This M.Tech programme is intended to generate trained academic and research personnel in the highly demanding, useful and emerging area of wireless networks. The programme includes core subjects from wireless communications, computer science, computer networks, advanced topics in wireless communications, mobile computing, sensor networks, embedded systems, internet-of-things, signal processing, multimedia systems, machine learning, big data analysis, and applications such as landslide detection, environmental monitoring, etc. Building on a very successful joint project called WINSOC with about a dozen international partners, this new M-Tech program was introduced with a view to strengthen the academic and research activities in this highly advanced topics: Wireless Networks and Applications.

Students, when they graduate, will be well trained to enter into a broad spectrum of industries such as computers, communication networks, internet of things, earth sciences, environmental sciences, disaster management, health care, e-governance activities, bio and nano-technologies, VLSI and embedded systems, agriculture and chemical industries and strategic planning.
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**Specialization II: Mobile Networks**

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**Specialization III: Wireless Systems and Application**

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</table>
18WN601 SIGNAL PROCESSING FOR WIRELESS COMMUNICATION 2-0-1-3

Basics of Signals and Systems: Sampling, Reconstruction, Quantization, Discrete-Time Systems.
Lab: Implementation using MATLAB/SystemVue.

TEXT BOOKS/REFERENCES:

18MA614 PROBABILITY AND STATISTICAL INFERENCE 2-0-1-3

Introduction to Probability, Conditional Probability, Bayes’ theorem; Random Variables, Analysis of discrete and continuous random variables, Probability Distributions, Distribution Functions, Mean and Variance of random variables, Standard Discrete and Continuous Distributions and their properties; Analysis of Joint Probability Distributions of discrete and continuous random variables, Two or more random variables, Joint, Marginal and Conditional Probability Distributions, independence of random variables, Covariance and correlation, Linear functions of random variables, several functions of random variables, Convergence of random variables, Law of Large Numbers, Central Limit Theorem.

Point estimation of Parameters and Sampling distributions: General concepts of point estimation, Methods of point estimation, method of moments, method of maximum likelihood, Bayesian estimation of parameters, Interval estimation, Confidence interval for the mean and variance of a normal population, large sample confidence interval for population proportions; Hypothesis Testing, general concepts, tests on mean and variance of one and two normal populations, tests on population proportion, testing for goodness of fit and independence; Introduction to nonparametric statistics, sign test, Wilcoxon signed rank test, Wilcoxon rank sum test.

TEXT BOOKS/REFERENCES:


**TEXT BOOKS/REFERENCES:**
4. NFV architecture document from ETSI NFV.

Programming in C, Basic Computer Organization and Architecture, Build and Compilation process, Debugging concepts, Data Types and Variables, Input/ Output implementation and usage, Control flow, Modular Programming with functions, Stack Frames and Activation Records, Arrays, Pointers, Strings, Structures, Implementation of Structures, Memory, Stacks, Recursion, Dynamic Memory Allocation, Heap, Program Runtime Analysis, Big-Oh Notation.

Significant labs, e.g., Spell Checker with a real dictionary, complicated data structure such as a Vector/Set, Customer Relationship Management system, custom string Abstract Data Type, Maze, etc.

**TEXT BOOKS/REFERENCES:**

Significant labs: Implementation of algorithms using a structured or object-oriented programming language.

TEXT BOOKS/REFERENCES:


Path Loss Models: Outdoor and Indoor Propagation Models, Signal Penetration into Buildings, Ray Tracing and Site Specific Modeling; Physical Modeling for Wireless Channels: Small-Scale Fading and Multipath Propagation, Input/output model of the wireless channel: The wireless channel as a linear time-varying system, Baseband equivalent model, discrete-time baseband model, Additive white noise. Time and frequency coherence: Doppler spread and coherence time, Delay spread and coherence bandwidth, Statistical characterization of channels, Rayleigh and Rician fading;

Capacity of Wireless Channel: AWGN channel capacity, Resources of AWGN channel, Linear time-invariant Gaussian channels, Capacity of fading channels, Frequency Selective Fading. Techniques for enhancing wireless channel capacity: Spatial channel characteristics; Introduction to Wireless MIMO Communications, Multiple Access Techniques: OFDMA, CDMA, SDMA. Wireless Link Improvement: Introduction to types of codes, Equalization techniques, Diversity methods.
Existing design analysis for application scenarios: Visible Light communication systems, communication systems for Healthcare applications, communication systems for nautical applications, communication systems for MM wave applications.

