Punyashlok Ahilyadevi Holkar Solapur University,Solapur

M.Sc.- I Electronics (Internet of Things)

Syllabus as per Revised Structure NEP-2020

(w.e.f. June 2023-24)

Punyashlok Ahilyadevi Holkar Solapur University,Solapur

M.Sc.I Electronics (Internet of Things)

Based on NEP-2020

(w.e.f. June 2023 - 24)

1. Title of the Course : M.Sc.-Electronics (Internet of Things)

2. Introduction:

Master of Science (M.Sc.) in Electronics (Internet of Things) is running program at Post Graduate Department of Electronics, Shri Shivaji Mahavidyalaya, Barshi, Dist Solapur from June 2023 and disseminating knowledge of the subject from fundamental concepts to State-of- technologies. With the view to provide exposure to the recent technologies of various sectors of the Electronics and to empower the students to make them competent for industrial needs, R & D sectors and self employment as well the curriculum is framed. Indeed, the curriculum compasses knowledge of Embedded System, Communication Electronics and IoT Programming Languages. Therefore, the student can realize the state - of art of the technological designing and development. The Choice Based Credit System (CBCS) is implemented for this course. Objectives of the course:

Following are objectives of the course.

- **To utilize various Embedded Technologies related to IoT, Sensor Networks, Communication Protocols, Cloud Computing, Accessing Resources and Services needed to perform functions with dynamically changing needs.**
- **To understand the IoT privacy and Security Concepts for secured IoT environment.**
- **To utilize the various IoT Platforms to explore Real Time IoT Applications Areas.**
- **To explore Modern IoT Trends**
- **To undertake industrial research projects for the development of future solutions in the domain of Data Analytics to make an impact in the technological advancement.**
- **To use advanced IoT Tools/ Decision-Making Tools/ Operation Research Techniques to analyze the complex problems and get ready to develop such new techniques for the future.**
- **To provide exposure to the students to there cent technologies.**
- **To provide the knowledge of design and implementation of instrumentation of significant preciseness.**
- **To inculcate awareness among the student to perform the project so find us trial standards, which could also, ensures the interdisciplinary approach.**
- **To empower the students to cater the needs of industrial sectors. It is also attempted to expose the students to there search activities and to inculcate there search awareness.**
- **To expose the students to the industrial environment a on job training and internship may be provided**
- **To empower the students to achieve the success in the NET/GATE/SET etc examinations.**
- **To expose the students to on-lineshooter certificate courses such as MOOC / SWAYAM/ NPTEL, etc.**

3. **Advantages of the Course:**

Electronics is the subject, which ensures wide application potential in diverse sectors. Along with the basic sciences, it bears the knowledge of technology as well. Therefore, it depicts the tremendous opportunities in the electronic industrial sectors. It ensures well confluence of Science and Technology. Therefore, the course helps to achieve all round development. Moreover, the students can also opt for education field for their career.

4. **Eligibility of the Course:**
   1. **B.Sc. with Electronics subject at Principal / Interdisciplinary /Allied / Applied / Subsidiary Level.**
   2. **B.Sc. Physics ,Computer Science or Any Relevant Subject with Electronics subject at subsidiary Level.**
   3. **B.C.S.(ECS)**
5. **Duration: 2 Years– 4 Semesters**
6. **The Choice Based Credit System(CBCS):**

A Choice based credit system (CBCS) is implemented for this course. According to this system, choice is given to the students..The Course has compulsory three Disciplinary Subject Course (DSC) Theory papers and three Disciplinary Subject Elective (DSE) Theory papers for Semester-I and Semester-II respectively. Thus Paper DSC- I, II, III, IV,V,VI are compulsory. Moreover, choice is given to the students to select One paper from DSE at each Semester.

7. **The Credit and Grading System (CGPA):**

Credit is a numerical value that indicates student's work load (lectures , lab work , seminars, tutorial, field work, etc.) to complete a course unit. In most of the universities 15 contact hours constitute one credit. As per the present norms there are 4 contact hours per paper per subject per week, which works out to be 60 contact hours per paper per subject per semester or 120 contact hours in annual pattern. By converting these contact hours into credit at the rate of 15 contact hours for one credit, there will be 04 credits per paper per subject per semester and 08 credits in annual pattern. There are five papers at M.Sc. I level. The M.Sc. I student must complete minimum of 22 credits (maximum 44 credit points) in each semester.

A) Conversion of marks in to Grades :A table for the conversion of the marks obtained by a student in each paper (out of 100) to grade and grade points is given below.

