Advantage and disadvantage of RTOS. POSIX standards, RTOS Issues – Selecting a Real Time Operating System, RTOS comparative study.	**10**
UNIT - IV	VxWorks / Free RTOS VxWorks/ Free RTOS Scheduling and Task Management – Realtime scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems – General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral.	**10**
UNIT - V	Case study Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board ().Testing a real time application on the board.	**10**

TEXT BOOKS:

1. Qing Li, "Real Time Concepts for Embedded Systems", 2011, Elsevier.
2. Essential Linux Device Drivers, Venkateswaran Sree krishnan.
3. Writing Linux Device Drivers: A Guide with Exercises, J. Cooperstein.

REFERENCE BOOKS:

1. Rajkamal, "Embedded Systems- Architecture, Programming, and Design", 2007, TMH.
2. W. Richard Stevens, Stephan A. Rago, "Advanced UNIX Programming", 2006, 2nd Edition, Pearson.
3. Dr. Craig Hollabaugh, "Embedded Linux: Hardware, Software and Interfacing", 2008, 1st Edition, Pearson.
4. Embedded Systems Architecture Programming and Design: Raj Kamal, Tata McGraw Hill.
5. Software Design for Real-Time Systems: Cooling, J E Proceedings of 17the IEEE Real-Time Systems Symposium December 4-6, 1996 Washington, DC: IEEE Computer Society.
6. Real-time Systems – Jane Liu, PH 2000 5. Real-Time Systems Design and Analysis: An Engineer's Handbook: Laplante, Phillip.

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Class		**M.TECH. – IOT**	**L**	**T**	**P**	**C**
Semester/Year		**III/II**	**-**	**-**	**20**	**10**
Subject Name		**Dissertation I**				
Subject Code		**MCSIOT20S307**				
Paper	**English**					
	Hindi					
Max. Marks		**250**				

Course Objective:

1. To undertake a substantial in-depth study of a specific topic in Computer Science, Software Engineering, Internet of Things.

Course Outcomes:

At the end of the course, the student will be able to:

CO1. Identify Computer Science engineering problems reviewing available literature.

CO2. Identify appropriate techniques to analyse complex Computer Science systems.

CO3. Apply engineering and management principles through efficient handling of project.

Syllabus

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem and End Sem will be monitored by the departmental committee.

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Class		**M.TECH. - IOT**	**L**	**T**	**P**	**C**
Semester/Year		**IV/II**	**-**	**-**	**32**	**16**
Subject Name		**Dissertation II**				
Subject Code		**MCSIOT20S401**				
Paper	**English**					
	Hindi					
Max. Marks		**500**				

Course Objective

Extension of the work on the topic identified in Dissertation – I.

Course Outcomes:

At the end of the course, the student will be able to:

1. Solve complex Computer Science problems by applying appropriate techniques and tools.

2. Exhibit good communication skill to the engineering community and society.

3. Demonstrate professional ethics and work culture.

Syllabus

Dissertation – II will be extension of the work on the topic identified in Dissertation – I.

Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.