Wireless Communication Laboratory: Conduct hardware and software experiments on Noise analysis and channel modelling, Modulation, Power spectrum analysis and Noise analysis, MIMO systems.

**TEXT BOOKS/REFERENCES:**


**18WN622 EMBEDDED SYSTEM DESIGN 3-0-1-4**

Microcontroller fundamentals: ARM ASM programming and basic of C; IO Interfacing: LED and Switch; Design and Development Process: Architecture, Microarchitecture, Design, Implementation, Verification and Validation; Development Tools: Block Diagrams, Flow Charts, Call Graphs, Dataflow Graphs, Finite State Machines; The Parallel Interface: GPIO; The Serial Interface: UART, I2C, SPI; PLL programming; Timer: SysTick; Fixed Point; Software: Structs, Stacks and Recursion; Device Driver: Interfacing with an Hitachi HD44780 display; IO Synchronization; Interrupts; DAC: Music Synthesis and Music Playback; ADC: Real world interfacing and Data Acquisition.

Significant labs include prototypes of actual embedded systems, e.g., Traffic Light Controller (FSM), LCD Device Driver (Hitachi HD44780), Digital Piano (DAC, Interrupts), Digital Vernier Caliper (ADC, Interrupts, LCD), Distributed Data Acquisition (Interrupts, ADC, LCD, UART).

Capstone Design Project, A popular video game, e.g., Space Invaders, Connect-4, Pipe Dream, etc.

**TEXT BOOKS/REFERENCES:**


**18WN623 DESIGN OF WIRELESS SENSOR NETWORKS 2-0-1-3**


Routing: Design challenges in WSN, Flat Routing: SPIN, Directed Diffusion, Hierarchical routing: LEACH, PEGASIS, TTDD, Location based routing: GEAR, GPSR, QoS based routing: TBP, SPEED. Data Aggregation: Types and Challenges, MFS, TAG.


**TEXT BOOKS/REFERENCES:**


18WN624 MOBILE COMMUNICATION NETWORKS 2-0-1-3

**Foundation - 3G Network architecture-** Overall core architecture- Access Stratum and Non-Access Stratum- End to End Security Overview-Radio access network -Physical layer & protocols - Key Network and UE procedures: - Call set-up/release, Mobility management in idle mode and active mode (handover)

**Specialist - 4G/LTE/LTE-A, Small Cells-** Network evolution from 3G to Evolved Packet Core (EPC) and LTE Small Cells-Architecture changes compared to 3G-Air interface upgrades - LTE-pro, SON &HetNets

Convergence foundations- Unlicensed spectrum- Private Networks-Neutral Hosts-Wi-Fi Technology Evolution-Introductory concepts-LTE in Wi-Fi- Concepts of private networks and insights into Neutral host networks"

TEXT BOOKS/REFERENCES:

18RM602 RESEARCH METHODOLOGY

Overview of Research and its Methodologies: The need for research, Steps in conducting research; Pathway to research: Understanding the structure of a research paper, how to read and write a research paper, Familiarization with Research Tools.

Literature review: Need for literature review, Identify various sources of information for literature review and data collection, Steps to carry out a literature review.

Critical analysis: Critical analysis of top rated research papers including at least one survey paper and one or two good journal paper in the broad areas such as Wireless Communication, Wireless Networks, Wireless Sensor Networks, Internet of Things, Context Aware Systems, Participatory Sensing, Embedded Systems; Understand the research components of the selected paper such as problem definition, assumptions, solution, and solution methodology, Analyze the findings of the paper, Identify the research gaps.

Problem Formulation: Formulate a research problem based on the critical analysis.

Formulation and presentation of research proposals on selected topic.

TEXT BOOKS/REFERENCES:

18WN625 INTRODUCTION TO IoT PROGRAMMING


TEXT BOOKS/REFERENCES:


18WN626 INTERNET OF THINGS: ARCHITECTURE AND SYSTEM DESIGN

Internet of things: Internet of Things definitions and frameworks, Internet of Things application examples, Fundamental IoT mechanisms and key technologies, Evolving IoT standards, Layer 1/2 connectivity: wireless technologies for the IoT; Applications of IoT Scenarios such as Environmental monitoring, Disaster management, Smart city, Smart Building, Healthcare, Structural monitoring. Internet of Aerial (flying) Things

Architectures of IoT: Three Layer and Five Layer Architecture, Cloud and Fog Based architectures, Social IoT.