Sr.No	Range of Marks	Grade	Grade Point
1.	80-100	O	10
2.	70-79	A+	9
3.	60-69	A	8
4.	55-59	B+	7
5.	50-54	B	6
6.	45-49	C+	5
7.	40-44	C	4
8.	<39	FC	0(Failed in Term Exam)
9.	<39	FR	0(Failed in Internal Assesment)

1. **Grade Point Average at the end of the Semester (SGPA)**

$$SGPA=\frac{(G_1xC_1)+(G_2xC_2)+\ldots\ldots}{\Sigma Ci}$$

(ΣCi-The total number of credits offered by the student during a semester

Cumulative Grade Point Average (CGPA)

$$\text{…CGPA} = \frac{(G_1 x C_1)+(G_2 x C_2)+\ldots\ldots}{\Sigma Ci}$$

(ΣCi -the total number of credits offered by the student upto and including the semester for which CGPA is calculated.)

2. **Final Grade Point Average (FGPA) will be calculated in the similar manner for the total number of credits offered for completion of the said course.**
   Where: Ci: Credits allocated for the course
   Gi: Grade point scored paper

B) **Scheme of Evaluation: The candidate has to appear for Internal Evaluation of 20/10 marks and External Evaluation (University Exam) for80/40 marks for each paper/practical. The nature of internal evaluation will be decided by the Post Graduate Department of Electronics. The internal evaluation comprises unit tests , tutorials ,seminars ,Group discussion, oral, etc., which ensures a process of continuous assessment.**

C) **Nature of Question Papers: The nature of question paper shall be as per time to time prescribed by the university authorities. The complete question paper has objective type questions, short answer type questionsand long answer type questions.**

D) **Passing Standard: The student has to secure a minimum of 4.0 grade points (Grade C) in each paper A student who secures less than 4.0 grade point (39% or less marks, Grade FC/FR) will be declared fail in that paper (subject) and shall be required to reappear for respective paper. A student who failed in Term End Examination (Theory) & passed in Internal assessment of a paper (subject) shall begiven FC Grade. Such student will have to appear for Term End Examination only. A student who fails in Internal assessment and passed in Term End examination (Theory) shall be given FR Grade. Such student will have to appear for Term End examination as well as internal assessment. In case of year down candidates from the mark scheme the candidates shall appear for the same 80 marks paper of the external examination and his performances Shall be scaled to 100 marks.**

E) **ATKT: A student who fails in one fourth (25%) or less papers of the total papers offered in the 1st and 2nd semester will be allowed for admission to second year (Sem.III -IV)**

8. **Structure of the Course:**

The Course Structure of M.Sc. Electronics (Internet of Things) is as depicted in the table. It is integrated course of 2 years i.e. 4 semesters. For, M. Sc. I, semester I has Two compulsory theory papers 4 credits each , One Elective paper of 4 credits & Three Practical of DSC 2 Credits each & 4 Credits for RM Paper . For, M. Sc. I, semester II has Two compulsory theory papers , One Elective papers of 4 credits each & Three Practical of DSC 2 Credits each & 4 Credits for OJT Paper .

Specializations : Internet of Things

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science and Technology

Proposed structure for Two Year PG Program Degree

M.Sc. Electronics (Internet of Things)

M.Sc. I Electronics

Level/ Difficulty	Sem.	Major		RM	FP/RP/OJT/ Internship/ Apprenticeship	Credits	Cumulative Credits
		Mandatory	Elective				
6.0/400	I	DSC1-1 (4+2) Hardware , Programming and IDE tools- AVR & PIC Series DSC 1-2 (4+2) Sensors and Actuators	DSE 1-1 (4+2) 1. Programming with C and C++ 2. .Modern Communication System 3. Electronics System Design	Research Methodology (4)	---	22	44 PG Diploma in Discipline
	II	DSC 1-3(4+2) Interfacing & Embedded System Design using – AVR & PIC Microcontrollers DSC 1-4 (4+2) Fundamentals of Internet of Things	DSE 1-2 (4+2) 1. Application Developme using Arduino, NodeMCU & LORA 2. Cellular Data Communication 3. Antenna and Wave Propogation	---	OJT/In-house Project/ Internship/ Apprenticeship(4)	22	
	Total 1 Yrs	24	12	04	04	44	
Exit option: Award of UG degree in Major with 132 Credits OR Continue with Major							

Abbreviations: DSC: Discipline Specific Core, DSE: Discipline Specific Elective, RM: Research Methodology, OJT: On job training internship/Apprenticeship, FP: Field project

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

M.Sc. Electronics (Internet of Things)

Choice Based Credit System (CBCS)

Course Structure (NEP-2020)

M.Sc. Part- I Electronics(IoT) w.e.f. 2023-24

M.Sc. Electronics (IoT) Semester -I

Paper Code	Title of the Paper	Credits	Contact hours/week			Distribution of Marks for Examination					
			Th (L)	Pr	Total	Internal		External		Total	
						Th	Pr	Th	Pr	Th	Pr
DSC-1-1	Hardware , Programming and IDE tools- AVR & PIC Series	4	4	---	4	20	---	80	---	100	---
DSC-1-2	Sensors and Actuators	4	4	---	4	20	---	80	---	100	---
DSE-1-1	1. Programming with C and C++ 2.Modern Communication System 3.Electronics System Design	4	4	---	4	20	---	80	---	100	---
RM	Research Methodology	4	4	---	4	20	---	80	---	100	---
Lab-1	Practical-1: (Based on DSC-1-1)	2	---	4	4	---	10	---	40	---	50
Lab-2	Practical-1: (Based on DSC-1-2)	2	---	4	4	---	10	---	40	---	50
Lab-3	Practical-1: (Based on DSE-1-1)	2	---	4	4		10		40		50
Total for Semester-I		22	16	12	28	80	30	320	120	400	150