Network Layer: IPv6, 6LoWPAN, RPL, IPSec
Transport Layer: TLS1.3, DTLS, TCP, TCP/UDP.
Application Layer: HTTP, XXMPP, DPWS, SOAP, CoAP, MQTT.

Introduction to Security Mechanisms and Technologies for Constrained IoT Devices extending to block chain based security. Cloudification of IoT concepts covering architecture, deployment models, and foundational technology enablers including XML, SoA/ web services, networking protocols, GPS and GIS.
Laboratory Exercises: Prototype design of IoT Systems for a specific application: Network protocols, Transport protocols, Application protocols, security protocols.

TEXT BOOKS/REFERENCES:

2. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers
18WN701  ADVANCED SIGNAL PROCESSING  2-0-1-3


TEXT BOOKS/REFERENCES:
1. Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithmsand Application, PHI.
2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI

18WN702  DISTRIBUTED SYSTEMS  2-0-1-3


Communication: Fundamentals, Remote Procedure Call, Message Oriented Communication, Socket interface and messaging with sockets, Multicast Communication

Naming: Flat – Home based solutions, DHTs. Structured – Name Space, Name Resolution, Examples – DNS, NFS. Attribute based; Coordination: Clock synchronization, Lamport’s Logical clocks, Vector clocks, Mutual Exclusion, Global Positioning, Election Algorithms


TEXT BOOKS/REFERENCES:
18WN703  WIRELESS LOCAL AREA NETWORKS  2-0-1-3


Advanced Topics: Long Range Wi-Fi, Li-Fi, Passive Wi-Fi, 802.11ah (HaLow), 802.11af (White-Fi), 802.11ax, 802.11ay

Lab: WLAN Lab based on the above topics will be conducted using Wireless routers, APs, Wi-Fi enabled smart phones, tablets and laptops and Long Range Wi-Fi base stations and CPEs as well as using QualNet simulation platform.

TEXT BOOKS/REFERENCES:

18WN704  ADVANCED EMBEDDED SYSTEMS  2-0-1-3


OS Principles: Threads, FIFO, Memory Management; Hardware Software Synchronization, Timing, Interrupts; Timer, PLL, PWM, Period and Frequency Measurement.

**TEXBOOKS/REFERENCES:**


**18WN705 ANTEENNA DESIGN AND APPLICATIONS 2-0-1-3**


Overview and types of Antennas: VHF, UHF and Microwave Antennas- Dipole array with Parasitic Elements, Folded Dipoles, Microstripantennas, Yagi-Uda Antenna, LPDA, metamaterial antennas, Reflector Antennas, Horn antennas.

Antenna Arrays: Two element arrays, Multiplication of patterns, Linear Array with n -isotropic point sources of equal amplitude and spacing (Broadside, End fire Arrays), Scanning Arrays, N element linear array and directivity, Binomial Arrays- Uniform spacing and Non-uniform Amplitude.

Antenna Measurements – Patterns measurement-arrangement for radiation pattern, Distance requirements, Directivity and Gain Measurements. Integration of Antenna to RF Front end system with matching networks,

Mathematical modelling: Computational electromagnetics-Introduction to FDTD, The 1D wave equation, Integral interpretation of FDTD, Dispersion analysis in three dimensions, Boundary condition for open region. FEM, MOM

Antennas and channel modelling in millimetre wave wireless PAN LAN and MAN: Types of antennas in millimetre wave WPAN, WLAN, and WMAN. Traditional and Time reversal channel modelling for ultra-Wide band communications.

Application of Antennas in Upcoming research areas: Long Range Wi-Fi/ Satellite communication/ Biomedical/ High frequency applications.

**Lab:**

- Design and implementation of antennas Using HFSS:
- Modelling of Designed antennas (MatLab, FDTD)
- Antenna Measurements
- System realization in research perspectives

**TEXT BOOKS/REFERENCES:**

18WN706 PRINCIPLES OF VIRTUALIZATION AND SOFTWARE DEFINED NETWORKING 2-0-1-3


TEXT BOOKS/ REFERENCES:

18WN707 MACHINE LEARNING 2-0-1-3
Role of learning in intelligent behavior, general structure of a learning system; learning from example; concept learning, Introduction to machine learning and machine learning applications, Supervised learning, Bayesian decision theory, Parametric methods, multivariate methods, dimensionality reduction, Support Vector Machine, clustering, nonparametric methods, decision trees, linear discrimination, Sparse Linear models, multilayer Perceptrons, local models, hidden Markov models, assessing and comparing classification algorithms, combining multiple learners, and reinforcement learning.

TEXT BOOKS/ REFERENCES:

18WN708 CODING AND INFORMATION THEORY 2-0-1-3


TEXT BOOKS/REFERENCES:

18WN709 OPEN SOURCE NETWORKING 2-0-1-3

Introduction to the Open Source Tools, - Open Source Air-interfaces, unbundled telecom networks, RAN, EPC - Role of open sourcing in 5G in terms of open interfaces, open HW&SW reference architectures, Open Source software and Open Ecosystem - Introduction to the application of OPNFV, ONAP and Openstack in the ETSI NFV architecture.

Overview of the families of OpenStack - Architecture IaaS principle, OpenStack release timeline, OpenStack Communication - OpenStack APIs, RabbitMQ - OpenStack Basic Services, Keystone and authentication, Glance and image store, Compute Resources and Nova, Nova architecture, Nova scheduling, Network Resources and Neutron, Neutron architecture, Neutron services, Storage Resources, Cinder and Swift, Types of storage, Cinder vs. Swift, Storage and Glance, Ceilometer and Monitoring, Telemetry meter types and Using Ceilometer.

Introduction to major open source initiatives including Facebook TIP, XRAN and ORAN.

TEXT BOOKS/REFERENCES:
The following websites, latest industry white papers and 3GPP, IETF and Open source forums will be used to deliver the course.

1. http://www.xran.org/
2. https://opencord.org/
5. https://www.openstack.org/

18WN710  
ADAPTIVE SIGNAL PROCESSING  
2-0-1-3

Wiener filter, Kalman Filter, Least Mean Square(LMS) and variants, LMS via DFT, DCT, Recursive Least Square(RLS), Fast transversal and Fast Lattice RLS, Convergence and tracking performance of adaptive filters; Applications of ASP, Spectral estimation, System identification, Channel equalization.

TEXT BOOKS/ REFERENCES:

18WN711  
DISTRIBUTED NETWORK ALGORITHMS  
2-0-1-3


TEXT BOOKS/REFERENCES:

18WN712  
INTRODUCTION TO PLATFORM TECHNOLOGIES AND APIS  
2-0-1-3

Introduction to Big Data Technology including Hadoop Procedure – Modules- Insights and Data Visualization and examples.

Introduction to the “PLATFORM” concept in research on product development, technological strategy, and industrial economics - Understanding of converged networks in the evolution of the role of platforms including product platform design: building blocks of products, technologies or services - Example platforms based on social networking trends and service provider platforms.

Introduction to the requirements of APIs, using APIs and End-to-End view of API - Insights into simplified API process and Technology behind APIs and Restful APIs - Introduction to OAuth 2 -
Introductory concepts of APIs in the Network Transformation with OpenStack APIs for VM principles - APIs in Software-Defined Networking - API Examples including Data center, Wireless networks and API platform.

Introduction to ‘R’ programming language.

TEXT BOOKS/REFERENCES:

18WN713 NETWORK AND APPLICATION SECURITY 2-0-1-3

Introduction, Network Security Model, Types of threats, Linux Security Overview, Malware Primer, Application vulnerabilities, Social Engineering attack techniques and prevention steps, Cryptography Primer - Symmetric keys for data encryption, asymmetric keys for secure key distribution, Diffie-Hellman Key Exchange. Integrity checking with hashes and MACs, User and host identity verification, Detecting and preventing system and network intrusions, Confidentiality with SSL and IPsec tunneling.

Overview of various wireless technologies, protocols, systems and applications and the respective security concerns and challenges - WLAN, WMAN, WPAN, WMN, WS[A]N, MANET, VANET, Smart Home, Smart Grid, Security considerations for various layers of the wireless protocol stack, Cross-layer attack and defense. Enterprise Wireless LAN security, Trust and reputation management, Synchronization & Localization based attacks and mitigation strategies, Smart Grid security, Telecom system and infrastructure attacks, Mobile App and OS security, PAN security, IoT security

TEXT BOOKS/REFERENCES:

18WN714 5G SMALL CELLS 2-0-1-3
Small Cells: Introduction to Small Cells and network densification- Types and applications of small cells - 3GPP releases and developments towards 5G small cells - Private Networks - Neutral host small cells.