M.Sc. Electronics (IoT) , Semester –II

Code	Title of the Paper	Credits	Contact hours / week			Distribution of Marks for Examination					
			Th (L)	Pr	Total	Internal		External		Total	
						Th	Pr	Th	Pr	Th	Pr
DSC-1-3	Interfacing & Embedded System Design using - AVR & PIC Microcontrollers	4	4	---	4	20	---	80	---	100	---
DSC-1-4	Fundamentas of Internet of Things	4	4	---	4	20	---	80	---	100	---
DSE-1-2	1. Application Development using Arduino , NodeMCU & LORA 2.Cellular Data Communication 3. Antenna and Wave Propogation	4	4	---	4	20	---	80	---	100	---
OJT/FP	OJT/FP	4	---	8	8	---	20	---	80	100	---
Lab-1	Practical-1: (Based on DSC-1-3)	2	---	4	4	---	10	---	40	---	50
Lab-2	Practical-1: (Based on DSC-1-4	2	---	4	4	---	10	---	40	---	50
Lab-3	Practical-1: (Based on DSE-1-2)	2	---	4	4	---	10		40		50
Total for Semester- II		22	12	20	32	60	50	240	200	400	150

DSC: Discipline Specific Course, DSE: Discipline Specific Elective, FP: Field projects **OJT:** On Job Training: Internship/ Apprenticeship, **RM**: Research Methodology, **RP**: Research Project

Paper Code : DSC-1-1 : Hardware , Programming and IDE tools- AVR & PIC Series

Credit 4 (Periods 60)

Unit I. Introduction to AVR **15**

General Architecture of AVR family , Salient features of AVR series , Architecture & Resources of ATMega328 , Pin Description, ALU, Program Memory, Flash Program Memory, SFR's , Data memory, General purpose Register, I/O Registers ,EEPROM Data memory , I/O Ports, Timers and Counters ,Watch Dog Timer, Serial interface – UART, Analog - Comparator, Reset and Interrupts, Interrupt Vector table, Reset Sources, On-Chip ADC and DAC , Reset and Clock Circuit.

Unit II PIC 16C Architecture **15**

PIC 16C Microcontroller Features, Architecture of PIC Microcontroller, Pin Description Memory Structure , Register and Register File Structure, Register Bank SFR's, Stack, W Register, Status Register, Option Register, etc, Interrupts, I/O ports , Timer- Capture Mode, PPW Mode , On-Chip ADC and DAC, Serial I/O- USART , watch Dog Timer Power-UP Timer, Sleep Mode, Reset and Clock Circuit , Interrupt and Interrupt Vector table , Type of reset , SPI Protocol

Unit III . IDE tools for AVR and PIC Series **8**

AVR tools introduction study of development tools for AVR series, AVR studio ,Win AVR PIC- Code vision IDE tools for PIC series-Overview of MPLab , IDE for Assembly language, Micro C IDE for Embedded C Programming, Developing , Compiling and Programming the microcontroller with example program

Unit IV Embedded C Programming – AVR Series **11**

I /O Port Programming , Arithmetic & logical Opertion Programming , Time Delay Programming ,Data Conversion Program ,Timer Programming , Serial Port Programming ,Interuupt Programming , Onchip ADC & DAC Programming

Unit V -Embedded C Programming – PIC Series **11**

I /O Port Programming , Arithmetic & Logical Opertion Programming , Time Delay Programming , Data Conversion Program ,Timer Programming , Serial Port Programming , Interuupt Programming , On chip ADC & DAC Programming

References -

1.PIC/AVR datasheets for I2C, SPI functions.

2.Overview and use of the SPI PICmicro Serial Peripheral Interface, Microchip Inc. http://www.microchip.com.

3. Robert Bosch GmbH, CAN Specification, 1997.

4.The AVR Microcontroller and Embedded Systems Using Assembly & C By–Muhammad di Mazidi , Sarmad Naimi

5. AVR Programming & Interfacing By Steven F. Barrett Daniel J. Pack

6. PIC Microcontroller & Embedded systm Design using Assembly & C , Pearson International Edition By Muhammad Ali Mazidi

7.Programming with PIC Microcontroller at www.researchdesignlab.com

Paper Code : DSC- 1-2 :Sensors & Actuators

Credit 4 (Periods 60)

Unit I SENSORS **5**

Difference between sensor, transmitter and transducer-Primary measuring elements-selection and characteristics – Ranges ; resolution, Sensitivity, error, Repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Classification of Sensor .