Introduction to LTE-Advanced and LTE-Advanced Pro features and evolution to 5G - Network Architecture including NG-RAN architecture - Next Generation Core and Interworking with 4G - 5G Service and performance requirements and supporting technologies covering NFV and SDN in 5G - Network slicing in 5G and Mobile Edge Computing (MEC)- Cloud RAN, Open RAN and 5G NGRAN- Cloud-C-RAN interworking with NFV and SDN- C-RAN interworking with SDN RAN variations including Open RAN interfaces - Cloud RAN architecture and NG-RAN: CU and DU - Fronthaul and backhaul topics including CPRI overview, CPRI for 5G and Distance requirements – 5G NR

Small Cell Deployment scenarios including RF design considerations - Signal propagation differences, Link budget consideration and Transport network considerations - Cloud and Open RAN Deployment via Centralized BBU and Virtualization in BBU.

TEXT BOOKS/REFERENCES:

18WN715EMERGING WIRELESS COMMUNICATION TECHNOLOGIES    2-0-1-3

Pre-requisite: Space-time processing, over view of Beamforming, spatial, temporal, frequency diversity, antenna gain, spatial cancelling of interference. Definition of diversity order; Spatial Channel modelling.

MIMO: Introduction to Wireless Point to point MIMO system Model - Capacity, SISO AWGN model-Performance; SISO Fading Channel Model- Performance; Outage 18 capacity, ergodic capacity; Capacity analysis of - Single user MIMO System with Full CSIT, Partial CSIT and Long term CSIT; Capacity Analysis of MIMO Fading Channel with long term and Short term channel Knowledge; Space-time Block Coded MIMO System, STTD, Alamouti Coding, Dominant mode Beamforming, ML, V-BLAST, D-BLAST- Performance analysis. Algorithms for MIMO.Spectral efficiency, link budget, coverage gain with MIMO.Limitations and implementation issues.

Millimeter Wave Technology: MAC protocol for millimetre wave wireless LAN and PAN, Millimeter wave for wireless networks, millimetre wave dedicated short range communication (DSRC) standard application and experiment study, millimeter wave wireless MAN cellular configurations

Satellites and Radar Communication: The Space Link, Satellite Link Design, Propagation on Satellite-Earth Paths. Interference between satellite circuits, Energy Dispersal, propagation characteristics of fixed and mobile satellite links.Applications of radar, Prediction of range performance, minimum detectable signal, receiver noise, probability density function, SNR, Integration of radar pulses, radar cross-section of targets, PRF and range ambiguities, transmitter power, system losses.

TEXT BOOKS/REFERENCES:


18WN716 BIG DATA AND APPLICATIONS 2-0-1-3

Introduction: Large databases and their evolution, Introduction to Data Science - Why Big Data? - Problems solved by Data Science - Data Science Process - Exploratory Data Analytics. Data Preparation: data munging - scraping - sampling - cleaning. Exploring and Analysis of Data - descriptive and inferential statistics, sampling, experimental design, parametric and non-parametric tests of difference, ordinary least squares regression, and general linear models; Data storage and management in order to be able to access data - especially big data - quickly and reliably during subsequent analysis - storage, search and retrieval systems for large scale structured and unstructured information systems.


TEXT BOOKS/REFERENCES:

**18WN717 INTRODUCTION TO DIGITAL TRANSFORMATION 2-0-1-3**

Introduction to concepts of Fourth Industrial Revolution and its impacts on the mobile and IT convergence - Overview of the current trends on Search Engines, Multimodal Human Interfaces - Digital Assistants including Home Assistants, Shopping Assistants and Chatbots - Principles of networks, applications and services in the digitalization framework - Overview of network automation trends - digital service design and network operations and performance - Insight into business operations and service operations including the emerging technologies including 5G, DevOps, Platforms and Blockchain.