Unit II RESISTIVE , INDUCTIVE & CAPACITIVE TRANSDUCER **15**

Principle of operation, construction details, characteristics and applications of potentiometer, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

Inductive Transducers:-Principle of operation, Construction Details, Characteristics and applications of LVDT, Induction Potentiometer, Variable Reluctance transducer,

Capacitive transducers :-Principle of operation, Construction details, Characteristics of Capacitive Transducers – different types & signal conditioning- Applications:- Capacitor Microphone, Capacitive Pressure Sensor, proximity Sensor.

Unit III ACTUATORS **15**

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Servo Motor; Stepper motors-Piezoelectric Actuator.

Unit IV MICROSENSORS AND MICROACTUATORS **15**

MicroSensors :Principles and examples, Force and pressure micro sensors, position and speed microsensors , Acceleration microsensors, Chemical sensors, Biosensors, Temperature Microsensors and flowmicro sensors.

MicroActuators: Actuation principle, Shape memory effects -oneway ,two way and pseudoelasticity .Types of microactuators-Electrostatic ,Magnetic, Fluidic, Inverse piezoeffect , other principle

Unit V SENSOR MATERIALS AND PROCESSING TECHNIQUES **10**

Materials for sensors : Silicon ,Plastics ,Metals, Ceramics, glasses, Nanomaterials

Processing techniques : Vacuum deposition, Sputtering, Chemical Vapour Deposition, Electroplating, Photolithography, Silicon micro machining, Bulk silicon micro machining, Surface silicon micromachining, LIGA process.

TEXTBOOKS

1.Patranabis.D,"SensorsandTransducers",Wheelerpublisher,1994.

2.SergejFatikowandUlrichRembold,"MicrosystemTechnologyandMicro botics", Firstedition,Springer–VerlagNEwyork,Inc,1997.

3.Jacob Fraden, Hand Book of Modern Sensors: Physics,Designs and Application"Fourthedition,Springer,2010.

Paper Code : DSE-1- 1.1 :Programming with C & C + +

Credit 4 (Periods 60)

Unit I C Basic – 10

Introduction ,C - Declaration , Operator and expressions , I / P. and O / P , Decision statement , loop control statement , Arrays , Pointers , functions (with suitable Example)

Unit II C Advanced – 05

Storage class , Pre - processor , directives , Structure and union ,file handling , Marching towards C ++

Unit III C + + Basic – 15

3.1 Beginning with C,Structure of C Program, Creating the source file, Compiling and linking

3.2 Tokens ,expressions and control structure - Tokens , Keywords identifiers and constant, Data types ,variables , operators , manipulators , operators , overloading and precedence , control structure

3.3 Functions in C - Main function , Function prototyping , Call by reference , in line functions , Function overloading

3.4 Classes and Objects - Specifying a class , Defining Member Function , C ++ Program with class , Nesting of Member Function, Private Member Functions , Arrays within class , Memory a location , Static Member and Member Function , Arrays of Objects , Friendly Function , Pointer to Member

Unit IV C ++ Advanced 15

4.1 Constructors and Destructors - Constructor , Porameterized constructors , Multiple Constructor in class , Dynamic initialization of object , Copy Constructor , Dynamic constructors , Constructing two Dimensional Arrays , Destructors

4.2 Operator overloading and type conversions- Defining operator overloading, overloading unary and binary operator , overloading binary operators , manipulation of strings using operators , Rules of over loading operators and type conversions .

4.3 Inheritance Defining derived classes , Single inheritance hierarchical inheritance , hybrid multilevel inheritance , Multiple inheritance , Vertical base classes , abstract classes, Constructor in derived classes .

4.4 Pointers - Virtual Functions and Polymorphism - Pointer , Pointer to Object Pointer to Derived classes , virtual function and Pure virtual functions ,

Updating file and error handling

Unit V Application of C ++ → 15

5.1 Managing I / O Operations . – C++ Streams Classes, Formatted and Unformatted Operations, Formatted Console I/O operations

5.2 Working with Files - Classes for file, stream file , Openings and a closing file , Detecting end of file, file Pointers and there manipulations, Updating a file and error handling .

5.3 Templates - Class templates, Multiple parameters - Class templates , Function templates , overloading template Functions Member Function templates .

5.4 Manipulating Strings , Creating string objects , Relational Operations , manipulating string Object ,String characteristics , Accessing Characters in string

Reference Books-

1.Let US C By YashwantKanitkar

2. Programming with C++ By Balguruswammy

3. C language- By VasmiBhavani

4. C in Depth – By S.K. Shrivastava

5.C++ By R.S.Salaria

6. C++ Beginners By BUD TENNY

Paper Code : DSE-1- 1.2 : Modern Communication Systems

Credit 4 (Periods 60)

Unit I. Fiber Optic Communication **10**

Need of light wave communication, working principle of fiber optic cable, Definition and terminologies: bit rate, baud rate, bandwidth, channel capacity,power calculation, Block diagram of Optical Fiber Communication System, Fiber optic cables, types, Splicer and Connectors. Sources and Detectors; Transmitter and receivers , Applications

Optical Communication: Introduction to Optical Fiber, Types of Fiber, Guidance in Optical Fiber, Attenuation and Dispersion in Fiber, Optical Sources and Detectors, Block Diagram of optical communication system, optical power budgeting.