**TEXT BOOKS/REFERENCES:**
5. Postor papers for websites and industry forums.

**18WN718 EDGE AND FOG COMPUTING 2-0-1-3**

Edge Computing in Networks: Introduction to Multi-Access Edge computing (MEC) MEC reference architecture with understanding on the role of each element, Characteristics, Technologies, Standardization groups including ETSI MEC framework. Introduction to list of different MEC server locations and list of key use cases and benefits offered by MEC. Overview of the Mobile Edge high level management and MEC services including Digital Enterprise and its connectors including universal CPE (uCPE). Introduction to data dense, high performance, distributed automation architecture in data-world. Fog concepts (cloud-to-sensor) and advantages of Fog computing and 8 pillars of Fog. Data shifting strategies to move compute, storage, communication, control, and decision making closer to IoT sensors and actuator to understand the overall work flow in the Fog era. Industry standards including OpenFog Framework.

**TEXT BOOKS/REFERENCES:**

**18MA704 RANDOM PROCESSES AND QUEUEING MODELS 2-0-1-3**

chains, Chapman-Kolmogorov Equations, steady state probabilities, continuous time Markov chains and birth and death processes and analysis of time series. Introduction to Regeneration process.

Queuing Models: Characteristics of Queuing Systems, Steady state solution of M/M/1 and M/M/C queuing models with Finite and Infinite Capacities, Stationary behavior of M/G/1. Queuing networks, G/G/1.

**TEXT BOOKS/REFERENCES:**

**18MA705 LINEAR ALGEBRA AND ITS APPLICATIONS 2-0-1-3**


**TEXT BOOKS/ REFERENCES:**

**18WN719 DETECTION AND ESTIMATION THEORY 2-0-1-3**


**TEXT BOOKS/ REFERENCES:**

**18MA706 COMPUTATIONAL OPTIMIZATION 2-0-1-3**

Introduction- mathematical optimization, least-squares and linear programming, convex and nonlinear optimization, Convex sets, Steepest Descent, Newton's Method, Linear optimization,
Quadratic optimization, Generalized inequality constraints, Integer programming, Combinatorial optimization, Dynamic programming, Genetic Algorithms for optimization


TEXBOOKS/REFERENCES:

18MA707 GRAPH THEORY AND ITS APPLICATIONS IN WIRELESS NETWORKS 2-0-1-3

Graph Theory: An Introduction to Graph theory, Definition and examples, Subgraph, Complements and Graph Isomorphism, Vertex Degree: Euler Trials and Circuits, Planar Graphs, Hamilton Paths and Cycles, Probabilistic graph, Social Graphs, Applications in Social Networks, Graph Coloring and Chromatic Polynomials, Digraph, Dijkstra’s Shortest-Path Algorithm, maximal matching- perfect matching – k-factor graphs.


Algorithms and Applications: Shortest and longest path algorithm, Minimal and Maximal spanning tree algorithms, maximal matching algorithms, Coloring algorithms, Graph Partitioning algorithm.

Research Paper Discussion and Presentation on applied graph theory in wireless networks.

TEXT BOOKS/REFERENCES:

18WN794 LIVE-IN-LABS I 0-0-0-0

AMRITA University has established live-in-labs at 100+ locations, mostly in rural areas spread across the length and breadth of India. Live-in-Labs© is an opportunity for students to live in a village environment so they can study problems first-hand in water, health, education, etc. and work together to devise solutions. Live-In-Labs will provide an experiential learning opportunity where each student can come and spend for 2 weeks to a semester in one of the live in labs basedon the area. They will
become part of the interdisciplinary team of students and faculty drawn from across the disciplines from all participating universities. The live-in- labs have varied focus areas such as energy, water, healthcare, education, waste management, ICT for billion, skill building etc.

During this process the students will share village life and observe and understand problems encompassing health and hygiene, energy, water, waste, environment, etc., touching the villagers’ lives, and define projects that seek to address these problems, devise solutions, implement, test and eventually demonstrate innovative solutions. One definitive achievement is that they will receive a deeper understanding of challenges faced by emerging developing countries. This gives the wonderful opportunity since emerging countries have the largest opportunity for new ideas, innovative solutions etc.

Identify the problem, Proposal Writing -Proposal Format, Budget Estimation, Proposal Drafts, Proposal re-evaluation, Final Proposal Draft. Advanced Human Centered Design

18WN795          LIVE-IN-LABS II    0-0-0-0

Sustainable Approach to Product Designing, Project Management, Planning, Implementing Evaluation of Implementation, Plan with Domain Experts, Design Optimization

18WN796          LIVE-IN-LABS III    0-0-0-0


18WN797          LIVE-IN-LABS IV    0-0-1-1

Field Implementation, Generating Community Awareness, Research Paper Writing-Structure, Writing Skills, Data Compilation, Deliverables