Unit II. Satellite Communication **12**

Satellite Orbits, Satellite Communication System, Earth Station, and Transponders, Application of Satellite communication system (TV distribution, surveillance and satellite phones) Satellite communication: Introduction, need, satellite orbits, advantages, and disadvantages of geostationary satellites. Satellite visibility, satellite system – space segment, block diagrams of satellite sub systems, uplink, downlink, cross-link, transponders (C-Band), effect of solar eclipse, path loss, ground station, simplified block diagram of earth station. Satellite access, TDMA, FDMA, CDMA concepts, comparison of TDMA and FDMA, Satellite antenna (parabolic dish antenna), GPS-services like SPS & PPS.

Unit III . Mobile Communication **12**

Concept of cell, basic cellular system and its operational procedure, Hand off, power requirements, Block diagram Transmitter, receiver, Frequency synthesizer, logic unit, control unit. Cellular Communication: Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram) of cellular mobile communication network, CDMA technology, CDMA overview, simplified block diagram of cellular phone handset, Comparative study of GSM and CDMA, 2G, 3G, and 4G concepts.

Unit IV. Microwave and Radar Communication **06**

Basics of microwave communication, advantages, Transmission lines, Waveguides and cavity resonators, Microwave semiconductor devices (Gunn diode), microwave tubes (Klystron). RADAR: Concept of radar, Pulsed Radar System.

Unit V. Computer Communication: **20**

Digital Modulation Technique: Block diagram of digital transmission and reception, Information capacity, Bit Rate, Baud Rate, and M-ary coding. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Binary Phase Shift Keying (BPSK), and Quadrature Digital Data Communications Concepts, Modems: Block diagrams of QPSK and QAMPSK). Binary Line Coding Technique, Multi-level coding, QAM (Modulation and Demodulation), Protocols., Computer Networks: LAN, MAN, WAN. Network Topologies (Star, Ring, and Bus) Concept of Internet, Bluetooth and Wi-Fi and theirstandards. Local area networks (LAN): Primary characteristics of Ethernet-mobile IP, OSI model, wireless LAN requirements-concept of Bluetooth, Wi-Fi, and WiMAX.

Reference Books

1.Communication Electronics – Frenzel (TMGH)

2.Analog and Digital Communication Systems – Martin S. Roden

3.Digital and Data Communications – Martin (PHI)

4.Hand Book of Electronic Communications – Miller

5.Optical Fiber Communication - Senior

6.Mobile Communication – Shiller

Paper Code : DSE-1- 1.3 : Electronic System Design

Credit 4 (Periods 60)

Unit I **18**

Introduction : Units and standards of measurement, functional elements of Measurement system, static and dynamic characteristics or performance characteristics of transducer, Measurement and calibration systems- Requirement. Working principle of Resistance type, Capacitance type, inductive, and displacement transducer. Working principle of level transducers, pressure transducers and flow transducers. Working principle of Thermometers, Resistance temperature detector (RTD), Thermistors, Thermocouples, and Pyrometers. pH measurement, Conductivity measurement, ORP (Oxidation reduction Potential) Measurement, Humidity measurement and Intelligent Sensors.

Unit II **12**

Zener series and Shunt Regulators, Transistors as Series and Shunt regulators, Regulator design with discrete components and IC 741/78xx, Current sources and their design with discrete components and ICs, SMPS design. Design of multivibrators, (AMV, MMV) using ICs (555, 741), Schimitt Trigger, Triangular Waveform Generator, Design of Oscillators using 741,

Unit III **12**

CMOS-TTL and TTL-CMOS interfaces, Design of counter using FF and counter ICs, Oscillator design using Schmitt trigger (7414), inverter and NAND gate, MMV using gates and ICs (74/54121, 74221), Design of binary to gray code converter, Design of full adder using MUX, Design of 16-1 using 4 4-1 MUXs, Design of parity checker.

Unit IV **18**

Need for signal conditioning, Current and Voltage standards.

Signal conditioning for Resistive sensors: RTD, Thermister, Load cell, Potentiometric sensors. Signal conditioning for Capacitive Sensors: Level sensor, Displacement Sensor, Proximity Detector, Humidity sensor, Differential pressure cell.

Signal conditioning for inductive sensors - Displacement transducer (LVDT/RVDT),

Design of capacitance and inductance meter, Design of DVM using 7107, Design of frequency synthesizer, Design of digital multimeter.

Text Books:

1. E. O. Doebelin, ―Measurement System Application and Design‖, McGraw-hill International, 5th Edition, 2007.

2. D. Patranabis, ―Principles of Industrial Instrumentation‖, Tata McGraw-Hill, 3rd Edition, 2010.

3. R.K.Jain, ―Mechanical and Industrial Measurement‖, Khanna Publications, 9th print 2013.

4.C.D.Johnson,―Process Control Instrumentation Technology

Paper Code : RM : Research Methodology

Credit: 4 (Periods: 60)

Unit I : Foundation of Research 15

Meaning, Objectives, Motivation, Utility. Types of research: exploratory, descriptive and experimental; Significance and characteristics of research; Criteria of good research, Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method- understanding the language of research - Concept, Construct, definition, Variable Research Process.

Unit II : Problem Identification 15

Definition and formulating the research problem, Necessity of defining the problem, Importance of literature review, need and importanceResearch Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & importance.

Unit III :Research Design 10

Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables. Qualitative and Quantitative Research: Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches.

Unit IV : Data collection 10

Data, types of data, methods, sample and population, sampling techniques, characteristics of a good sample; Tools of data collection: observation method, interview, questionnaire, various rating scales, characteristics of good research tools.

Data analysis: Univariate analysis: frequency tables, bar charts, piecharts, percentages; Bivariate analysis: cross tabulations and Chi-square test.

Unit V : Research writing 10

Report: definition, importance,types; Research paper writing: methods& style; Seminar & conference paper writing;Synopsis writing: methods; Thesis/Project writing: structure & importance; 7 Cs of effective research writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration.

Reference Books:

1. **Research Methodology: Methods and Techniques - Kothari, C. R., 2004. New Age International.**
2. **Research Methodology: An Introduction - Stuart Melville and Wayne, 2014. 2nd edition, Juta Academic.**
3. **Practical Research Methods - Catherine Dawson, 2002.**
4. **Research Methodology - Sinha, S. C. and Dhiman, A. K., 2002., Ess Publications.**
5. **An introduction to Research Methodology - Garg, B. L., Karadia, R., Agarwal, F. and Agarwal, U. K., 2002., RBSA Publishers.**

M.Sc. –I Semester -II

Paper Code: DSC- 1-3 : Interfacing Programming and Embedded System Design – using AVR & PIC microcontroller

Credit 4 (Periods 60)

Unit I. Fundamentals of Embedded Systems design – 15

Definition of an embedded system, Basic architecture of embedded system, characteristics of embedded systems, Applications of embedded systems. Minimum 89s51 based hardware for general embedded system using 8051 microcontroller.

Fundamentals of Embedded C - Basic Structure of Embedded C program, Need of Operating System, Concept of Super loop. Illustrative Embedded C programs for - Generation of Time delay without use of timers, Square wave generation , Programming of I/O port , Serial Port , Interrupts.

Unit II - Interfacing and programming of AVR microcontroller- 15

Sensor and signal conditioning, keyboard, ADC and DAC, LCD ,7 segment and Dot Matrix Display interfacing, Electromechanical Relay, solid state Relay, Solenoids, Optoisolator, PWM control DC motor using H Bridge, Stepper motor control, Servo Motor, RTC DS1307 interfacing(Embedded C program for every interface expected)

Unit III -Embedded System design using AVR- 08

Process - Project Description, References, pre-design , design implement, type , preliminary testing, complete documentation.

1.Electronic weighing system design

2.Tread mill Using H Bridge PWM control of DC motor green house automation

3. Green House Automation .

Unit IV - Interfacing and Programming of PIC microcontroller- 07

LCD ,7 segment and Dot Matrix, keyboard, ADC and DAC, sensor and signal conditioning, Electro- mechanical relay, solid state relay, Solenoidis, Opto isolator, PWM control DC motor using H Bridge, stepper motor control, servo Motor, RTC DS1307 interfacing(embedded C program for every interface expected)

Unit V- Embedded system design using PIC

1. Automatic Designing of Elevator system 2.Designing of 3D LED Cube

3.Designing of Scrolling display for advertising 3.Time and temperature monitoring system.

Reference Books -

1.The AVR Microcontroller and Embedded Systems Using Assembly & C By–Muhammad di Mazidi , Sarmad Naimi

2. AVR Programming & Interfacing By Steven F. Barrett Daniel J. Pack

3.PIC Microcontroller &Embedded systm Design using Assembly & C, Pearson International Edition By Muhammad Ali Mazidi

4. Programming with PIC Microcontroller at www.researchdesignlab.com

Paper Code : DSC- 1-4-: Fundamentals of Internet of Things .

Credit 4 (Periods 60)

Unit - I . Basic of IoT

Introduction, Characteristics , IoT applications , Connectivity layers , Base line technology, IoT Vs M2M, IPV4 Vs IPV6 ,IoT architecture ,IoT , IoT Challenges ,Sensors, Transducers, Actuators types and principle of operation , IoT components, IoT implementation, IoT Gateways, IoT architecture ,IoT key Tecnologies , IoT Challenges ,wireless networks, MQTT, SMQTT, CoAP, XMPP, core-XMPP, AMQP ,Communication Protocols , Features of IEEE802.15.4 Protocol ,Zigbee ,6LOWPAN,RFID ,Wireless HART, wireless HART VS Zigbee ,NFC, Bluetooth, LZAP RF COMM service discovery protocol, PICONETS ,Zwave, Zwave VS Zigbee ,ISA 100.11A

Unit II. Sensor Networks

WSN , Basic component of Sensor node ,Sensor Web wireless Adhoc and sensor network , WSN Behaviour, Event aware topology management in WSN , application of WSN, wirless multimedia sensors networks (WMSN), Topology management in WMSN ,Optimal Geographical Density Control (OGDC) algorithm, Components of MWSN , UAV networks, UAV network topology , FANETS, adhoc FANETS , FANETS and VANETS ,Machine to Machine communication (M2M) , Interoperability-types

Unit III. IoT Implementation in Arduino & Rasberry Pi

Types of Arduino Boards , Arduino Uno,Arduino IDE- Overview & Example Programs, supported data types & function libraries, statements , Sensors- interface with Arduino ,Actuators- interface with Arduino, Python IDE & Programming examples,Data types ,functions and statements & operations , networking in python, Raspberry Pi -specification, basic architecture, pin configuration ,basic setup ,os setup ,basic initial configuration, application- LED blinking ,camera configuration, networking of devices ,sensor- actuators with Rasberry Pi interface and programming, relay program, remote data logging with Pi-II & III

Unit IV Software defined networking & Cloud Computing

Benefits of integrating SDN in IoT ,SDN for IoT-I,II and III , wireless sensor network I & II, software defined WSN FOR IoT –I &II ,ODIW –I &II , Ubi –flow –I, Mobi flow-I,II,III,IV , Evaluation of cloud computing, NIST visual model of cloud computing , Business , advantages, Characteristics , components of cloud computing , service models, Software as a Service(SaaS), Infrastructure as a Service (IaaS) , types of cloud ,cloud computing , service models, working methodology , platform as a service (PaaS),features, working model , Saas architecture , cloud Computing Service Management and security, managing data in cloud ,cloud Security, identity and access management (IAM),features , authentication in cloud computing & access control

Unit V Case Studies

Smart Homes ,Connected Vehicle , Smart Grid , Agriculture & Healthcare

Text & References

1. **The Second Machine Age: Work, Progress and Prosperity in a Time of Brilliant Technologies by Erik Brynjolfsson and Andrew McAfee. ISBN-10: 0393239357**
2. **Getting started with Internet of Things, by Cuno Pfister, Shroff; First edition (17 May 2011), ISBN-10: 9350234130**
3. **Big Data and The Internet of Things, by Robert Stackowiak, Art licht, Springer Nature; 1st ed. edition (12 May 2015), ISBN-10: 1484209877**
4. **Web Reference: Cisco.netacad.net**
5. **NPTL IoT Book By Sudip Mishra**

Paper Code : DSE- 1-2.1-:Application Development using Arduino NodeMCU and LORA

Credit 4 (Periods 60)

Unit I Arduino Basics - 10

Arduino basic overview, Board types ,Boards description, Installation , Program structure , Data types , Variables and Constant , operator ,control statement, loops functions, strings ,strings object, Time and Array

Unit II Arduino function libraries- 20

Arduino I/O function ,I/O pin mode, Digital Read/ Write, AnalogRead, advanced I/O function , Analog Reference, Math library , Library macro , Library function , Trigonometric function

Arduino Advanced- Pulse width modulation , AnalogWrite function ,interrupt communication , parallel and serial I^2C board , I^2C pins , Arduino I^2C, Master Transmitter Slave Receiver, Master Receiver Slave Transmitter , NodeMCU

Unit III .Introduction to NodeMCU - 9

Block diagram specification and features ESP8266/32 development board layout and pin description programming in arduino IDE

Unit IV LORA RF Module - SX1278 9

Pin description and Features, Specification Block diagram, LORA development Board, layout Interfacing and Programming in Arduino IDE

Unit V Arduino Application - 12

Temperature Sensor PIR Sensor Ultrasonic sensor humidity Sensor dC motor Speed control, Stepper Motor control, Wireless Communication Network Communication, Mouse Button Control

Reference Books -

1.The AVR Microcontroller and Embedded Systems Using Assembly & C By–Muhammad di Mazidi, SarmadNaimi

2.AVR Programming & Interfacing By Steven F. Barrett Daniel J. Pack

3.PIC Microcontroller &Embedded systm Design using Assembly & C, Pearson International Edition By Muhammad Ali Mazidi

4. Programming with PIC Microcontroller at www.researchdesignlab.com

Paper Code : DSE- 1-2.2: Cellular Data Communication

Credit 4 (Periods 60)

Unit I .Cellular Radio System Design& Specifications of Analog System **10**

A basic cellular system, Performance criteria, Uniqueness of Mobile radio environment, Operation of cellular systems, Definitions of terms and functions of analog system, Specification of Mobile station &Land station, Different specification of the analog cellular system.

Unit II. Cell Coverage& Antennas **15**

Cell coverage-Introduction, Point-to-point model ,Foliage loss, Propagation-over flat open area , Near distance, Long distance, Mobile-to-mobile,Cell-site antenna height & signal coverage cells.

Antennas- Cell site antennas, Unique situation of cell-site antennas, Mobile antennas, Design of an Omni directional & Directional antenna system

Interference: A) Cochannel interference-Cochannel interference area, Real-time cochannel interference, reduction of cochannel linterference B) Nonchannel interference-Adjacent channel interference, Near-end-far-end interference & avoidance of interference, Effect of site components

Unit III Cell frequency Management & ChannelAssignment. **20**

Frequency management- Frequency spectrum utilization, Set-up channels, Definition of channel assignment,Fixed channel assignment, Nonfixed channel assignment, Operating with additional spectrum, Traffic and channel assignment.

Handoffs & Dropped calls-Value of implementing handoffs, Initiating handoffs, Delaying a handoffs, Forced handoffs, Queuing of handoffs, Power difference handoffs, Mobile assisted handoffs & softh and offs, Inter system handoffs, Introduction to dropped call rate, Formula of dropped call rate.

Unit IV Operational Techniques & Switching. **10**

Adjusting the parameters of the system, Hole filler, Leaky feeder, Cell splitting, Microcells. Concept of switching ,Analog & Digital switching equipment,Features for handling traffic, MTSO interconnection

Unit V .Digital Cellular Communication . **05**

Introduction to digital technology, ARQ techniques, Digital mobile telephony, GSM, Intelligent cell concept , Applications of intelligent micro-cel lsystem

Reference Books:

1. **Mobile Cellular Telecommunications Analog Digital SystembyW.C.Y.Lee,MGH2nd Ed.**
2. **Mobile Communication Engineering Theory & ApplicationsbyW.C.Y.Lee,MGH2ndEd.**
3. **William C.Y. Lee, Mobile Cellular Telecommunications : Analog and Digital Systems, Singapore : McGraw-Hill, 1995**
4. **William C.Y. Lee, Mobile Communication Engineering, McGraw-Hill.**

Paper Code : DSE- 1-2.3: Antennas & Wave propagation

Credit 4 (Periods 60)

UNIT I : ANTENNA BASICS **15**

Introduction, Radiation Mechanism, Antenna Parameters-Radiation Patterns, Patterns in Principle Planes, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, Antenna Theorems- Applicability and Proofs for equivalence of directional characteristics.

Radiation from Wires: Retarded Potentials, Small Electric Dipole, Quarter wave Monopole and Half wave Dipole Radiation characteristics

UNIT II : WAVE PROPAGATION **20**

Concepts of Propagation- frequency ranges and types of propagations. Ground Wave propagation - characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations, Sky Wave Propagation-Formation of Ionospheric Layers and their characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF & Skip Distance Calculations for flat and spherical earth cases, Optimum Frequency, Virtual Height, Ionospheric Abnormalities, Ionospheric Absorption, Fundamental Equation for Free-Space Propagation, Basic Transmission Loss Calculations, Space Wave Propagation - Mechanism, LOS and Radio Horizon, Tropospheric Wave Propagation- Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations, M-Curves and Duct Propagation, Tropospheric Scattering.

UNIT III: ANTENNA ARRAYS, HF, VHF AND UHF ANTENNAS **13**

Two element array, Principle of Pattern Multiplication, N element Uniform Linear Arrays - Broadside, End fire Arrays, EFA with Increased directivity, Binomial Arrays, Traveling wave radiators –basic concepts, Long wire antennas-field strength calculations and patterns, V-antennas, Rhombic Antennas and Design Relations, Small Loop antennas-Concept of short magnetic dipole, Helical Antennas, Yagi-Uda Arrays, Log periodic antennas.

UNIT IV: MICROWAVE ANTENNAS AND ANTENNA MEASUREMENT THEORY **12**

Reflector Antennas: Flat Sheet and Corner Reflectors, Paraboloidal Reflectors, Casse grain Feeds. Slot antennas-Babinets principle, Microstrip antennas, Horn antennas, Lens antennas (Qualitative treatment only) Antenna Measurements-Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and Antenna Methods).

TEXT BOOKS:

1. G.S.N Raju, "Antennas and Wave Propagation", 1st Edition Pearson Education, 2004.

2. K.D.Prasad, Satya Prakashan, "Antennas and Wave Propagation", Tech Publications, 3rd Edition, 2001.

3 Communication Electronics – Frenzel (TMGH)

4 .Analog and Digital Communication Systems – Martin S. Roden

5.Hand Book of Electronic Communications – Miller